Los Angeles Community College District

Facility Design Standards

Version 02

November 2019

TABLE OF CONTENTS

DIVISION 26 – ELECTRICAL

DIVISION 27 – COMMUNICATIONS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

DIVISION 31 – EARTH WORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

END TABLE OF CONTENTS

ABOUT DISTIRCT WIDE FACILITY DESING GUIDELINES

With input and feedbacks from the College's Facilities and Maintenance staff and IT Department, this document was created to respond to Measure CC Projects. The Table of Contents shows the last revision date for each section. The revision date is also shown on the footer of each individual section.

HOW TO USE THIS DOCUMENT

This document has been assembled by the project team with input from various associated sources. It is intended to provide general design criteria and requirements, materials and product standards for implementation in every renovation and new construction project in the campus. However, it has not been researched for specific project conditions and requirements. Therefore, each design professional using this document should only do so for minimum performance purposes and should not rely that the products, materials and systems indicated will be the correct application and use for a specific building project. All design professionals are assumed responsible for their designs and specifications.

In case there is a valid need to deviate from the standards, a written request needs to be submitted to and a formal written approval needs to be received from Campus Maintenance & Operations (M&O) or IT Department. Furthermore, these design standards are not to be deviated from for the purpose of value engineering unless formally approved by M&O or IT.

There are several items that are sole source: check with College for latest information.

INTENT

The following pages are intended to establish a set of Design Standards for new and renovation building projects for LACCD. The minimum criteria for establishment of these standards are quality, maintenance, cost, location, energy efficiency, life cycle costs, and safety.

The Los Angeles Community College District (LACCD) is concurrently developing district-wide standards for standardization on all 9-district campuses. In most cases, current district standards are incorporated into this document. However, there may be differences between the standards included herein with those produced by each College. The design team shall bring forward any such differences to the M&O and IT for resolution.

A campus Master Plan has been prepared that addresses overall design intent for at each campus. It is recommended that this document is referenced for design implementation criteria.

FORMAT

This document consists of Design Criteria/Requirements for individual disciplines followed by CSI Master Index 49 Division format for product and material standards.

This format will allow anticipated updates of this document in the future as new information is acquired and developed. The District shall continue to implement existing provisions of its design standards which address the selection of materials and products. The District will continue to refine and update the standards to help ensure that these elements are adequately addressed during renovation and construction of new facilities on a campus-wide basis.

The outline developed for each CSI section is intended to convey the basic information for architects, engineers and design professionals to specify campus standard products, materials and building

systems. This information includes a summary of the section scope, reference standards, the materials and criteria for specification, distribution contacts (if any), special issues (if any), and special warranty information.

Catalog numbers and specific brands or trade names followed by the designation "or equal" are used in conjunction with material and equipment required by the Specifications to establish the standards of quality, utility, and appearance required. Wherever catalog numbers and specific brands or trade names not followed by the designation "or equal" are used in conjunction with material or equipment required by the Design Standards, it is intended that only the indicated items should be used.

ADA ACCESSIBILITY

Many of the products and materials identified in these design standards are compliant with current disabled access requirements as determined by subject codes and laws. Other items are compliant but require the proper design implementation such as mounting locations, dimensional criteria, and placement. It is LACCD's intention that the all College campus maintains a barrier free environment providing equal access to all students, faculty, staff and visitors. As such, every effort shall be made in pursuit of this direction.

SUSTAINABLE DESIGN

In many cases, new buildings have been mandated to achieve a LEED rating as defined by the US Green Building Council (USGBC). Many of the products, materials and criteria contained in this document have been selected in part due to their sustainable "green" qualities. Although not mentioned in each case, every effort should be made to pursue a sustainable design direction in new and renovation construction projects. Such criteria would include recycled material content, location of material manufacturing, energy consumption, water consumption, air quality, and overall environmental impact. The current version of LEED should be referenced as a basis for sustainable design measures and criteria.

Build-LACCD

November, 2019

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete steel reinforcement.

1.2 REGULATORY REQUIREMENTS

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

1.3 REFERENCES:

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

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI) Publication:

1. ACI SP-66 – ACI Detailing Manual.
2. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC Sections 1903A and 1908A.

C. American Welding Society (AWS):

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

1.4 SUBMITTALS

A. Shop Drawings: Submit steel reinforcement Shop Drawings in accordance with ACI 315. Include assembly diagrams, bending charts and slab plans. Indicate lengths and location of splices, size and lengths of reinforcing steel.

B. Closeout Submittals: Record exact locations of reinforcing that vary from Shop Drawings.

1.5 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:
   1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
   2. American Welding Society (AWS).
   3. American Concrete Institute (ACI).
   4. CBC-SS/CC, Chapter 19A, Concrete.

B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the Owner shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:
   1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
   2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.

C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 MATERIALS

A. Steel Reinforcing Bars: ASTM A615, or ASTM A706 deformed grade 60 billet steel unless otherwise specified or indicated.
B. Bars or Rod Mats: ASTM A184.
C. Welded Wire Fabric for Reinforcement: ASTM A185.
D. Tie Wire: ASTM A82, fully annealed, copper-bearing steel wire, 16 gage minimum.
E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.3 FABRICATION OF REINFORCING BARS:

A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.

B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.

C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC-SS/CC requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.

B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.

C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.

D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.

E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.

F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been

thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.

G. Use deformed bars unless otherwise indicated, except for spiral reinforcement.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place normal weight and lightweight concrete, placement and finishing.

1.2 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
4. ACI 305R - Specification for Hot Weather Concreting.
5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
6. ACI 318 - Building Code Requirements for Structural Concrete, as modified by CBC-SS/CC Sections 1903A and 1908A.

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

1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C88 - Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
10. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.

11. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
12. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
14. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
15. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
16. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
19. ASTM C845 - Standard Specification for Expansive Hydraulic Cement
20. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
21. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
22. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
23. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures
24. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
25. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
26. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
27. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
28. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

29. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.

B. Mix Design Data: Submit concrete mix designs as specified herein and in Article 2.02.

1. Submit name, address and telephone number of the concrete production facility which the contractor intends to engage to design the concrete mixes. Submit name and qualifications of the proposed concrete technologist.

2. Mix Design: Submit a concrete mix design for each strength and type of concrete indicated in the drawings or specified. Include water/cement ratio, source, size and amount of coarse aggregate and admixtures. Predict minimum compressive strength, maximum slump and air content percentage. Clearly indicate locations where each mix design will be used.

3. Test Reports: Submit copies of test reports showing that the proposed mixes produce concrete with the strengths and properties specified. Include tests for cement, aggregates and admixtures. Provide gradation analysis.

C. Material Samples: Submit Samples illustrating concrete finishes and hardeners, minimum 12-inch by 12-inch.

D. Certificates: Submit certification that each of the following conforms to the standards indicated:

1. Portland cement: ASTM C150.

2. Normal weight concrete aggregates: ASTM C33.

3. Lightweight concrete aggregates: ASTM C330.

4. Aggregates: Submit evidence that the aggregate is not reactive in the presence of cement alkalis. In the absence of evidence, aggregate shall be tested per ASTM C289. If results of test are other than innocuous, aggregates shall be tested per ASTM C1567 as reported per ACI 318 as modified by CBC-SS/CC, Section 1903A.3.

5. Curing materials: ASTM C171.

E. Admixtures: Submit product data for proposed concrete admixtures.

F. Curing method and construction activity coordination reports shall be submitted in a separate submittal before the submission of Concrete Mix Design. The submittal shall including curing duration and load bearing requirements.

G.

1.4 QUALITY ASSURANCE

A. Continuous inspection shall be provided at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.

B. Inspection shall be performed by a representative of a testing laboratory selected by the Owner. Owner will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.

C. Contractor shall assist the testing laboratory in obtaining and handling samples at the project site and at the source of materials.

D. Continuous batch plant inspection requirement may be waived in accordance with CBC-SS/CC Section 1704A.4.3. Waiver shall be in writing, including DSA approval. When batch plant inspection is waived by DSA, the following requirements shall be met:

1. Approved inspector of the testing laboratory shall check the first batching at the start of work and furnish mix proportions to the licensed weighmaster.

2. Licensed weighmaster shall positively identify materials as to quantity and certify to each load by a ticket.

3. Tickets shall be transmitted to the Inspector by a truck driver with load identified thereon. The Inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to DSA.

4. At the end of the project, the weighmaster shall furnish an affidavit to DSA certifying that all concrete furnished conforms in every particular to proportions established by mix designs.

E. Special Inspections and Tests shall be in accordance with CBC-SS/CC Chapter 17A, Reinforcement and Anchor testing per CBC-SS/CC Section 1916A and Specification Section 01 4523.

1.6 PROJECT CONDITIONS

A. Cold Weather Requirements: Batching, mixing, delivering and placing of concrete in cold weather shall comply with the applicable requirements of ACI 306.1.

B. Hot Weather Requirements: Batching, mixing, delivering and placing of concrete in hot weather shall comply with the applicable requirements of ACI 305R.

C. Concrete temperature of freshly mixed concrete shall be determined per ASTM C1064.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: ASTM C150. Portland Cement.

B. Aggregates: Conform to the following standards:

1. Normal weight concrete: ASTM C33.
2. Lightweight concrete: ASTM C330, with fine aggregates per ASTM C33.
3. Aggregate shall be tested for Potential Alkali Reactivity of Cement-Aggregate Combinations per ASTM C289.
4. Nominal maximum size of coarse aggregate shall be no larger than:
   a. 1/5 the narrowest dimension between sides of forms, nor
   b. 1/3 the depth of slabs, nor
   c. 3/4 the clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, or ducts.
   d. Contractor may request the Architect and DSA waiver of the above limitations reported per ACI 318 as modified per CBC-SS/CC Section 1903A.3, provided that the workability and methods of consolidation are such that the concrete can be placed without honeycombs or voids.

C. Water: Water for concrete mixes, curing and cleaning shall be potable and free from deleterious matter.

D. Admixtures: Shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 3.6.

1. Admixtures containing chlorides or sulfides are not permitted.
2. Air-entraining admixtures shall comply with ASTM C260. Air-entrained admixtures shall not be used for floor slabs to receive steel trowel finish.
3. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
4. Admixtures for producing flowing concrete shall conform to ASTM C1017.
5. Fly ash, pozzolan and ground granulated blast-furnace slag: Modify ACI 318 Sections 3.6.6 and 3.6.7 as follows:
   a. Fly ash or other pozzolan used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:

1) Shall conform to ASTM C618 for Class N or F materials

6. Admixtures containing ASTM C845 expansive cements shall be compatible with the cement and produce no deleterious effects.

7. Silica fumes used as an admixture shall conform to ASTM C1240.

E. Reinforcement Fibers: Chop strands of alkali-resistant polypropylene or nylon fibers added to the concrete mix for protection against shrinkage cracks.

F. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D1751.

G. Curing Paper: Shall conform to ASTM C171 and consist of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions. The paper shall be light in color, shall be free of visible defects, with uniform appearance.

H. Floor Hardener: Water soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound. Aquaseal W20 by Monopole Inc., Kure-N-Harden by BASF, Chem Hard by L&M, Liqui-Hard by W. R. Meadows, or equal.

I. Underlayment: Two component latex underlayment for filling low spots in concrete for both interior and exterior applications, from featheredge to a maximum of 3/8 inch in thickness. Underlayment shall be non-shrink and suitable for repairing exposed concrete surfaces and for underlayment of carpet, resilient, tile and quarry floor coverings. La-O-Tex by TexRite, Underlay C, RS by Mer-Krete Systems, Underlayment 962 by C-Cure, or equal.

J. Vapor Barrier: Polyolefin-based 15 mils minimum thickness, meeting or exceeding ASTM E1745, 10 feet minimum width. Permeance shall be less than 0.01 perms [grains/(ft^2*hr*inHg)] as determined by ASTM E96 or ASTM F1249 and after mandatory conditioning tests per ASTM E154 Sections 8, 11, 12, & 13. Include accessories including tape and/or mastic. Stego Wrap by Stego Industries LLC, Perminator by W.R. Meadows, Ecoshield-E by Epro, or equal.

K. Stair Strips and Nosing: Nystrom two part stair treads and nosings.

2.2 CONCRETE MIX

A. Mix shall be signed and sealed by a Civil or Structural Engineer currently registered in the State of California.

B. The required strength and durability of concrete shall be determined by compliance with the proportioning, testing, mixing and placing provisions of CBC-SS/CC Sections 1905A.1 through 1905A.13. Concrete mix shall meet the durability requirements of ACI 318, Chapter 4.

C. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 5.3. Proportions of materials shall

provide workability and consistency to permit concrete to be placed readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.

D. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of ASTM C94.

PART 3 - EXECUTION

3.1 GENERAL

A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.

B. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the Inspector at least 24 hours before placing concrete; do not place concrete until inspected by the IOR.

C. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the Architect and DSA.

3.2 TOLERANCES

A. Concrete construction tolerances shall be as specified in ACI 117 and as modified herein.

B. Refer to ACI 302.1R, Tables 8.1 and 8.2 Slab on Ground and Suspended Flatness/Levelness Construction Guide, for recommended concrete placing and finishing methods.

C. Floor Flatness and Floor Levelness shall be tested in accordance to ASTM E1155. Floor measurements shall be made within 48 hours after slab installation, and shall precede removal of shores and forms.

D. Floor Flatness (FF) and Floor Levelness (FL) shall be as indicated below:

	Specified Overall Value		Minimum Local Value	
	FF	FL	FF	FL
Slabs on ground: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry	20	15	15	10

	Specified Overall Value		Minimum Local Value	
	FF	FL	FF	FL
flooring.				
Slab on ground: carpet.	25	20	17	15
Slab on ground: thinnest tile and resilient flooring.	35	25	24	17
Suspended slabs: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	N/A	N/A
Suspended slabs: carpet.	25	20	N/A	N/A
Suspended slabs: thinnest tile and resilient flooring.	35	20	N/A	N/A

3.3 PREPARATION

A. Vapor Barrier: Before installation of screeds and slab reinforcement, install vapor barrier under slabs on grade, as indicated in the drawings.

1. Install in accordance to ASTM E1643.
2. Place vapor retarder sheeting with the longest dimension parallel with the direction of the concrete pour.
3. Laps or seams shall be overlapped 6 inches, or as recommended by manufacturer. Las and penetrations shall be sealed with the manufacturer's recommended tape and/or mastic.
4. Inspector will inspect and mark areas of damage and insufficient installation of the vapor barrier sufficiently in advance of concrete placement.
    a. Deficiencies shall be corrected before concrete is placed.
    b. Patch damaged areas with vapor barrier overlapping four sides 6 inches and adhering with tape.

B. Reglets and Rebates:

1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise

indicated. Requirement does not apply to exterior walks, unless specifically indicated.

C. Anchor Slots: Embedded anchor slots in concrete walls to receive masonry veneer shall be set vertically in forms, 24 inches maximum on centers measured horizontally. Anchor slots shall be No. 24 gage galvanized sheet steel with removable fiber filler to prevent seepage of cement in slot.

D. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.4 INSTALLATION

A. Conveying and Placing:

1. Concrete shall be placed only under direct observation of the PI. Do not place concrete outside of regular working hours, unless the Inspector has been notified at least 48 hours in advance.

2. Concrete shall be conveyed from mixer to location of final placement by methods that will prevent separation or loss of materials.

3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re- tempered concrete or concrete which has been remixed after initial set be placed.

4. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.

5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.

6. Concrete shall be thoroughly consolidated by suitable means during placement, and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

7. Where conditions make consolidation difficult or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.

B. Cold Weather:

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. All ground with which concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.

2. The temperature of concrete at the time of placement shall not be below the minimum temperatures given in Table 3.1 of ACI 306.1.

3. Concrete shall be maintained at a temperature of at least 50° F. for not less than 72 hours after placing or until it has thoroughly hardened. Cover concrete and provide sufficient heat as required. When necessary, aggregates shall be heated before mixing. Special precautions shall be taken for protection of transit-mixed concrete.

C. Hot Weather:

1. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 5.13.

2. Maintain concrete temperatures indicated in Table 2.1.5 of ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square feet of exposed concrete per hour.

3. Cool concrete using methods indicated in ACI 305R Appendix B.

4. Place and cure concrete as specified in ACI 305R Chapter 4.

D. Compaction and Screeding:

1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tampered with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.

2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.

E. Floating and Troweling:

1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.

2. For interior finish slabs, final troweling shall provide a hard, impervious, and non- slip surfaces, free from defects and blemishes. Finished surface shall be within tolerances indicated in Article 3.02. Avoid burnishing. Do not add cement or sand to absorb excess moisture.

3. Exterior Paving and Cement Walks: Finish as specified above, except surface shall be given a non-slip broom finish to match Sample reviewed by the Architect.

4. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.

F. Curing:

1. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 5.11.

2. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.

3. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.

4. Immediately after finishing, monolithic floor slabs shall be covered with curing paper. Paper shall be lapped 4 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.

G. Filling, Leveling and Patching:

1. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.

2. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.

H. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea

gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.5 FINISHING

A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.

B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.

1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.

2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.

C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.

D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish.

E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener.

1. Protect adjacent surfaces. Clean surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, laitance, dust and dirt are removed prior to application.

2. Apply hardener in accordance with manufacturer’s instructions as soon as concrete is firm enough to work on after final troweling.

F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.

G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.

H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturer's written recommendations.

3.6 EXPANSION AND CONSTRUCTION JOINTS

A. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:

1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.

2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.

3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.

B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.

C. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.7 TESTING

A. Molded Cylinder Tests:

1. Inspector or testing lab personnel will prepare cylinders and perform slump tests. Samples for concrete strength shall be taken in accordance to ASTM C172. Each cylinder shall be dated, given a number, point in structure from which

sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.

2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of three days, seven days, and 28 days. A strength test shall be the average of the compressive strength of two cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'c.

3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C31, and tested in accordance with ASTM C39.

B. Core Test: At request of the Architect, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC-SS/CC and ASTM C42.

1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the Architect.

2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.

3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.

C. Concrete Consistency: Measure consistency according to ASTM C143. Test twice each day or partial day's run of the mixer.

D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.

E. Air Content Testing: Measure in accordance to ASTM C173 or ASTM C231, for each composite sample taken in accordance to ASTM C172.

F. Defective Concrete:

1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the Architect and DSA.

2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, contains sawdust shavings, wood or embedded

debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.

G. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall have a minimum f'c = 3,000 psi. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 1000 Concrete Forming and Accessories, and reinforced as described in Section 03 2000 Concrete Reinforcing. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch maximum aggregate.

3.8 PROTECTION

A. Protect the Work of this section where concrete is designed as the finish surface.

END OF SECTION

SECTION 03 71 34

SELF-LEVELING PORTLAND CEMENT BASED UNDERLAYMENT

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. Furnish and install liquid applied, Portland cement based self-leveling floor underlayment as indicated on the drawings, where depressions, holes, unevenness or other irregularities exist in the existing floor surface required to receive new finish flooring requiring a smooth and even substrate.

1.3 ACTION SUBMITTALS

A. Product Data: Provide physical characteristics, and product limitations.

B. Manufacturer's Installation Instructions: Indicate mixing, application and, curing instructions.

C. Manufacturer's Certificate: Certify that the proposed product meets or exceeds specified requirements.

1.4 QUALIFICATIONS

A. Applicator: The applicator shall be an organization specializing in performing the work of this Section with minimum 3 years documented experience and approved by manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install underlayment until floor penetrations and peripheral work are complete. Maintain minimum ambient temperatures of 50 degrees F for 24 hours before, during and 72 hours after installation of underlayment. During the curing process, ventilate spaces to remove excess moisture.

PART 2 - PRODUCTS

2.1 SELF-LEVELING PORTLAND CEMENT BASED UNDERLAYMENT

A. Subject to compliance with specified requirements, self-leveling Portland cement based underlayment shall be the one of the following products (or equal):

1. Ardex, Inc., Ardex K-15.
2. Gyp-Crete Corporation, Level-Right.
3. Quikrete Companies, Normal Set No. 1249-50.
4. USG, Levelrock

B. Underlayment: Provide portland cement based mix.

C. Primer: Provide manufacturer’s recommended type.

D. Joint and Crack Filler: Latex based.

E. Site mix materials in accordance with manufacturer's instructions. Mix to achieve following characteristics:
   1. Density: 115 lb/cu ft minimum dry density.
   2. Compressive Strength: 2500 psi at 28 days minimum in accordance with ASTM C472.
   3. Fire Hazard Classification: 0/0/0 (Flame/Fuel/Smoke) rating in accordance with ASTM E286.

F. Mix to consistency to achieve self-leveling.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum by-products, or other compounds detrimental to underlayment material bond to substrate.

B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.

C. Vacuum clean surfaces.

3.2 INSTALLATION

A. Install the self-leveling underlayment in accordance with manufacturer's instructions. Place to thickness required to provide a smooth, even substrate suitable for the finish flooring material to be superimposed upon the portland cement based underlayment. The minimum thickness shall not be less than recommended by the manufacturer. Install before partition installation.

B. Air cure in accordance with manufacturer's instructions.

3.3 APPLICATION TOLERANCE

A. Maintain top surface level to 1/8 inch in 10 ft.

3.4 PROTECTION OF FINISHED WORK

A. Protect finished Work from damage. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 04 20 80

INSULATING SHEATHING FOR BRICK VENEER

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. Furnish and install insulating sheathing for brick veneer as indicated on the drawings, including base coating.

1.3 SUBMITTALS

A. Submit product data and specifications for insulation board, seal coat, adhesives, sealants, and base coat materials.

B. Submit product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of materials with requirements based on comprehensive testing within last 3 years of current product formulations and systems.

PART 2 – PRODUCTS

2.1 INSULATION BOARD ASSEMBLY MATERIALS

A. Provide surface sealer, mounting adhesive, board insulation, reinforcing fabrics, base coat materials, sealants, and accessories that are compatible with one another and the brick veneer.

B. Provide molded polystyrene board insulation, rigid cellular thermal insulation formed by the expansion of polystyrene resin beads or granules in a closed mold to comply with ASTM C578 for Type I, thickness as indicated on the drawings.

C. Provide a surface sealer for coating the gypsum board sheathing to which the insulation board is to be applied. The surface sealer shall be an adhesion enhancer that is designed to improve bond between gypsum board sheathing indicated and the mounting adhesive for application of insulation.

D. Provide a polymer based adhesive for application of insulation sheathing in contact with the previously installed gypsum board sheathing. The mounting adhesive shall be compatible with the surface sealer and the insulation.

E. Provide reinforcing fabric for covering joints in the insulating sheathing. The fabric shall be balanced, alkali-resistant open weave glass fiber fabric treated for compatibility with other system materials; made from continuous multiend strands with tensile strength of not less than 145 lb and 150 lb in warp and fill directions per ASTM D 1682; complying with ASTM D578.

F. Coat the insulating sheathing with base coat Materials. The base coat shall be a job-mixed formulation of portland cement complying with ASTM C150, Type I, and the standard polymer-based adhesive by one of the following manufacturers (or equal):
   1. Bonsal; W.R. Bonsal Co.
   2. Dryvit Systems, Inc.
   3. Senergy Inc.
   4. Thoro System Products.

G. Sealant Products: Provide chemically curing, elastomeric sealant that is compatible with insulation, surface sealer, base coat, joint fillers, joint substrates, and other related materials.

H. Comply with the manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as approved by system manufacturer. Mix materials in clean containers.

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect contiguous work from soiling resulting from application of systems. Provide temporary overing and other protection needed to prevent spattering of coatings on other work.

B. Protect system, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind system and deterioration of substrates.

C. Substrate Preparation: Prepare and clean substrates to comply with system manufacturer's requirements to obtain optimum bond between substrate and adhesive for insulation.

3.2 INSTALLATION

A. Comply with the insulation manufacturer's current published instructions for installation of system. Adhesively bond insulation to comply with the following requirements:
   1. Apply adhesive to insulation by notched trowel method in manner that results in adhesive coating entire surface of gypsum sheathing once insulation is adhered to sheathing.
   2. Allow adhered insulation to remain undisturbed for period prescribed by system manufacturer but not less than 24 hours, prior to beginning application of base coat and reinforcing fabric.
   3. Spear or make the masonry ties or anchors penetrate the insulation with a close fit. Seal all penetrations with elastomeric sealant.
   4. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes conforming to details indicated.

5. Interrupt insulation where expansion joints are indicated in substrates behind exterior insulation and finish systems.
6. Form joints for sealant application by leaving gaps of width needed between adjoining insulation edges as well as between insulation edges and dissimilar adjoining surfaces projecting through insulation, including masonry anchors and ties.
7. Treat exposed edges of insulation board by encapsulating them with base coat, and reinforcing fabric.

B. Apply base coat to exposed surfaces of insulation in minimum thickness specified by the coating manufacturer.

C. Fully embed reinforcing fabric in wet base coat to produce wrinkle-free installation with fabric continuous at corners and lapped or otherwise treated at joints to comply with system manufacturer's requirements.

D. Protect the insulation sheathing from damage until it is covered by the brick veneer.

END OF SECTION

SECTION 04 21 20

DRY SET BRICK VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all tools, equipment, materials, supplies, accessories and perform all labor to install dry set brick veneer.

1.2 QUALITY ASSURANCE

A. Dry set brick veneer shall be in accordance with the following requirements:
   1. Conform to UBC Chapter 30, Current Edition.
   2. Conform to ANSI A108.10, Installation of Grout in Tilework
   3. Conform to ANSI A108.5, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
   4. Conform to ANSI A118.1, Dry-Set Portland Cement Mortar.
   5. Conform to ANSI A118.4, Latex-Portland Cement Mortar.

B. Tile Council of America (TCA): Conform to TCA W44-99, modified for exterior installations.

1.3 SUBMITTALS

A. Submit the following:
   1. Product Data: Submit catalog information fully describing the veneer units, mortar and grout materials proposed for use.
   2. Samples: Three samples showing color of veneer units facing and 3 samples of colored pointing mortar shall be provided.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup at a location that is mutually agreeable to the Architect and the Contractor.
   2. Build mockups as a complete assembly with all associated materials incorporated in the exposed unit masonry construction, including accessories.
      a. Include lower corner of window opening framed with trim at upper corner of exterior wall mockup.
      b. Include flashing around openings in the wall.
   3. Protect accepted mockups from the elements with weather-resistant membrane.
   4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
   5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Shop Drawings: If not provided on architectural drawings, provide shop drawings indicating layout according to standard module dimensions. Reconcile horizontally and vertically with openings and trim. Show expansion and control joints. Indicate corner and trim pieces.

PART 2 - PRODUCTS

2.1 VENEER UNITS

A. Brick shall comply with ASTM C1088, size, color, and texture as indicated on the drawings, or as selected by the Architect. Special materials are required. Normal brick will not be acceptable.

B. Subject to compliance with specified requirements brick shall be as manufactured by Belden Brick Company, or an "Or Equal" product by one of the following:
   1. Interstate Brick Co.; Division of Pacific Coast Building Products.
   2. Pacific Clay Products, Inc.
   3. Del Piso Brick & Tile Co.
   4. Higgins Brick Co.

2.2 DRY SET MORTAR AND GROUT MATERIALS

A. Subject to compliance with specified requirements dry set mortar and grout materials shall be the products of one of the following:
   1. American Olean Tile Co., Inc.
   2. W.R. Bonsal Corporation.
   3. Custom Building Products
   4. Laticrete International Inc.

B. Dry-Set Portland Cement Mortar: Conform to ANSI A118.1.

C. Dry-Set Grout: Polyblend grout by Custom Building Products, or equal, ANSI A118.6, color as indicated on the drawings, or if not so indicated shall be as selected by the Architect.

2.3 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Face cutting of veneer units at the site shall be done with a power-driven abrasive or diamond saw.

B. Backing surfaces shall be clean, sound, and have a rough textured surface that is suitable for adhering the setting materials.

3.2 WORKMANSHIP

A. Workmanship shall be in accordance with best practice; work performed by skilled workers; jointings, intersections and returns well formed; drilling and cutting neatly done without marring the material; joints straight and solidly filled conforming to applicable "Standard Specifications" of the American National Standards Institute, Inc. ANSI A108.5.

B. Application of mortar and grout shall be in accordance with manufacturer's directions and American National Standard Institute, Inc. Specification for Glazed Ceramic Mosaic Tile and Quarry Tile.

C. Surface Conditions: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until detrimental conditions are corrected at no added cost to the District.

D. Veneered surfaces shall fall within a vertical tolerance of 1/4 inch in 10 feet.

E. Grouting and Pointing:

1. Grout all tile joints full and neatly point.
2. Pointing Joints: Apply grout to full depth of joint and finish flush and concave tool joints. Grout stains to be removed from all exposed brick and other surfaces, before the grout has set, to the satisfaction of the Architect.

3.3 CLEANING

A. Required: Wherever necessary to present clean masonry work.

1. Remove mortar and grout prior to hardening during progress of work.
2. Clean surfaces thoroughly after grouting and pointing have set sufficiently; remove all dust and other foreign matter with plain water or mild alkaline cleaner. Sandblasting of exposed surfaces is prohibited.
3. Cleaning shall be done in accordance with the manufacturer's recommendations.

B. Replace damaged surfaces before time of final acceptance.

END OF SECTION

SECTION 05 41 00

STRUCTURAL METAL STUD FRAMING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Full design with structural calculations must be submitted to DSA at the same time of the full construction documents submittal. No deferred approval allowed.

B. Product Data: Submit manufacturer's catalog data for each item proposed for installation.

C. Certificates: Furnish manufacturer's certification that materials meet or exceed Specification requirements.

1.2 QUALITY ASSURANCE

A. Comply with following as a minimum requirement:

1. AISI - Specifications for Design of Cold Formed Steel Structural Members.

2. Welds shall be performed by AWS certified welders. Welding shall be performed in accordance with requirements of American Welding Society (AWS) Structural Welding Code-Steel D1.1 and D1.3. Structural welding Code-Sheet Steel.

3. Welding shall be inspected by a special inspector, approved by DSA to inspect Work of this section. The Project Inspector shall be responsible for monitoring work of special inspector to ensure that inspection program is satisfactorily completed.

4. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by Hot Dip Process.

5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet Metallic-Coated by Hot-Dip Process.

6. ASTM A1003 – Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

7. ASTM A1008 – Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability.

8. ASTM C954 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks) and Bracing or Bridging for Screw Application of Gypsum Panel Products and Plaster Bases.

9. ASTM C955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
10. ASTM C1007 – Standard Specification for Installation of Structural (Axial and Transverse) Steel Framing Members and Accessories.
11. ASTM E488 – Standard Test Methods of Strength Anchors in Concrete and Masonry.
12. ASTM E1190 – Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
13. Manufacturer shall be a member of the Steel Stud Manufacturers Association (SSMA).

B. Tolerances: Install walls and partitions on straight lines, plumb, free of twists or other defects, and contacting a 10-foot straight edge for its entire length at any location within a 1/8 inch tolerance. Install horizontal framing level within a tolerance of 1/8 inch in 12 feet in any direction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide studs, tracks, joists, header, and accessories manufactured by one of following:

1. Clark Western Building Systems.
2. Dietrich Industries, Inc.
3. Marino/WARE.
4. Cemco.
5. Equal.

B. Special Connection Accessories: Products manufactured by The Steel Network, Inc., or equal.

2.2 MATERIALS

A. Light Gage Metal Framing:

1. Metal framing shall be formed from corrosion resistant-steel conforming to requirements of ASTM A653, 50 ksi minimum.
2. Metal framing shall be zinc coated in conformance to requirements of ASTM A926, G60.
3. Metal framing shall be manufactured in conformance to ASTM C955.
4. Install metal framing per ASTM C1007, Standard Specification for Installation of Load-Bearing (Transverse and Axial) Steel Studs and Related Accessories.

B. Gages and properties of studs shall be as indicated on Drawings.

C. Mechanical anchors to concrete and masonry shall be metal cinch at least 3/8 inch in diameter threaded bolt head type. Anchor bolts to be installed in concrete shall be hook type ½ inch diameter or more. Unless otherwise indicated.

D. Mechanical anchors to metal framing shall be No. 10 self-tapping and self-drilling wafer-head screws, unless noted otherwise.

E. Accessories: Special top tracks, angles, fasteners, and strips of gypsum wallboard, as required for fire rating assembly required at each condition.

F. Mineral Wool Safing Insulation: 4.0 pcf density. Thermafiber, Fibrex, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumb and true. Install necessary accessories for proper installation.

B. Anchor top and bottom runner track to ceiling or roof structure overhead and to floor structure below.

C. Install studs squarely in top and bottom runner track with firm abutment against track webs.

D. Align and plumb studs, and fasten to flanges of both top and bottom runner tracks.

E. Provide three studs minimum at corners of stud walls. Locate so as to provide surfaces for attachment of interior and exterior facing materials.

F. Members not indicated to be welded together shall be attached with manufacturer recommended screws with minimum one screw at each flange of stud to top and bottom track. Wire tying of framing members is not permitted.

G. Provide lateral bracing and bridging in accordance with manufacturer's written recommendations or as required by CBC-SS/CC.

H. Intersecting walls and partitions, whether load-bearing or not, shall be connected.

I. Splices in axially loaded studs are not permitted.

J. Splice or butt weld butt joints in runner tracks. No splices are permitted in tracks over lintels, diaphragm sheathing, or diagonal bracing.

K. Weld connections by fillet welds or plug welds in accordance with AWS recommended procedures and practices.

L. Touch-up field abrasions and welds with galvanizing touch-up material.

M. Studs that frame door openings shall be clipped to floor with 14 gage angle clips. Each clip to have two fasteners into studs and two fasteners into floor.

N. Provide additional joists or blocking adjacent to exterior and interior walls, openings and elsewhere as required to provide support for indicated ceiling construction.

O. Provide an additional joist under parallel partitions where partition length exceeds ½ joist span and around floor and roof openings which interrupt one or more spanning members.

3.2 CONNECTIONS TO METAL DECKING

A. Provide premolded neoprene filler strips matching flute profile for non-fire-rated walls and partitions covered on one or both sides up to metal decking.

B. Top runner track of fire-rated partitions shall be a minimum of 36 mils (20 gage), unless noted otherwise, and attached to metal deck with required fasteners at spacing required for fire rating, but in no case over 16 inches on center. Areas above runner shall be friction fit with a minimum depth of 2 ½ inches of 4 pounds per cubic foot density mineral wool insulation. A minimum of ½ inch of firestopping compound shall be installed to each side of mineral wool insulation for a one-hour system, and one inch of firestopping for a two-hour system. Install required special tracks, angles, fasteners and strips of gypsum wallboard to provide required fire resistance rating.

C. Fire-rated top tracks shall be installed in accordance with manufacturer's recommendations and fire rating approval requirements.

3.3 QUALITY CONTROL

A. Welding Inspection:

1. Inspection of field welding operations shall be performed by special inspector.

2. The special inspector shall inspect material, equipment, procedures, welds, and welder qualifications.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal fabrications:

1. Steel pipe.
2. Square and rectangular steel tubing.
3. Pipe columns.
4. Steel stairs.
5. Handrails and guardrails.
6. Steel thresholds.
7. Steel ladders.
8. Steel Gates.
9. Gratings, frames and covers.
10. Miscellaneous fabrications, as indicated on the Drawings.

1.2 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating provided materials, dimensions, anchoring detail, and details of termination or connection to adjacent construction. Indicate items that are purchased from a manufacturer and items that are shop fabricated. Indicate component parts requiring Project site fabrication or assembly.

B. Product Data: Submit Product Data for manufactured items. Submit Product Data for primers and finishes.

C. Material Samples: Submit Samples of primers and finishes on fabricated items.

D. Installation Instructions: Submit installation instructions for manufactured items.

1.3 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Design, fabricate, and install miscellaneous metals in accordance with AISC - Design, Fabrication, and Erection of Structural Steel for Buildings.
2. AWS D-1.1 Code - Welding in Building Construction.
3. Inspection of Welding: As required by Construction Documents and Authorities Having Jurisdiction.

B. Coordinate installation of accessory items required for metal fabrications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes: ASTM A36.

B. Steel Pipe:

1. Steel pipe for pipe columns and other structural purposes shall conform to ASTM A53, Type E or S, Grade B, as required.
2. Steel pipe other than pipe furnished for structural purposes shall conform to ASTM A53.

C. Square and Rectangular Steel Tubing:
1. Steel tubing for structural purposes shall be carbon steel conforming to ASTM A500 or ASTM A36.
2. Steel tubing other than tubing furnished for structural purposes shall be hot or cold rolled carbon steel electric welded tubing.

D. Cast Steel: ASTM A27, Grade 65-35.

E. Steel Bolts: ASTM A307, Grade A, with bolt head and nut dimensions conforming to ANSI B 18.2.1.

F. Rolled Steel Plates and Shapes:
1. Shapes and plates shall conform to ASTM A36, except for plates to be bent or cold-formed.
2. Plates to be bent or cold-formed shall conform to ASTM A283, Grade C.

G. Chain: Chain shall be 4/0 double loop pattern coil chain.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications “Rapid set Cement”.

2.2 FABRICATION

A. General:
1. For fabrication of Work exposed to view, provide only materials smooth and free of blemishes. Remove blemishes by grinding or by welding and grinding, before cleaning, treating, and installation of surface finishes including zinc coatings.
2. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated or specified.

B. Steel Pan Type Stairs:
1. Provide stringers, risers, sub-treads and platforms to profiles indicated. Form each tread pan and riser in one continuous piece to receive finished tread. Weld or bolt risers and treads to carrier angles. Weld or rivet carrier angles to structural steel stringers. Fasten countersunk bolts, or stud weld clips, through pans and platforms to facilitate fastening of welded wire fabric for concrete fill. Provide welded-on clips for support of soffits. Close ends of channel or box stringers.
2. At intermediate landings, provide metal bases formed of stringers. Miter and weld internal and external corners of metal bases.
3. Provide uprights and posts of rectangular or round tubing as indicated. Provide members a special shop straightening to eliminate distortion and to provide

straight alignment. Correct bends, distortions, and damage. Fill dents and grind smooth.

4. Provide railings of profile indicated, fastened to stair stringers and wall substrates as indicated or required.
5. Countersink rivets, bolt heads and screws on finished surfaces, or cut flush with surfaces.
6. Fit and securely fasten components together, with exposed tight-fitting joints. Cut, drill, punch and tap as required for installation.
7. Furnish joints as strong and rigid as adjoining sections. Weld continuously along entire line of contact, except where spot welding is indicated.

C. Stair and Balcony Railings:
1. Railings: Handrails and standards shall be fabricated of Grade B standard weight steel pipe or indicated on Drawings. After fabrication, rails shall be galvanized. Standards shall be attached to stringers and face of balcony as detailed.
2. Panels:
   a. Mesh: refer to drawings.
   b. Frame members: refer to drawings.
3. Handrail Brackets: Type indicated.

D. Ladder Extensions: Where vertical ladders are installed for access to roof hatches, provide the following:
1. Roof hatch ladders shall be provided with ladder extensions. Ladder extensions shall be Bilco Model 1, "LadderUP Safety Post," Maxam Metal Products, "Spring Balance Safety Post", or equal, on fixed ladders below roof hatches. Device shall be manufactured of high strength steel with telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless-steel spring balancing mechanism. Finish shall hot dip galvanized. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

E. Miscellaneous Framing and Supports:
1. Except as otherwise indicated, space anchors 2 feet on center, and provide minimum anchor units of 1 ¼-inch by ¼ inch by 8-inch steel straps.
2. Shelf angles for exterior construction shall be galvanized steel of sizes indicated.

F. Welding:
1. Weld connections unless otherwise indicated.
2. Weld corners and seams continuously and in accordance with requirements of AWS Code. Welds shall be inspected as required in Section 05 1200: Structural Steel Framing.
3. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

G. Galvanizing:

1. ASTM A123, ASTM A153, or ASTM A386, as applicable, hot dip with 2.0 ounces per square foot on actual surface and 1.8 ounces per square foot minimum on any specimen, and as specified herein.
2. Galvanizing Repair Material: DRYGALV as manufactured by the American Solder and Flux Company, Galvalloy, Galvion, or equal. Hot applied repair material, or anodic zinc- rich galvanizing repair paint conforming to Mil Spec DOD-P-21035.
3. Items to be galvanized shall be hot-dip galvanized in sections as large as possible.

H. Shop Finish:

1. Metal fabrications shall be provided with a coat of primer, except those indicated to be completed with exposed galvanized finish.
2. Primers:
   a. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
   b. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
   c. Minimum dry film thickness of primer shall be 2.0 mils.
3. Preparation for Primer Painting: Miscellaneous ferrous metal, except items specified galvanized, shall be thoroughly cleaned and prepared for painting, including removal of shipping oils or protective coatings, mill scale, grease, dirt and rust. Prepare in accordance with SSPC recommendations. Deliver to Project site primed or galvanized as indicated, and ready to receive Project site applied finishes.
4. Galvanized Metal Work to receive Paint: Clean oil, grease and other foreign materials from surfaces. Apply vinyl wash pretreatment coating. Follow manufacturer's instructions for drying time, and then prime with one coat of metal primer.
5. For finishes refer to Section 09 0600.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Handrails and Guardrails:

1. Install standards into metal sleeves cast in concrete, and extending into it at least 9 inches. Wedge standards true, plumb, and fastened by packing with grout. Finish grout smooth and flush with adjacent surfaces.
2. Rails contacting a vertical surface shall be fitted with standard pipe rail flanges, secured to concrete or masonry surfaces with 3/8 inch 2-unit cinch anchor bolts and secured to wood frame surfaces with 3/8 inch lag screws, unless otherwise indicated.

3. Railings abutting pipe columns shall be provided with shaped end caps to fit columns welded to rails, and secured to columns with self-tapping machine screws.

B. Steel Thresholds: Fabricate channel or angle thresholds of rolled steel sections of size indicated, galvanized after fabrication. Anchor into concrete with countersunk 2-unit cinch anchor bolts, unless otherwise indicated.

C. Steel Ladders: Provide at locations indicated, fabricated as detailed. Ladders shall be anchored to concrete or masonry with 1/2 inch cinch anchor bolts. Ladders secured to a metal framed wall shall be anchored with 1/2 inch lag screws. Provide provisions for anchoring ladders before lath is applied to plastered walls.

D. Gratings, Frames and Covers:

1. Over areas indicated, provide steel gratings and grating frames as detailed. Frames shall have mitered and welded corners, and be fitted with anchors.
2. Provide steel checkered plate covers and steel frames for sumps, grease traps, and sand traps, and other covers for access where indicated. Frames shall be provided with mitered and welded corners and be fitted with anchors as detailed. Cover shall be perforated. Each section of access cover shall be furnished with steel pull rings and tool operated fastening device. Screws to fasten covers shall be brass.

3.2 ADJUSTING

A. Touch Up Damaged Surfaces:

1. Shop Painted Finishes: Comply with SSPC-PA-1 for touch-up; apply with brush to produce a minimum 2.0 mil dry film thickness.
2. Galvanized Surfaces: Clean field welds, connections and damaged areas. Repair galvanized finishes in accord with ASTM A780.

END OF SECTION

SECTION 05 54 10

PIPE HAND RAILINGS AND BRACKETS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install pipe hand railings and brackets as indicated on the drawings and specified.

1.2 SUBMITTALS

A. Full design detail shall be furnished with 100% Construction Documents before submitting for DSA approval

B. Submit shop drawings showing fabrication and installation of handrails and hand railings and brackets. including sections, details of components, and attachments to other units of Work.

PART 2 - PRODUCTS

2.1 PIPE HAND RAILINGS AND BRACKETS

A. Materials and corresponding locations shall be as indicated on the drawings.
   1. Pipe shall be galvanized per ASTM A53 schedule 40.
   2. Stainless steel shall be Type 304

B. Brackets: Match the supported railings, either galvanized or stainless steel.

C. Zinc coating shall be hot dip galvanizing conforming to ASTM A123.

D. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of the pipe.

E. Fasteners: Select fasteners of the grade, and class required to produce connections that are suitable for anchoring railing to other types of construction as indicated.

F. Railings shall be joined by mitered and welded joints made by mitering corners, groove welding joints, and grinding smooth, butt railing splices, reinforced by an interior sleeve not less than 6 inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hand railings and brackets in accordance with approved shop drawings and installation instructions. Fit exposed connections accurately together to form tight, hairline joints. Set hand railings accurately in location, alignment, and elevation, measured from established lines and levels. Provide anchorage devices and fasteners where necessary for securing handrails and hand railings to in-place construction.

END OF SECTION

SECTION 06 11 60

BLOCKING AND ACCESSORIES

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Structural and framing lumber shall be graded in accordance with the "Standard Grading Rules" of the West Coast Lumber Inspection Bureau (WCLIB) or the "Western Lumber Grading Rules" of the Western Wood Products Association (WWPA) latest editions.

B. Plywood shall conform to requirements of "Product Standard PS 1-09, or PS 2-10, as applicable issued by the U.S. Department of Commerce, and shall be grade marked by a recognized grading agency (APA and PTL).

C. Preservative and fire treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with the California Building Code, latest edition. Fire treated lumber shall be pre-coated to prevent corrosive chemical reaction with metal studs.

1.2 REGULATORY REQUIREMENTS

A. Conform to Chapter 23, of the California Code of Regulations, Title 24 - Building Standards, Part 2, California Building Code with State Amendments, latest edition.

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber Grading Rules: WCLIB.

B. Species: Douglas Fir and as indicated on Drawings.

2.2 BLOCKING AND ACCESSORIES

A. Pressure-treat blocking with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood blocking, furring, stripping, and similar concealed members in contact with walls.

B. Fasteners and Anchors:

1. Metal Screws: Bugle head, hardened steel, power driven type, length to achieve full penetration of the substrate.
2. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
   a. Use only common wire nails or spikes whenever indicated, specified or required.
   b. Whenever necessary to prevent splitting, holes shall be prebored for nails and spikes.
   c. Nails in plywood shall not be overdriven.

C. Connectors: Hot dipped galvanized steel.

D. Install telephone and electrical panel back boards with plywood sheathing material where required. Size the backboard by 12 inches beyond size of electrical space panel.

E. Fire retardant treatment shall conform to AWPA Treatment C20, Type, for interior wood components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set blocking and accessories members level and plumb, in correct position.

B. Provide blocking to all restroom accessories, toilet partitions, fixtures, telecommunication equipment, and casework per design requirement.

END OF SECTION

SECTION 06 11 80

INSULATION BOARD SHEATHING

PART 1 - PRODUCTS

2.1 MATERIALS

A. Extruded Polystyrene Foam Board Sheathing: Conform to ASTM C578 Type IV, with 1.55 pcf minimum density and 5- year aged r-value of 5.4 and 5 at 40 and 75 deg F mean temperature; in manufacturer's standard lengths and widths with T & G or shiplap long edges as sta

B. ndard with manufacturer, thickness as indicated on the drawings.

C. Products: Subject to compliance with specified requirements, provide Owens Corning “Foamular 250 SE 1”, or products by one of the following manufacturers (or equal):

1. Amoco Foam Products Co.
2. UC Industries, Inc.
3. The Dow Chemical Company.
4. The Celotex Corp.

D. Power Driven Fasteners: National Evaluation Report NER-272.

E. Screws: Comply with ANSI B18.2.1, galvanized or cadmium plated.

F. Adhesives: Shall not be used unless it is the only method approved for use with type of insulation sheeting and substrate indicated by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's printed directions for application of insulation board sheathing. Install vapor relief strips for permitting escape of any moisture vapor that otherwise would be trapped behind the sheathing.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish and install finish carpentry work as indicated.

1.2 SUBMITTALS

A. Submit in accordance with Section 013400: Submittals.

B. Submit shop drawings of each item of Finish Carpentry and Millwork, showing materials, dimensions, construction and anchorage details.

C. Submit manufacturer's standard color samples of wall panels.

1.3 QUALITY ASSURANCE

A. Douglas fir finish lumber shall be manufactured and graded in accordance with WCLIB Standard No. 17 Grading Rules for West Coast Lumber, latest edition, of the West Coast Lumber Inspection Bureau.

B. Hardwood finish lumber shall be manufactured and graded in accordance with the National Hardwood Lumber Association "Rules for the Measurement and Inspection of Hardwood and Cypress Lumber", latest edition.

C. Softwood Plywood: Plywood shall comply with Voluntary Product Standard PS 1-09, or PS 2-10 as applicable, issued by the U.S. National Bureau of Standards. Plywood shall be grade marked by American Plywood Association.

D. All millwork shall be fabricated in accordance with specifications of the North American Architectural Woodwork Standards, latest edition, for “Premium” application.

E. Finish lumber shall be kiln-dried according to accepted methods for the thickness and species. Lumber 1" thick or less, shall be dried to an average moisture content of not more than 15%. Lumber 1-1/4" to 2" in thickness shall be dried to an average moisture content of not more than 19%.

1.4 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to site in undamaged condition, stored in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

B. Interior millwork and finish carpentry shall not be permitted in building before plaster in story or section for which it is intended is reasonably dry.

PART 2 PRODUCTS

2.1 MATERIALS

A. Douglas Fir: Interior trim, solid lumber, plywood, backboards, and other concealed members of interior finish; "C and Better".

B. Hardwood: Birch, maple "Firsts and Seconds."

C. Softwood Plywood: Except where otherwise specified, Group 1, Interior Type, Grade A-A.

D. Hardwood Plywood: U.S. Product Standard PS 51-75, Type II, Grade I Veneer.

E. Douglas Fir: Douglas fir finish lumber more than 2" thick shall be "B and better" Industrial Clear.

2.2 FABRICATION

A. Wherever practicable, means of fastening various parts together shall be concealed. All curved work shall be made from solid, or if veneered, shall be bent over suitable drums.

B. All interior wood finish shall be smoothly dressed, belt sanded at mill, and hand sanded at building after erection until all machinery, sandpaper or other defacing marks are entirely removed.

PART 3 EXECUTION

3.1 GENERAL

A. All interior and exterior finish, millwork and other fixed wooden equipment shall be installed level, plumb and true. Members shall be neatly and accurately scribed in place, maintaining full widths of end members, wherever possible. All trim shall be put on in full lengths, without piecing, except where use of single lengths is impossible. Butt joints, if necessary, shall be beveled. All exterior angles shall be mitered, and interior angles of moulded parts coped. All nails shall be set for putty. Grain and color of adjoining interior finish shall match and harmonize. Where work specified in this Section adjoins other work, a neat, tight joint shall be made.

B. Any interior and exterior finish carpentry and other fixed wooden equipment showing hammer marks or other damage will be rejected.

END OF SECTION

SECTION 06 40 08

PLASTIC LAMINATE FACED ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Furnish and install plastic laminate faced architectural woodwork, casework, trim, hardware, countertops, and shelving as indicated on Drawings and specified.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide wood products from certified sustainably harvested sources.

1.4 QUALITY ASSURANCE

A. Comply with AWI North American Architectural Woodwork Standards (NAAWS), latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer's Association of Canada, and the Woodwork Institute of California, grades as specified herein.

B. Each elevation of casework shall bear AWI Certified Compliance Label indicating that casework fully meets requirements of AWI grade specified.

C. Each plastic laminate countertop shall bear AWI Certified Compliance Label indicating tops fully meet requirements of AWI grade specified.

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE FACED ARCHITECTURAL WOODWORK

A. Plastic laminate: High pressure plastic laminate conforming to NEMA standard LD-3; 0.050 inches at horizontal surfaces, 0.028 inches at exposed vertical surfaces and edge bands, and 0.042 inch minimum for post-formed countertops.

B. Particle Board Core Material: 45 lb. density, conforming to ANSI A208.1, Table 1, Grade 1-M-2.

C. Solid Lumber:

1. Solid lumber for exposed members, drawers, trays and special details shall be Clear birch or maple.
2. Unexposed solid lumber for concealed webs or structural members shall be of Douglas Fir., alder or birch.

D. Softwood Plywood: Rotary cut exterior type A-C grade softwood plywood complying with PS1.

E. Hardboard: Factory finished pressure sealed hardboard conforming to the requirements of PS 58. Oil tempered hardboard shall conform to CS 251.

F. Cabinet Liner: Semi-exposed surfaces shall be finished with 0.020 inch high-pressure laminate cabinet liner, conforming to NEMA Standard LD-3.

G. Edge Banding:
   1. 0.028 inch minimum thickness plastic laminate.
   2. PVC, 0.6 mm at cabinet sides, top, bottom divisions and shelves, 3 mm at doors, drawer fronts and false fronts.

H. Glass Doors: 1/4 inch laminated safety glass.

I. Adhesive: Type II water-resistant, rigid type glue of formula conforming to PS 51.

J. Sealer: Thompson Water Seal 101, Watco Oil, Zinsser, or equal.

K. Base: Cover toe spaces with typical wall base unless otherwise indicated.

L. Countertops:
   1. 3/4 inch 1-M-2 grade particleboard, ANSI A208.1.
   2. Medium Density Fiberboard (MDF): ANSI A208.2.

M. Hardware:
   1. Drawer Slides for Custom Grade Cabinetry:
      a. Pencil drawers: Partial extension type: Accuride 2006, Blum, Hafele, or equal.
      b. Drawers and box drawers, up to 24 inches wide: Accuride 3832A, Blum, Hafele, or equal.
      c. Lateral file drawers, up to 30 inches wide: Accuride 4034 overtravel or 4033 equal travel, Blum, Hafele, or equal.
      d. Lateral file drawers, more than 30 inches wide: Accuride 3640, Blum, Hafele, or equal.
   2. Flipper Door Slides for Premium and Custom Grade Cabinetry:
      a. For vertically mounted retracting cabinet doors up to 75 pounds and 72 inches tall: Accuride 1432, Blum, Hafele, or equal, with hinge carrier strip.
   3. Mutes: Rubber, approximately 1/4 inch diameter, colors to match adjacent finish.
   4. Plastic Grommets: Doug Mockett, Alliance Express, Rockler, or equal; color as selected by Architect.
   5. Adjustable Shelves with Clips: Adjustable shelf supports (EDP type, unless otherwise noted) set in 5 mm holes spaced 32 mm on center:
      a. Hafele America, Co., No. 282.04.711, Blum, Hettich, or equal.
      b. Hafele America, Co., No. 282.24.13, Blum, Hettich, or equal.
   6. Cabinet Hinges: Concealed type, minimum 170 degree opening, self-closing:
      a. Hafele America, Co. Euro/cup
      b. Julius Blum, Inc. Modul.
   7. Five-knuckle hinges, stainless steel, recessed, heavy duty. Required in all classrooms, optional at administrative and non-student areas.
   8. Cabinet Locks:
      a. Door Locks: Pin tumbler type – National No. 3713 x 2475-172 strike, Olympus 100DR x 12-1 strike, CCL Security Products, or equal.

b. Locks for Sliding Doors: National No. C8142 x thimble strike, Olympus 300 SD x thimble strike, CCL Security Products, or equal.
c. Drawer Locks: National 68-3718 x 68-2480C brass strike, Olympus 200 DW x 12-1 strike, CCL Security Products, or equal.
d. Cabinet locks shall be flush with surface of door and protrude no greater than 3/16 inch.

9. Top-hung Hardware Assembly for Sliding Doors: Grant No. 6064, Hafele, Blum, or equal.
10. Track for Sliding Doors: K & V 455 x or 455.55, Hafele, Blum, or equal.
11. Pull Flush Ring at Drawers behind Doors: Safe No. 6116, Trimco 24, Quality, or equal.
12. Pulls: Quality No. 179 x 180, Trimco No. 553P, Hafele, or equal.
13. Catches: Magnetic type - Epco No. 592, Lawrence No. SC1364-AL, or equal.
14. Four-way Tension Catch: Glynn-Johnson GJ21A, Trimco, Quality, or equal.
15. Noiseless Catch: Precision Lock PLS24 concealed magnetic catch
16. Elbow Catch: , Schlage SP2A3, or equal.
17. Bolts: Surface type, Quality B6, Trimco No. 4856-6, or equal.
18. Brackets and Shelf Strip for Glass Shelves: K & V No. 80 x 180, Garcy 604 x 686, or equal.
19. Shelf Standards and Brackets: K & V No. 255 x 256, line bored holes for pins as approved by AWI Standards Stanley No. 798 x 799, steel zinc plated, or equal.
20. Card Holders for Drawers: Corbin No. 1913-1/4H, Garcy No. 853, or equal.
21. Hanger Rods: 1-1/16 inches minimum diameter metal tubing, aluminum or stainless steel clad, KV660; heavy wall steel tubing KV770, Stanley, or equal.
22. Hanger Rod Flanges: KV757, or flanges KV734, KV735; Ronther Reiss R44-55; or equal.
23. Hardware Finish: With exception of finish hardware items which have finishes specified, hardware shall be furnished with dull chrome US 26D or dull stainless steel US 32D finish.
24. TV Pullout Extension and Swivel: Accuride Model CB360-258TV, Blum, Hafele, or equal or equal.
25. Keying:
    a. Key locks inside one room alike. Furnish three keys for each lock keyed separately, and 2 keys for each lock in keyed alike groups. Master keys shall be tagged and delivered to the Owner. Locks and keys shall be stamped with coded set number / direct digit.
    b. Cabinet locks shall be master-keyed and keyed alike. Backside of cabinet lock bolts (on visible side following installation) and change keys shall be stamped with manufacturer's code, either direct digit or coded series. Change keys shall also be stamped with set numbers direct digit.
    c. Master keys shall be as directed by the Owner.

2.2 FABRICATION

A. Plastic Laminated Casework: Construction of plastic laminated casework shall conform to the material and construction requirements for AWI Architectural Woodwork Standards Custom grade flush overlay construction, except, modified as follows:

1. Panels and Doors: All components shall be 3 ply laminate construction consisting of plastic laminate or cabinet liner with particle board and a balancing sheet, bonded together under pressure with adhesive. Total nominal thickness of panels and doors shall be 0.75 inch unless otherwise indicated.
2. Exposed surfaces shall be High Pressure Decorative Laminate.

a. Edge Band: PVC 1 mm. for cabinet body and 3 mm. at doors and drawer fronts.

3. Exposed bottoms of wall-hung cabinets shall be furnished with plastic laminate finish.
4. Exposed Interiors: Interior surfaces of open cabinets shall be laminated to match exteriors. Cabinets with glass doors shall use cabinet liner.
5. Semi-exposed Surfaces: Shall be cabinet liner and edges of panels shall be edge banded.
6. Webs: Stiles, rails and muntins of web frame shall be tongue and grooved at joints and glued. Top and bottom rails shall be continuous. Use of 8 mm wooden dowels, screws or biscuits shall be in accordance with AWI Standards.
7. Cabinet bases may be integral or separate. Bases shall be 3/4 inch thick plywood securely jointed at four corners to a supporting block 1 ½-inch thick.
8. Ends: Cabinet ends shall be minimum 3/4 inch thick, lock-jointed, doweled, or screwed to webs or top and bottom of the cabinet. All joints shall be securely glued.
9. Backs shall be 1/4 inch thick plywood or 1/4 inch thick particle board, and shall be plowed into sides and top (except countertops) glued and nailed on 4 inch centers. Back shall be braced with horizontal 3/4 inch by 3 ½-inch backing strips on 3 feet centers maximum. Cabinets with exposed finish backs shall have 3/4 inch backs of laminate construction. Where exposed finished cabinet end and back form an external corner, plastic laminates shall meet at corner.
10. Adjustable shelving shall be 3/4 inch thickness particleboard for spans up to 25 inches and one inch thickness for spans over 25 inches up to 34 inches. Adjustable shelving over 34 inches in span shall be one inch thick plywood core with 0.020 inch cabinet liner both sides. Shelving hardware shall be adjustable to one inch centers. Faces of shelving shall be finished with 0.020 inch thickness cabinet liner both sides.
11. Drawers:
    a. Sides, backs, and sub-fronts of drawers shall be of dovetail or dowel construction and made of 1/2 inch thick clear birch or maple solid stock, or

9 ply plywood without knots. Drawer bottoms shall be in accordance with AWI requirements, glue blocked and nailed.

b. Drawers shall be fitted with ball bearing slides accurately installed for smooth drawer operation.

c. Drawer fronts shall be of 3/4 inch thick plastic laminate construction, fully edge-banded with plastic laminate T-banding to be used when matching existing. T-banding joint shall occur at center of bottom edge of panel.

12. Doors:

a. Doors shall be of overlay type with flush exposed surfaces. Doors shall be fully edge-banded. Doors of cabinets within any group of adjacent units shall be in alignment.

b. Wrap around hinges shall be routed into edge of door. Doors over 40 inches in height shall have three hinges.

13. Back Priming: Seal unfinished materials installed for backs, bases, self-edge backing, stripping and other concealed portions with a water-repellent sealer.

14. Banding:

a. Exposed edges of interior and exterior laminates shall be edge banded.

b. Edge banding shall be accurately fitted. Where edge band joins plastic surfaces, there shall be no open spaces, voids, or chipping of plastic laminate surface.

c. Exposed cabinet surfaces shall be flush, and any protruding edges of banding shall be machined or trimmed to provide a flat smooth corner at intersection of banding and adjoining surfaces. Plastic laminate edgebanding shall be installed on tops, webs, bottoms, ends, and inside partitions. T banding may only be installed on drawer fronts and door edges and when required to match existing.

B. Countertops:

1. Plastic Laminate Tops: Each plastic laminate countertop shall bear the AWI Certified Compliance Label.

a. Laminated plastic countertops shall be self-edged, except that plastic countertops containing sink cutouts shall have a no-drip tilt-front edge. Edge shall rise 1/8 inch above counter surface and back and return splashes shall be 6 inches high measured from exposed countertop surface, unless otherwise indicated.

b. Cove and roll front sticking, for plastic laminate back-up, shall be kiln dried clear sugar pine glued to core material. Cove sticking shall be secured in each direction with 2 ½-inch long wood screws, 3 inches from each end and 10 inches on center.

c. Square butt splashes, including end splashes tops shall be Deck Mount. Splashes shall be end applied and be set in mastic and secured to top with screws 8 inches on centers. Splash edges shall be self-edged and scribed to wall.

d. Joints shall be splined and fastened with screw clip fasteners on at least 8 inch centers. Water resisting mastic or glue shall be applied in joints. Joints shall not occur at sink cutouts. Sink cutouts shall be sealed.
e. Core material for counters and splashes shall be 3/4 inch thick 1-M-2 grade particleboard.
f. Installation of plastic laminate shall be in accordance with published specifications and recommended practices of the plastic laminate manufacturer.

2.3 FINISHING

A. Wood casework and wood components of laminated plastic casework shall be factory finished. Exposed surfaces shall be finished with one coat of lacquer sealer and 2 coats of finish lacquer. Unexposed materials such as backs, webs, back of tops, and the like, shall be sealed with one oil base prime coat. Semi-exposed wood surfaces such as drawers shall be finished with one coat of sanding sealer and one coat of clear gloss lacquer.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 07 11 00

SHEET MEMBRANE WATERPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply and install Sheet Membrane Waterproofing as indicated.

1.2 SUBMITTALS

A. Submit in accordance with Section 01340: Submittals.

1. Submit a letter of certification, indicating that materials comply with Specifications.
2. Submit letter certifying that applicator is approved by manufacturer of membrane waterproofing materials.
3. Submit manufacturer's recommended method of application which, when approved, shall form basis for accepting or rejecting work.
4. Submit data indicating that materials do not exceed 350 grams per liter volatile organic content.

1.3 QUALITY ASSURANCE

A. Reference Standards (ASTM):

1. E96, Method B: Tests for Water Vapor Transmission of Materials in Sheet Form.
2. E154, Puncture Resistance: Testing Materials for use as Vapor Barriers under Concrete Slabs.

1.4 PROJECT CONDITIONS

A. Apply membrane waterproofing materials only in dry weather when outside temperature is above 40 degrees F.

B. Do not apply membrane waterproofing materials to damp, wet surfaces, unless specifically approved for such application by manufacturer.

C. Use of chlorinated primers is not permitted.

1.5 WARRANTY

A. Manufacturer provides a 5 year material warranty.

B. Contractor shall provide a 5 year labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Sheet membrane waterproofing shall be as manufactured by W.R. Grace & Co., or W.R. Meadows, Inc. or approved equal.

B. As a substitute to the above-specified products, PVC Waterproofing System 4001 by Sarnafil, or equal, will also be acceptable, subject to approval by the Architect.

C. The PVC waterproofing system shall be comprised of a thermoplastic membrane, flashings, leveling and separating layers, protection and drainage layers and miscellaneous accessories that are proprietary to the manufacturer of the system.

2.2 MATERIALS

A. Membrane waterproofing material shall be self-adhesive, cold-applied, equal to Bituthene 4000, and shall include protection board, either as an integral element or separate component.
   1. Protection board for horizontal surfaces shall be 1/8" thick asphalt-impregnated hardboard; APOC or approved equal. Protection board for vertical surfaces shall be 1" thick expanded polystyrene.

B. Latex based surface conditioner shall be System 4000 surface conditioner or approved equal.

C. Drainage panel shall be Hydroduct 2 by W.R. Grace & Co., or approved equal.

2.3 SUBSTITUTION

A. As a substitution to the above-specified products, PVC Waterproofing System 4001 by Sarnafil, or equal, will also be acceptable, subject to approval by the Architect.

B. The PVC waterproofing system shall be comprised of a thermoplastic membrane, flashings, Leveling and separating layers, protection and drainage layers and miscellaneous accessories that are proprietary to the manufacturer of the system.

PART 3 - EXECUTION

3.1 APPLICATION

A. Membrane waterproofing shall be applied in accordance with manufacturer's written instructions.

B. Entire area to be covered with membrane waterproofing shall receive, prior to installation, a priming coat.

C. Protect adjoining surfaces which are not to be waterproofed from damage while performing work.

D. All membrane waterproofing shall be protected from damage during application and until finished work is approved and accepted.

E. Leak test and sign off by Commissioning Agent prior to cover up the waterproofing with finish material.

END OF SECTION

SECTION 07 18 03

PEDESTRIAN TRAFFIC URETHANE BASE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install light pedestrian traffic coatings as indicated on the drawings and specified

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including installation instructions.

B. Shop Drawings: For traffic coatings.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.

C. Samples for Initial Selection: For each type of exposed finish.

D. Samples for Verification: For each type of exposed finish, prepared on rigid backing.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An Installer who is trained and approved by manufacturer.

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

1. Build mockup for each traffic coating and substrate to receive traffic coatings.
2. Size: 100 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install traffic coating until items that penetrate membrane have been installed.

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 LIGHT PEDESTRIAN TRAFFIC URETHANE BASED COATING

A. Provide the manufacturer's standard urethane based, low-odor, low-VOC, exterior exposure, light pedestrian traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for pedestrian traffic. Subject to the Architect's review of action submittals for compliance with requirements, provide the following:
   1. Tremco Incorporated: Vulkem OC 810

B. Primer: Liquid waterborne primer recommended for substrate and conditions by traffic-coating manufacturer.
   1. Material: Urethane.
      a. TREMPrime Multi Surface Primer
      b. Vulkem Primer 191 QD Primer

C. One Coat System: Aliphatic polyurethane, applied as recommended by the
   1. Application: Roller-applied or Self-leveling.
   2. Thicknesses: Minimum wet film thickness (35-40 wet mils) as recommended in writing by manufacturer for substrate and service conditions indicated, measured excluding aggregate.
   3. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.
   4. Color: As selected by Architect from manufacturer's standard range.

D. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

E. VOC Content: Traffic coating shall have a VOC content that comply with the requirements of the South Coast Air Quality Management District (SCAQMD) and comprised of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. In lieu of the foregoing products and after the Architects review of action submittals for compliance with requirements, comparable and equal products by the following manufacturers may be proposed for acceptance:
   1. Pacific Polymers.

2. Gaco Western.
3. Neogard.
4. Tufflex.

2.2 ACCESSORY MATERIALS

A. Single Component, NonSag, Traffic-Grade, polyurethane Joint Sealant: ASTM C 920, Type NS, Class 50, for Use T, NT
1. Products: Subject to compliance with requirements, provide one of the following:

a. Tremco Incorporated; Dymonic 100

2. Products: Tremco Incorporated; DualFlex Membrane.

B. Aggregate: 12-20 mesh, post manufactured/SBR ground rubber
1. Products: Subject to compliance with requirements, provide one of the following:

a. Tremco Rubber Aggregate 12-20 mesh

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.

B. Verify that substrates are visibly dry and free of moisture.
1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
3. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. General: Before applying traffic coatings, clean and prepare substrates according to ICRI CSP 2-4 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

C. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

D. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ICRI CSP 2-4. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.
3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and non-reinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic- coating manufacturer.

3.5 TRAFFIC-COATING APPLICATION

A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.

B. Verify that wet film thickness of 35-40 wet mils complies with requirements every 100 sq. ft.

C. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

D. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

E. Cure traffic coatings. Prevent contamination and damage during application and curing stages.
F. ADD curing time requirement and restriction.

3.6 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.
B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 21 22

GLASS-FIBER BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install glass-fiber blanket insulation as indicated on the drawings and specified.

1.2 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Provide QII (High Quality Insulation Inspection) where required by owner's program.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following (or equal):

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Provide either of the following insulations of the thickness required to achieve minimum Resistance Value as required by energy calculations and owner's performance goals, whichever is greater.

1. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
2. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
3. Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
4. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

5. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

C. Electrical Outlet Box Pads: for all types of electrical and communication outlet boxes in located sound insulated walls and partitions, provide “Lowry’s Outlet Box Pads” by Harry A Lowry & Associates or equivalent. “Sound Pad No. 68” by L.H. Dottie Co. or equivalent, sizes and types as required for sound control.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation as recommended by the manufacturer of the product to achieve an R-Value indicated on the drawings, or greater.

B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438-mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. Install outlet box pads at electrical type outlet boxes in sound insulated walls; plug unused knock-outs in boxes with knock-out caps before installing pads.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. Ft. (40 kg/cu. M).
2. Spray Polyurethane Insulation: Apply according to manufacturer’s written instructions.

3.2 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thickness indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

END OF SECTION

SECTION 07 22 40

POLYSTYRENE BOARD INSULATING SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install polystyrene board insulating sheathing as indicated on the drawings or specified.

1.2 SUBMITTALS

A. Product Data: Submit the manufacturer's product literature and installation instructions for the board insulation.

B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values, densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

1.3 DELIVERY, STORAGE, AND HANDLING

A. General Protection: Protect polystyrene board insulation from physical damage and from becoming wet, or soiled.

B. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE INSULATING SHEATHING BOARD

A. Manufacturers: Subject to compliance with requirements, provide Formula 250 by Owens Corning, or an equal product of one of the following (or equal):

1. Amoco Foam Products Co.
2. Dow Chemical U.S.A.
3. Minnesota Diversified Products, Inc.
4. UC Industries.

B. Extruded Polystyrene Board Insulation: Provide rigid, cellular thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C578, Type IV, and dimensions as indicated on the drawings.

1. Surface Burning Characteristics: Flame spread and smoke developed values of not greater than 10 and 175, respectively.
2. Compressive strength shall be 25 psi or greater, in accordance with ASTM D1621.

C. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, and complying with requirements for fire performance characteristics.

D. Fasteners: Type and size indicated or, if not indicated, as recommended by insulation manufacturer for type of application and condition of substrate.

E. Crack Sealer for Board Insulation: Provide polymeric insulating foam in aerosol dispenser designed for filling voids in board insulation.

1. Product: Subject to compliance with requirements, provide "Polycel 100" by Construction Products Div., W.R. Grace & Co., or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install polystyrene board insulation as recommended by its manufacturer.

B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

C. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

D. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

E. Bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

F. Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

END OF SECTION

SECTION 07 25 00

MOISTURE RESISTIVE BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install moisture resistive barrier on exterior walls where indicated on the drawings and specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Polyethylene sheet, 0.0061 inch thick, formed by spinning continuous strands of fine high density polyethylene interconnected fibers and bonding them together by heat and pressure; with a moisture vapor transmission rate of 400 grams/sq. meter/24 hrs., and flame spread and smoke developed ratings of 10, OR

B. Woven polyolefin sheet, 0.005 inch thick, with a moisture vapor transmission rate of 70 grams/sq. meter/24 hours.

C. Available Products: Subject to compliance with specified requirements, moisture resistive barriers shall be the product of one of the following (or equal):

1. At plaster, provide "Stucco Wrap" by Simplex Products Division, Anthony Industries, Inc.
2. At brick, provide "Tyvek Commercial Wrap" by Fibers Department, Du Pont Company.
3. At metal panels, provide “Ice & Water Shield” by GCP Applied Technologies, Inc.

D. Moisture Barrier Tape: Provide laminated aluminum foil and glass fiber reinforced tape with pressure sensitive adhesive.

E. Adhesive: As recommended by the moisture barrier manufacturer.

F. Fasteners: Stainless steel or galvanized steel screws with neoprene washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the moisture barrier on the supporting members as recommended by the manufacturer, using screws or adhesives, or a combination of adhesive and screws.

B. Protect moisture barriers so that other trades do not puncture, damage or otherwise cause deterioration of the barrier.

END OF SECTION

SECTION 07 25 40

SPRAY-APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and apply spray applied fire proofing as indicated on the drawings and specified.

1.2 REFERENCES

A. ASTM E84 - Test for Surface Burning Characteristics of Building Materials.

B. ASTM E119 - Fire Tests of Building Construction and Materials.

C. ASTM E605 - Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members.

D. ASTM E736 - Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

E. ASTM E760 - Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members.

F. ASTM E761 - Test Method for Effect of Deflection of Sprayed Fire-Resistive Material Applied to Structural Members.

G. ASTM E759 - Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.

H. ASTM E859 - Test Method for Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members.

I. ASTM E937 - Test Method for Corrosion of Steel by Sprayed Fire-Resistive Materials Applied to Structural Members.

J. CCR - California Code of Regulations, Title 24 and Title 21.

K. UBC - (International Council of Building Officials): Standard No. 24-8; Thickness and Density Determination for Spray-Applied Fireproofing.

L. UL - Fire Resistance Directory.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01340.

A. Manufacturer's Data: Submit information regarding the physical properties, certificate of compliance with the specifications, and manufacturer's instructions for applying spray-on fireproofing.

B. Test Reports: A complete report and test records from a certified independent laboratory shall be submitted, attesting that the fireproofing material and installation procedures conform to the requirements of this section. Performance test reports shall conform to the requirements of the applicable test method.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to the jobsite in the original sealed packages and containers properly marked and labeled to show manufacturer's name, brand and certification of compliance with the requirements of this section.

B. Keep fireproofing materials dry until ready to be used and stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Materials with shelf-life shall be applied prior to expiration of the shelf-life period.

1.5 ENVIRONMENTAL CONDITIONS

A. Maintain substrate and ambient air temperature above 40 degrees F during application, and for 24 hours before and 24 hours after application. Maintain relative humidity within the limits recommended by the fireproofing manufacturer.

B. Provide adequate ventilation to dry the fireproofing after application. Provide forced air circulation for enclosed areas without adequate natural ventilation.

1.6 QUALITY ASSURANCE

A. Qualifications of Applicator: Applicator shall be licensed by the manufacturer of the fireproofing material.

B. Regulatory Requirements: Comply with the requirements of the local building code, and the following:

1. Sprayed fireproofing shall be evaluated and accepted by ICBO Evaluation Service, Inc., in accordance with UBC Standard 43-8 and ASTM E119.
2. Sprayed fireproofing shall comply with the requirements of the indicated UL Assembly. Where spray applied fireproofing is required, but no UL Assembly is indicated, conform to the schedule at the end of this Section.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specified requirements, fireproofing shall be one of the following products:

1. W.R. Grace & Co., Monokote.
2. Cafco, Blaze-Shield; White where exposed to view.
3. Spraydon Standard.

2.2 MATERIALS

A. Spray Fireproofing: Factory mixed, asbestos free, material blended for uniform texture; conforming to the following requirements:

1. Bond Strength: The material when applied to uncoated and galvanized steel shall have the following bond strength when tested in accordance with ASTM E736:
   a. Cementitious Fireproofing: 200 psf.
   b. Fibrous Fireproofing: 80 psf.

2. Impact Resistance: No cracking or delamination when subjected to impact tests in accordance with ASTM E760.
3. Dry Density: Not less than average and minimum density required by applicable UL Assembly listing when tested in accordance with ASTM E605.
4. Compressive Strength: Shall not deform more than 10 percent when subjected to 500 psf compressive forces in accordance with ASTM E761.
5. Deflection: No cracking or delamination when subjected to deflection tests in accordance with ASTM E759.
6. Air Erosion: When tested in accordance with ASTM E859, not more than 0.025 grams per square foot air erosion when exposed to an 80.0 fpm air stream for not less than six hours.
7. Corrosion Resistance: ASTM E937: No evidence of corrosion to bare, galvanized, or coated steel.
8. Flame Spread: ASTM E84, 0.
9. Smoke Development: ASTM E84, 0.

B. Water: Potable and free of substances which could adversely affect fireproofing and its bond.

C. Metal Lath: Expanded metal lath; 3.4 lb/sq yd, galvanized finish.

D. Hard Coat and Sealer: In the following locations, provide hard coat or sealer of type recommended by the fireproofing manufacturer:
1. Exposed fireproofing above dining areas.
2. Exposed fireproofing 8 feet or less above floor.

E. Primer Adhesive: If required, provide type as recommended by fireproofing manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that conditions are satisfactory for the installation of spray applied fireproofing.

B. Verify clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.

C. Verify ducts, piping, equipment, or other items which would interfere with application of fireproofing are not positioned until fireproofing work is complete.

D. If unsatisfactory conditions exist, do not commence the installation until such conditions have been corrected. Beginning installation means installer accepts existing surfaces.

3.2 PREPARATION

A. Clean substrate of rust, dirt, dust, grease, oil, and other substances which could affect the bond of fireproofing. Sandblast surfaces if normal cleaning methods fail to remove adhering substances.

B. Provide test application on painted steel surfaces to determine that the paint will not impair adhesion.
   1. Primer Adhesive: If required, apply in accordance with manufacturer's recommendations.
   2. Remove incompatible materials which affect bond by scraping, brushing, scrubbing, or sandblasting

3.3 PROTECTION

A. Mask off adjacent areas not receiving fireproofing to protect from overspray.
B. Provide drop cloths as required to protect materials below.
C. Close off and seal openings in ductwork, piping and conduit to prevent infiltration by fireproofing.

3.4 APPLICATION

A. Mix and apply fireproofing system in accordance with the manufacturer's printed instructions and the fire-resistive ratings specified.
B. Do not use fireproofing mix that has partially set, or that contains lumps, or that is frozen or caked.
C. Apply fireproofing as required by Code and as indicated in Drawings to structural steel framing, and metal decking.
D. Prior to the application of fireproofing to the underside of roof decks, roof construction must be complete and roof traffic prohibited until fireproofing materials have cured. Concrete work above metal decking must be complete prior to commencement of fireproofing application.

3.5 FIELD QUALITY CONTROL

A. Perform inspections to verify compliance with requirements.
B. Correct unacceptable work and provide further inspection to verify compliance with requirements.

3.6 CLEANING

A. Upon completion of fireproofing application, clean fireproofing from surfaces not specifically required to be fireproofed that will be exposed to view in the completed Work.

3.7 PATCHING AND REPAIRING

A. After other work adjacent to fireproofing is completed, but prior to concealment, original installer shall patch and repair damaged sprayed fireproofing.

END OF SECTION

SECTION 07 41 01

METAL ROOF AND WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preformed roof and wall panels as indicated.
2. Accessories, supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a waterproof installation.

1.2 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings, indicating panel and fastener layout, joints, corners, supports, anchorages, trim, flashing, closures and special details.

B. Product Data:

1. Submit catalog cuts, technical data sheets and descriptive literature on sheets, panels, accessories and fasteners.
2. Submit complete installation recommendations.

C. Material Samples: Submit Samples showing full range of manufacturer's standard colors, minimum 3 inch x 5 inch size.

1.3 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. AISC - Steel Construction Manual.
2. AISI - Cold Form Steel Design Manual.
3. ASTM A 653 - Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A 792 - Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
5. ASTM A 924 - Steel Sheet, Metallic- Coated by the Hot-Dip Process.
6. SMACNA – Architectural Sheet Metal Manual.

B. Qualifications of Installer: Minimum 2 years experiences in the installation of roof and wall panel systems of similar complexity as required by this section.

C. Trained and certified by manufacturer to install the specified products.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver panels to the Project site without damage.

B. Storage: Store materials and accessories above ground on skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up.

C. Handling: The bending, warping, or twisting of panels is not permitted during unloading, storing or installation.

1.5 WARRANTY

A. Manufacturer shall provide a 20 years material warranty.

B. Installer shall provide a 5 years labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Berridge Manufacturing Company, 1720 Maury Street, Houston, TX
B. IMETCO, 2070 Steel Drive, Tucker, GA.
C. AEP-Span, 5100 East Grand Avenue, P.O. Box 150449, Dallas, TX
D. Peterson Aluminum Corporation, 1005 Tonne Road, Elk Grove Village, IL.
E. Una-Clad Copper Sales, Inc., 1001 Lund Boulevard, Anoka MN
F. McElroy Metal Inc. 1500 Hamilton Rd., Bossier City, LA 1-800-950-6531.

2.2 MATERIALS

A. Roof and wall panel materials:
   1. Galvanized Steel: ASTM A 653, Coating Class G90.
   2. Galvalume (Zincalume): Steel sheets coated with 55 percent aluminum and 45 percent zinc/mischmetal by weight, conforming to ASTM A 792, 0.55 ounces per square foot.
   3. Aluminum: ASTM B 209, for sheets, alloy 3003-H14 aluminum not less than 0.040 inch thick. For fasteners, clips, and accessories, alloy 6063-T5 extruded aluminum, 0.051 inch minimum thickness.

B. Accessory materials:
   1. Clips, flashings, ridge sections, closures and other accessories: Manufacturer's standard, finished to match roof sheets where exposed.
   2. Underlayment: Vycor Ultra, manufactured by W.R. Grace, or equal, high temperature resistant, butyl rubber-based adhesive-backed, high-density cross laminated polyethylene sheet, 30 mils thick, furnished in 34" wide rolls.
   3. Slip sheet: Unsaturated building paper weighing not less than 5 pounds per 100 square feet.
   4. Sealant: Elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber-like consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.
   5. Gaskets and insulating compounds: Non-absorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be non-running after drying.

2.3 FABRICATION

A. Roll form panels in continuous lengths, full length of detailed runs.
B. Fabricate trim, flashing and accessories to detailed profiles.
C. Fabricate trim and flashing from same material as panel.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examination: Examine substrates and other installed item to verify suitability for installation. Do not proceed until unsuitable conditions have been corrected.

3.2 INSTALLATION

A. Install panels weathertight, without waves, wraps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
B. Install panels in accordance with manufacturer's installation instructions and Shop Drawings.
C. Provide concealed anchors at all panel attachment locations.
D. Install panels plumb, level and straight with seams and ribs/battens parallel, conforming to design indicated on Drawings.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

SECTION 07 52 02

30-YEAR WARRANTY MODIFIED BITUMINOUS ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install the 30-year warranty modified bituminous roofing as indicated on the drawings and specified.

B. TPA flashings shall be proposed as an alternate to the standard bituminous flashings advertised by the manufacturer in commercial literature.

1.2 ACTION SUBMITTALS

A. Product Data: Submit descriptions of the following:

1. Sample Warranty certificate indicating 30-year coverage.
2. Submit all data describing the insulation. Include in data written acceptance by the roof membrane manufacturer of the products and accessories provided. Products must be as listed in the applicable wind uplift and fire rating classification listings.

B. Manufacturer's Instructions: Submit the manufacturer’s recommendations and guidance, covering the following:

1. Modified Bitumen Membrane Application.
2. TPA Flashing
3. Cold Adhesive Applied Modified Bitumen Membrane
4. Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

C. Closeout Submittals: Include the following:

1. Warranty (30-Year): "No-Dollar-Limit" warranty for labor and materials.
2. Include copies of Safety Data Sheets for maintenance and repair materials.

1.3 QUALITY ASSURANCE

A. Qualification of Applicator: Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of five years of experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

B. Pre-roofing Conference: After approval of submittals and before performing roofing [and insulation] system installation work, hold a pre-roofing conference to review the following:

1. Drawings, including Roof Plan, specifications and submittals related to the roof work
2. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

1.4 FIRE WATCH

A. All personnel on the roof during torch application or hot-mopped application must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of [two hours after completion of all torch work and 30 minutes after completion of hot-mopped kettle operations at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist.

B. Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.5 30-YEAR WARRANTY

A. Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 30 years.

B. Furnish the roof membrane manufacturer's 30-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation in compliance with ASTM C1289, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Owner and commence warranty effective date at time of Owner's acceptance of the roof work. The warranty must state that:

1. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.
2. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.
3. Upon completion of installation, and acceptance by the Architect, the manufacturer must supply the appropriate warranty to the Owner.
4. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the Architect.

C. Roofing System Installer Warranty: The roof system installer must warrant for a period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Owner. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

D. Continuance of Warranty: Repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 - PRODUCTS

2.1 30-YEAR WARRANTY MODIFIED BITUMEN ROOFING

A. Subject to the Architect's review of action submittals for compliance with specified requirements, the 30-year warranty modified bitumen roofing shall be the product indicated on the drawings (Certainteed), or a substitution that has been reviewed by the Architect, found acceptable, and manufactured by one of the following:
   1. Certainteed Corp.
   2. Garland Company
   3. Tremco, Inc.
   4. Johns-Manville Corp.
   5. Firestone Building Products
   6. Sorprema, Inc.

B. Furnish a combination of specified materials that comprise the modified bitumen manufacturer's 30-year warrantied system of the number and type of plies required. Materials provided must be suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

C. The base sheet must be tripolymer alloy (TPA) membrane flashing system compatible with the roof membrane installed and conforming to the warranty provisions. The TPA material shall be based on elvaloy and blended with CPE and PVC, and exceed the performance standards of ASTM D 4434, Type IV.

D. Asphalt must comply with ASTM D312/D312M, Type III or IV, in accordance with modified bitumen membrane manufacturer requirements and compatible with the slope conditions of the installation.

E. Cold applied membrane adhesive must be the membrane manufacturer's recommended low volatile organic compound (VOC) cold process adhesive for application of the membrane plies.

F. The membrane surfacing must be modified bitumen roof membrane cap sheet with factory-applied granule surfacing of light color as selected from membrane manufacturer's standard colors.

G. Primers must comply with ASTM D41, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

H. Modified bitumen roof cement must comply with ASTM D4586/D4586M, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.2 CANT AND TAPERED EDGE STRIPS

A. Provide standard cants and tapered edge strips of perlite conforming to ASTM C728, the same material as the roof insulation, or when roof insulation material is not available, provide pressure preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the manufacturer.

2.3 FASTENERS AND PLATES

A. Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions. For fastening of membrane or felts to wood materials, provide fasteners, or one piece composite fasteners with heads not less than 1 inch in diameter.

B. Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 2 inch in diameter. Form discs to prevent dishing or cupping.

2.4 WALK PADS

A. Roof walk pads must be polyester reinforced, granule-surfaced modified bitumen membrane material, minimum 197 mils thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels must not exceed 4 feet in length. Other walk pad materials require approval of the Architect prior to installation.

2.5 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

A. Insulation must be compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of ASTM C552, ASTM C578, or ASTM C726.

2.6 MEMBRANE LINER

A. Provide self-adhering modified bitumen underlayment conforming to ASTM D1970/D1970M, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material as approved by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure that the following conditions exist prior to application of the roofing materials:
   1. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.
   2. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a10 foot straight edge placed anywhere on the substrate.
   3. Substrate is sloped as indicated to provide positive drainage.
   4. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.
   5. Verify all Fire Watch personnel assignments.
   6. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

3.2 PREPARATION

A. Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. Inspect for damage, pinholes, and particles of foreign matter, non- dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

B. Apply membrane to clean, dry surfaces only. Do not apply membrane to surfaces that have been wet by rain within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 APPLICATION

A. Apply roofing materials as recommended by the materials manufacturers as required to provide the 30-year warranty specified. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt.

B. Cap Sheet Installation: The underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. Minimize traffic on newly installed cap sheet membrane.

C. Apply modified TPA strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply TPA membrane flashing in accordance with the roof membrane manufacturer’s instructions. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of TPA base flashing 6 inches on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

D. Install walk pads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walk pads to accommodate drainage.

E. Apply surface coating materials to membrane and flashing in accordance with coating material manufacturer's recommendations.

3.4 CORRECTION OF DEFICIENCIES

A. Where any form of deficiency is found, additional measures must be taken as deemed necessary by the Architect to determine the extent of the deficiency and corrective actions must be as directed by the Architect.

3.5 PROTECTION OF APPLIED ROOFING

A. At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

3.6 CONSTRUCTION MONITORING

A. During progress of the roof work, Contractor must make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

1. Materials comply with the specified requirements.
2. Materials are not installed in adverse weather conditions. All materials are properly stored, handled and protected from moisture or other damages.

3. Equipment is in working order. Metering devices are accurate.
4. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.
    a. Nailers and blocking are provided where and as needed. Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.
    b. The proper number, type, and spacing of fasteners are installed. Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.
    c. The proper number and types of plies are installed, with the specified overlaps. Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.
    d. Lap areas of all plies are completely sealed. Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations. Installer adheres to specified and detailed application parameters. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements. Temporary protection measures are in place at the end of each work shift.

B. Roof Drain Test: After completing roofing, but prior to Owner acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.7 INSTRUCTIONS TO OWNER PERSONNEL

A. Furnish written and verbal instructions on proper maintenance procedures to designated Owner personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

END OF SECTION

SECTION 07 52 03

TRIPOLYMER ALLOY (TPA) FLASHING FOR ROOFING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install tripolymer alloy (TPA) flashing for assemblies as indicated on the drawings and specified.

1.2 SUBMITTALS

A. Submit product data in form of manufacturer's TPA product specifications, installation instructions, and general recommendations for the flashing assemblies indicated.

B. Submit shop drawings showing full extent of TPA flashing assemblies. Include large-scale details indicating profiles of each type of roofing assembly, splice joints between sections, joinery with other materials, special end conditions, fasteners, and relationship to adjoining work and finishes.

C. Submit samples for each type of TPA flashing assembly.

1.3 QUALITY ASSURANCE

A. Manufacturer's Instructions: Comply with manufacturer's instructions and recommendations for all phases of work, including preparation of substrate, applying flashing materials, and protection of installed flashing assemblies.

B. Single Responsibility: Obtain TPA flashing assemblies from a single manufacturer.

PART 2 - PRODUCTS

2.1 TRIPOLYMER ALLOY (TPA) FLASHING FOR ROOFING ASSEMBLIES

A. Subject to the Architect’s review of action submittals for compliance with specified requirements, provide products of TPA products of Tremco Inc., or equal.

B. The TPA material shall be thermoplastic tripolymer based on evaloy and blended with chlorinated polyethylene (CPE) and PVC. It is designed and manufactured to withstand continuous, and prolonged exposure to the weather without rupture, splitting, cracking, or deteriorating, and to exceed the requirements of ASTM D 4434, Type IV.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install TPA flashing assemblies in accordance with the manufacturer's installation instructions, with a minimum number of end joints. Install flashing assemblies in true alignment and proper relationship to adjoining surfaces measured from established lines and levels. Allow movement for thermal expansion and contraction to avoid buckling.

END OF SECTION

SECTION 07 60 00

GALVANIZED SHEET METAL FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install galvanized sheet metal flashing as indicated on the drawings and specified.

1.2 SUBMITTALS

A. Shop Drawings: Submit for fabricated sheet metal indicating shapes, details, methods of joining, anchoring and fastening, thicknesses and gages of metals, concealed reinforcement, expansion joint details, sections, and profiles.

B. Samples: Submit Samples for materials or assemblies as requested.

C. Product Data: Submit brochures of manufactured items.

1.3 QUALITY ASSURANCE

A. Drawings and requirements specified govern. Provide the Work of this section in conformance with the Architectural Sheet Metal Manual published by SMACNA for conditions not indicated or specified and for general fabrication of sheet metal items.

B. Materials shall conform to ASTM A 653 - Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. Pre-installation Meetings: Refer to Division 7 roofing sections as appropriate. Attend the pre-installation and inspection meetings for roofing Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Galvanized Sheet Steel: ASTM A 653, coating designation G90, hot-dip galvanized.

1. Sheet Materials shall be bonderized.

B. Fastenings (Galvanized Steel): Screws, rivets, and other fastenings furnished in connection with galvanized sheet steel Work shall be sealed with rust resistive coating. Rivets shall be tinned. Screws and other fastenings shall be zinc-coated.

C. Soldering Flux: Raw muriatic acid for galvanized steel; rosin for tin, lead and tinned; non-corrosive soldering salts for uncoated and acid-type flux formulated for soldering stainless steel.

D. Solder: ASTM B 32, Grade 50A. Name of product manufacturer and grade designation shall be stamped or cast onto each bar.

E. Elastomeric Seam Sealer: Provide elastomeric based seam cementing compound recommended by SMACNA

2.2 FABRICATION

A. Accurately form sheet metal Work to dimensions and shapes indicated and required. Cope finish molded and brake metal shapes with true, straight, sharp lines and angles and, where intersecting each other, to a precise fit. Unless otherwise specified, all galvanized sheet steel shall be not lighter than the gage thickness indicated on the drawings. Exposed edges of sheet metal shall have a 1/2 inch minimum hemmed edge.

B. Soldering of sheet steel shall be performed with well-heated soldering iron or soldering torch, joints full flowing, neat and consistent. Thoroughly clean materials at joints before soldering, and tin before soldering. Exposed soldering on finished surfaces shall be scraped smooth. Lock seam Work shall be fabricated flat and true to line and soldered along its entire length. Acid-fluxed Work shall be neutralized after fabrication.

C. Form and install sheet metal Work to provide proper allowances for expansion and contraction, without causing undue stresses in any part of completed Work. Installation shall be water and weathertight.

D. Miscellaneous Flashing: Unless otherwise indicated, miscellaneous flashing shall be fabricated of galvanized steel. Exterior doors and windows, unless covered by overhangs shall be provided with 26 gage galvanized steel drip flashing as detailed. At wood construction, fasten flashing to framing with screws before paper backed lath is installed.

E. Roof Pipe Flashings: Provide welded seam 4 pound lead flashings. Field fabricated flashings shall also be welded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Concrete, plaster, and masonry materials in contact with sheet metal shall be painted with alkali resistant coating, such as heavy-bodied bituminous paint. Wood in contact with sheet metal shall be painted with 2 coats of aluminum paint or one coat of heavy-bodied bituminous paint.

1. Edges of field cut flashing shall be painted at least one coat of zinc rich paint.
2. Overlapping Joints: Form overlapping joints as recommended by SMACNA, sealed with elastomeric sealant.

B. Flashings shall conform to the approved shop drawings and comply with SMACNA requirements.

C. Prime all exposed flashings with zinc rich paint after installation paint flashings 2 coats of industrial enamel, colors as selected by the Architect.

END OF SECTION

SECTION 07 72 46

ROOF WALKWAYS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Application of roof traffic pads.

1.02 REFERENCE STANDARDS

A. Comply with ASTM D517 for built-up membranes.

B. Comply with ASTM E108 for fire ratings.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

Specified manufacturers for purpose of establishing general quality.

A. W.R. Meadows, Inc., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax (847) 683-4544. Web Site www.wrmeadows.com ."Whitewalk" roof traffic pads.

2.02 MATERIALS

A. Roof Traffic Pads for built-up roofs: Minimum 3/4" x 3'x4' thick multi-ply, asphaltic panels, consisting of a reinforced carrier sheet, fortified asphaltic core and a non-slip top surface of white mineral granules.

B. Roof Traffic Roll for single-ply TPO roofs: Carlisle sure-weld TPO walkway rolls.

2.03 ACCESSORIES

A. Plastic Cement: # 625 Plastic Cement by W.R. Meadows for built-up assemblies.

B. Carlisle Weathered Membrane Cleaner for TPO roofs.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive traffic pad. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Built-Up Roofing and Modified Bitumen Systems.

1. Ensure roof has been completely surfaced with gravel or slag.
2. Sweep away all loose surfacing materials from the area to receive the panels.
3. Install the panels with spot applications of plastic cement or the same coating used to embed the gravel.
4. Embed and step each panel into the spot applied cement or coating.
5. Apply panels with minimum of 1” to 3” between panels to permit unrestricted flow of free water.

B. Single-Ply Roofing Systems

1. Use Weathered Membrane Cleaner to prepare the membrane to be welded to the walkway material.
2. Position the walkway material. Cut the Walkway Rolls into maximum 10' lengths and position with a minimum 1" gap between adjacent pieces to allow for water drainage. Cut the walkway so a 4" minimum gap is created over any field splices. Since the attachment of the walkway to the membrane is permanent, this will allow access to the field seams.
3. Using an automated welder, weld all four sides of the walkway material to the membrane. Typically, the same speed and temperature settings will be used for this procedure as for welding membrane to membrane. A test weld is always recommended prior to performing welds to the installed membrane. A hand held welder may be utilized, however, productivity will be decreased.
4. Allow the walkway to relax and warm up in the sun prior to welding in place.
5. When possible, weld the walkway rolls when the ambient temperature is above 60° F (16° C) to help prevent wrinkles.

C. Walking pads must be installed around the entire perimeter of each HVAC component, and to the service portions of all equipment and all power shutoffs. The pads shall provide a path-of travel from roof access points (ladders, hatches, access doors, etc.) to all rooftop equipment.

END OF SECTION

SECTION 07 77 22

ROOF HATCHES WITH SAFETY POLE

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install roof hatches with safety pole, and accessories is indicated on the drawings and specified.

1.2 QUALITY ASSURANCE

A. Submit manufacturer’s technical product data, illustrations, specifications, rough-in diagrams, details, dimensions, installation instructions and general maintenance recommendations.

B. Coordinate rough opening sizes and installation work with that of the roofing installer and other trades to ensure proper fit up, and weather tightness.

C. Exercise care to avoid damage during unloading, storing and installation. Immediately remove and replace any damaged products.

PART 2 - PRODUCTS

2.1 PREFABRICATED ROOF HATCHES:

A. Fabricate units of sizes shown, single-leaf type unless otherwise indicated, for 40 lbs. per sq. ft. external loading and 20 lbs. per sq. ft. internal loading pressure. Frame with 9" high integral-curb double-wall construction with 1-1/2" insulation, cant strips and cap flashing (roofing counter-flashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1" insulation core. Equip units with complete hardware set including hold-open devices, interior padlock hasps, and both interior and exterior latch handles. Provide gasketing. Fabricate units of aluminum or zinc coated steel, or in combination, at Contractor's option.

B. Manufacturers: Subject to compliance with specified requirements, provide prefabricated roof hatch units with ladder up safety pole Bilco Type S, or an "or equal" type by one of the following:

1. Babcock-Davis Hatchways Inc.
2. Dur-Red Products; Cudahy, CA
3. Bristol Fiberlite Industries; Santa Anna, CA
4. O'Keefe's, Inc.; San Francisco, CA

2.2 LADDER-UP SAFETY POLE

A. Safety: Ladder shall be equipped with a center mounted mechanism that fosters the safety of the person using the ladder. The safety pole shall be readily raised as an

individual ascends through the hatch door and affixes securely in the upright position, automatically locks when fully extended.

B. Mechanism: A release mechanism shall allow the safety pole to be lowered from below the hatch door. The mechanism shall meet OSHA requirements, and shall be Bilco Model LU-2 (galvanized), or an "or equal" model by one of the aforementioned manufacturers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and vapor barriers, roof insulation, roofing and flashing; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Flange Seals: Except as otherwise indicated, set flanges of the unit in a thick bed of roofing cement, to form a seal.

C. Cap Flashing: Where cap flashing is required as component of hatch, install it to provide adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant.

D. Operational Units: Test operate hatches, ladder up pole, and other operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

E. Clean exposed surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

F. Demonstrate by water hose that the installation is completely weathertight.

END OF SECTION

SECTION 07 81 22

SMOOTH INTUMESCENT PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of smooth fire-retardant intumescent paint to interior items and surfaces as indicated on the drawings.

1.2 ACTION SUBMITTALS

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

1. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include manufacturer's recommended spreading rate for each separate coat for each type of substrate indicated.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies coatings approved by MPI, with the proposed product highlighted.

B. Samples for Initial Selection: For each intumescent paint finish indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of intumescent paint finish indicated.

1. Submit Samples on rigid backing, not less than 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each paint system from single source from single manufacturer or provide a system approved in writing by intumescent paint manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. MPI Standards: Comply with indicated requirements for the following:

1. Products: MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

D. Mockups: Apply benchmark Samples of paint system indicated and of each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one actual substrate to represent surfaces and conditions for application of coating.
2. Apply benchmark Samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark Samples.

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

E. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

PART 2 - PRODUCTS

2.1 SMOOTH INTUMESCENT PAINT MATERIALS

A. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each material or coat, provide products and spreading rates recommended in writing by intumescent paint manufacturer for use on substrate indicated. Comply with requirements for fire-retardant coating classification and surface-burning characteristics indicated.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction (SCAQMD).
1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
6. Shellacs, Clear: 730 g/L.
7. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Colors and Gloss: Provide smooth finish, non-pebbled surface, as selected by Architect from manufacturer's full range of finishes.

2.2 SMOOTH INTERIOR, PIGMENTED, INTUMESCENT PAINT SYSTEM

A. Products: Subject to the Architect's review of action submittals for compliance with requirements, provide products indicated on the drawings (CAFCO Spray Film and Topseal) or an approved substitution of one of the following:
   1. Isolatek International (CAFCO)
   2. Albi Manufacturing, a division of StanChem, Inc.
   3. Flame Control Coatings, LLC.
   4. International Fire Resistant Systems, Inc.
   5. Magna Coatings Technology Inc.

B. Intumescent fire resistive material shall be applied in accordance with drawings and specifications, and shall have been tested in accordance with the procedures of ANSI/UL 263 or ASTM E119, and reported by Underwriters Laboratories, Inc..

C. Primer: Intumescent paint manufacturer's recommended primer compatible with substrate and other materials indicated,

D. Water Based Intumescent Material: CAFCO Spray Film WB5, or equal.

E. Smooth Top Seal: Provide water based two-part epoxy, CAFCO Spray Film Top Seal, or equal.

PART 3 - EXECUTION

3.1 APPLICATION

A. General: Apply intumescent paints according to manufacturer's written instructions and to comply with requirements for fire-retardant coating classification.
   1. Use equipment and techniques best suited for substrate and type of material being applied.
   2. Coat surfaces behind movable items the same as similar exposed surfaces.
   3. Apply each coat separately according to manufacturer's written instructions.
   4. Finish doors on faces with intumescent finish. Paint tops, bottoms, and side edges with fire-inert finish.

B. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
   1. Pigmented Finishes: If undercoats or other conditions show through pigmented topcoat/overcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
   2. Clear Finishes: Produce a smooth surface film of even sheen using multiple coats.

3.2 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

E. Topcoat/Overcoat: Apply if required or recommended and approved by intumescent paint manufacturer.

END OF SECTION

SECTION 07 84 03

FIRE SAFING INSULATION

PART 1 - GENERAL

1.2 SUMMARY

A. Furnish and install perimeter wall fire safing insulation as indicated on the drawings and specified.

1.3 SYSTEM DESCRIPTION

A. Provide fire safing and smoke seals to prevent the passage of fire, smoke, toxic gasses or water from one floor or area to another. Seal openings in floors, fire rated perimeter walls penetrated by pipes, ducts, conduits and other items as shown, specified, and as required for the type of construction.

B. Fire safing insulation installed as fire safing at non-rated penetrations not containing pipes, ducts, conduits, and other items in floor slabs, wall partitions, construction-joint conditions between slabs and adjacent construction and where indicated or required.

C. Provide damming material, clips, and closures as required for support and containment of dams, and other insulation materials required for tested and rated fire safing systems.

1.4 QUALITY ASSURANCE

A. Provide materials and Work to conform to source quality control criteria specified herein and CBC requirements in fire resistant wall and floor assemblies to prevent the passage of fire, smoke, and toxic gases.

B. Installed fire safing shall be of sufficient thickness, width, and density to provide a fire resistance rating at least equal to the floor, wall, or partition construction into which it is installed.

C. Comply with CBC requirements for fire rated construction.

D. Qualifications of Manufacturer: Products furnished for fire safing shall be manufactured by a firm which has been continuously and regularly employed in the manufacture of these materials for a period of at least 3 years; and which can provide evidence of these materials being satisfactorily installed on at least 3 projects of similar size and type within such period.

E. Qualifications of Installer: The Work of this section shall be installed by a firm which has been in the business of installing similar materials for at least 3 consecutive years; and can provide evidence of satisfactory completion of 3 projects of similar size and scope. Installer shall have applicators trained and certified by manufacturer for performing this Work.

1.5 SUBMITTALS

A. Submit manufacturer's Product Data for fire safing material proposed for installation. Indicate product characteristics, typical installations, performance, and limitation criteria and test data.

B. Submit manufacturer's printed installation instructions for each type of product, system, and construction required for the Work. Indicate fire resistance rating of each installation.

C. Submit fire test reports from independent testing agency indicating the following:

1. Fire test report of fire stop material installed to substrate and penetration materials similar to the Work of this section. Test to indicate both Flame (F) and Temperature (T) Ratings.

2. Test reports of products to be installed shall indicate conformance to ASTM E 814, UL rating with UL classified system description, and UL classified system detail.

D. Manufacturer's Qualifications: Submit evidence of conformance with qualification requirements specified above.

E. Installer’s Qualifications: Submit evidence of conformance with qualification requirements specified above.

PART 2 - PRODUCTS

2.1 PERIMETER WALL FIRE SAFING INSULATION

A. Fire safing material shall be either, mineral fiber or ceramic wool non-combustible insulation, and as follows:

1. Mineral Fiber: Density 4 pounds per cubic foot, USG Thermafiber, Fibrex "FBX Safing Insulation,” or equal.

2. Ceramic Wool: Density 6 pounds per cubic foot, Johns Manville "Ceramic Fiber Insulation", Carborundum "Fiberfrax" ceramic fiber, or equal. Provide material in tested thickness for required hour rating.

2.2 MATERIALS

A. Fire Stop Sealant: Provide single component, noncombustible fire stop sealant Biotherm "S" gun grade, or Biotherm "T" self leveling silicone by Bio, Pensil 100 by GE, CP25WB by 3M, or equivalent.

B. Fire Stop Putty: Provide one-part intumescent type FSP by Nelson, MPS/MPP by 3M, or equivalent.

C. Cementitious Fire Stop Mortar: Provide Novasit K-10 (55 lb. density) by Bio, 3M mortar by 3M, or equal. Cementitious mortar shall be non-shrinking, asbestos free type.

D. Fire Stop Pillows: Provide Manufactured by Bio Fireshield, Nelson, or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install perimeter wall fire safing insulation as recommended by the product manufacturer. Conform to CBC and UL requirements.

B. Provide mineral fiber insulation for fire safing at perimeter walls. Fire safing shall be packed and wedged solidly from both sides of walls and partitions, and from both top and bottom sides of floors with noncombustible mineral fiber insulation.

END OF SECTION

SECTION 07 92 00

SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install sealants as indicated on the drawings and specified.

1.2 REFERENCES

A. ASTM C834 - Latex Sealing Compounds.

B. ASTM C920 - Elastomeric Joint Sealants.

C. ASTM D695 - Compressive Properties of Rigid Plastics.

D. ASTM D732 - Aging Effects of Artificial Weathering on Latex Sealing Compounds.

1.3 SUBMITTALS

A. Samples: Submit color mockups showing the standard colors available for each sealant material intended for installation in an exposed location.

B. Certificates: Submit certificate that materials specified and proposed for use are suitable for intended application.

C. Manufacturer's installation instructions.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in the unopened, original containers or unopened packages with manufacturer's name, labels, product identification, and lot numbers where appropriate. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturer.

1.5 GUARANTEE

A. Guarantee sealant Work against leakage for 2 years. Include coverage of installed sealants and accessories which fail to achieve air tight and water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 SEALANTS

A. Type A Sealant:

1. Manufacturers
    a. Mameco International "Vulkem 245".
    b. Sika Corp. "Sikaflex 2C-SL".
    c. Sonneborn Building Products "Sonolastic Paving Joint Sealant".
    d. Euclid Chemical Company, "Eucolastic II - Pourable.
2. Multiple component, self-leveling polyurethane based sealant conforming to ASTM C920, Type M, Grade P, Class 25.

B. Type B Sealant

1. Manufacturers

a. Mameco International "Vulkem 922".
b. Sika Corp. "Sikaflex 2C-NS".
c. Sonneborn Building Products "Sonolastic NP II".
d. Tremco "Dymeric".
e. Euclid Chemical Company "Eucolastic II - Gun Grade.

2. Multiple component, non-sag, polyurethane-based sealant conforming to ASTM C920, Type M, Grade NS, Class 25.

C. Type C Sealant

1. Manufacturers
a. Adco Seal "No. B-100".
b. Pecora Corp. "BC-158".
c. PTI Sealants "No. 707".
d. Tremco "Butyl Sealant".

2. Butyl rubber based sealant conforming to ASTM C920, Type S, Grade NS, Class 7.5.

D. Type D Sealant

1. Manufacturers
a. Pecora Corp. "AC-20".
b. Sonneborn Building Products "Sonolac".
c. Tremco "Acrylic Latex Caulk".

2. Latex acrylic based sealant conforming to ASTM C834.

E. Type E (Acoustical) Sealant

1. Tape
a. Manufacturers
1) Norton Co. "Norseal V30 Series".
2) Arlon "Series 6A".
b. Polyvinylchloride foam tape with pressure sensitive adhesive on one side, 3/4 inch wide by the thickness required to accommodate unevenness of substrate and completely fill openings between partition framing and building floors and concrete walls.

2. Compound
a. Manufacturers
1) Ohio Sealants "Sound Caulk (solvent type)".
2) Pecora Corp. "BA-98".
3) Tremco "Acoustical Sealant".
b. Permanently resilient type manufactured specifically for acoustical applications.

F. Type F Sealant

1. Manufacturers
a. Dow Corning Corp. "No. 795".
b. General Electric Co. "Silpruf".
c. Sonneborn Building Products "Omniseal".

d. Tremco "Spectrem 1".
e. Substitution under provisions of Division 1.

2. Low-modulus silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 50.

2.2 ACCESSORY MATERIALS

A. Backer Rod
1. Material: Closed-cell foam, non-staining, resilient material such as neoprene, butyl, or polyurethane, compatible with sealant to be used.
2. Sized and shaped to control depth of sealant and to provide 20 percent to 50 percent compression upon insertion.

B. Joint Cleaner
1. For metal and glass: Xylol, xylene, toluol, or toluene.
2. For removing lacquer coatings: Lacquer thinner.

C. Primer: As recommended by sealant manufacturer for use intended.

D. Masking Tape: Pressure-sensitive adhesive paper type.

E. Bond Breaker: Pressure-sensitive adhesive polyethylene tape.

2.3 SEALANT COLORS

A. Sealant color for use in exposed locations shall be as selected by the Architect from manufacturer's standard colors.

B. Wherever sealants are not exposed to view, provide manufacturer's standard color which has the best overall performance characteristics for the application indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect joints to be sealed to determine if conditions are satisfactory for the proper installation of joint sealants.

B. If unsatisfactory conditions exist, do not commence Work until such conditions have been corrected.

3.2 GENERAL

A. Provide sealants wherever required to prevent light leakage as well as moisture leakage; and at exposed joints around plumbing fixtures, casework, door and window frames, and at other locations as required to facilitate cleaning and sanitation.

B. Consult the Architect if in doubt as to whether sealant is required at a given location.

3.3 PREPARATION

A. Cleaning: Clean joint surfaces, using joint cleaner as necessary, of dust, dirt, oil, grease, rust, lacquers, laitance, release agents, moisture, and other matter which could adversely affect adhesion of sealants.
B. Masking: Mask areas adjacent to joints.
C. Priming: Apply primer, if required, following manufacturer's printed instructions.
D. Joints shall enclose sealant on three sides. Where adequate joints for sealants have not been provided, suitable joints shall be cleaned out to the depth required, or as indicated, and ground to a minimum width of 1/4 inch without damage to the adjoining Work, unless otherwise specified or indicated. No grinding shall be performed on metal surfaces.

3.4 APPLICATION

A. Install sealant and backing materials in accordance with manufacturer's instructions.
B. Install backing materials in joints using blunt instrument to avoid puncturing.
    1. Do not twist backing while installing.
    2. Install backing so that joint depth is 50 percent of joint width, minimum 1/4 inch deep.
C. Apply sealants in joints using pressure gun with nozzle cut to fit joint width.
D. Place sealants in uniform, continuous beads without gaps or air pockets.
E. Tool joints to required configuration within 10 minutes of sealant application.
F. If masking materials are used, remove immediately after tooling.
G. Seal joints adjacent to painted Work before the final coat of paint is applied.

3.5 CLEANING

A. Remove spilled and excess materials adjacent to joints without damaging adjacent surfaces.
B. Leave finished Work in neat, clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.6 SCHEDULE

A. Type A: Joints in concrete paving, and concrete floors surfaces subject to foot traffic.
B. Type B
    1. Exterior joints in plaster walls.
    2. Around metal door, window and louver frames penetrating plaster surfaces.
    3. Do not use single component sealants when excessive movement is expected within the curing time of the sealant.
C. Type C
    1. Interior wall penetrations for pipe and conduit that will be concealed by escutcheons and other trim and plate, and for lap joints in sheet metal.
D. Type D

1. Joints, voids and penetrations not otherwise specified for interior surfaces exposed to view and requiring painting.
2. Bedding of fixtures, partitions, equipment and accessories fastened to walls and floors, flanges and escutcheons of items penetrating surfaces in Kitchens, Toilet Rooms, and other areas requiring sanitary conditions to eliminate any open joints between contact surfaces.

E. Type E
1. Perimeter joints around sound-retardant partitions and electrical boxes and other penetrations in such partitions.

F. Type F
1. Exterior and interior joints in contact with anodized aluminum and plaster.

3.7 CURING

A. Sealants shall cure in accordance with manufacturer's printed recommendations. Exercise care not to disturb seal until completely cured.
B. Damaged sealants shall be repaired as recommended by product manufacturer.

END OF SECTION

SECTION 08 11 10

PLASTIC LAMINATE FACED STEEL DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply and install steel doors as indicated or specified.

1.2 SUBMITTALS

A. Shop Drawings: Show sizes, materials, thickness, joining methods, door and frame reinforcement, sizes and locations of steel doors.

1.3 QUALITY ASSURANCE

A. Manufacture all labeled doors in accordance with the specifications of Underwriter's laboratory, (UL). Doors shall have UL listing and label when delivered to the job site.

B. Steel doors shall conform to Commercial Standard CS242-62, U.S. Department of Commerce.

1.4 COORDINATION

A. Coordinate closely with hardware supplier for proper preparations of doors to receive hardware items. Provide copies of approved shop drawings to interface subcontractors and insure orderly progress of work.

1.5 PRODUCT HANDLING

A. Doors: Provide wrapping as required to protect doors during shipping and storage. Store doors upright in a protected, dry area with 1/4" air space between doors.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Doors: Prime quality cold rolled, pickled, annealed and stretcher leveled carbon steel sheets, free from scale, pitting and surface defects.

B. Filler: Non-combustible sound deadening material standard with manufacturer.

C. Louvers: Construct louvers integral with and welded into the door. Finish flush with face sheets of door. Louvers where indicated shall be type and manufacturer for wood doors.

D. Wire glass vision panels in fire labeled doors and exterior doors shall be framed with FGS-75 Fire Glass Stop by Anemostat-West and shall be State Fire Marshal listed. Frame shall be furnished with manufacturer's standard baked on finish, color as selected by the Architect.

E. Facing: 0.050" thick high pressure plastic laminate, product of Formica, Laminate, Nevamar, Wilsonart, Micarta, or equal, color and pattern as selected by the Architect. Finish stiles to match faces.

F. On Both Vertical Edges of Doors: Provide matching laminate plastic.

2.2 CONSTRUCTION

A. Doors: Flush type constructed of 2 sheets of #16 gage steel.
   1. Assembled and reinforced with # 20 gage minimum, vertical channel shaped sections at approximately 6" on center.
   2. Reinforce doors at 4 edges as is standard with manufacturer.
   3. Close ends of doors with continuous stiffener channels, # 18 gage steel minimum, spot welded between face sheets and profile filler channels at tops of exterior doors to form flush surface.
   4. Vertical door edge seams shall be spot welded at approximately 2" o.c., filled, ground and finished smooth.
   5. All parts of doors shall be welded and finished flush and smooth.
   6. Fill Spaces between reinforcements with high density non-combustible foam filler to provide sound deadening and door stability.
   7. Where Fire Labels are required and continuous hinge is specified, place label on top of door within 6" of hinge side of door.
   8. Hardware Reinforcement: Provide reinforcement for finish hardware items. Mortise, drill and tap to template requirements for mortise type hardware. Reinforcement shall be sheet steel or plate.
      a. Butt reinforcing shall be # 10 gage minimum.
      b. Door Closer reinforcement shall be from top of door down 10" , full width of door, # 10 gage sheet steel.
      c. Kickplate reinforcement shall be from bottom of door 12" high, full width of door, # 10 gage sheet steel.
      d. Reinforcing for other items of finish hardware shall be # 12 gage minimum.

PART 3 - EXECUTION

3.1 DOOR INSTALLATION

A. Install steel doors in accordance with manufacturer's instructions and as indicated on drawings.
B. Adjust operable parts for correct function.
C. Remove Hardware, except prime coated items, tag, box and re-install after finish painting has been completed.

END OF SECTION

SECTION 08 20 50

PLASTIC LAMINATE FACED SOLID CORE DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install plastic laminate faced solid core doors as indicated on the drawings and specified.

B. Related Work: Furnishing and Installing of Finish Hardware is specified in Section 08710.

1.2 SUBMITTALS

A. Submit the following:

1. Materials list of items proposed to be provided.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Samples, approximately 8" x 8" in size, of each of the proposed laminated plastic door face materials.

1.3 QUALITY ASSURANCE

A. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with:

1. "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute, for the grade specified.
2. Certification and stamps will not be required.

B. Warranty: Submit written warranty in approved form, that all defective materials and workmanship reported written a period of 2 years after final acceptance will be promptly repaired or replaced.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the specified requirements, plastic laminate faced doors shall be the product of one of the following (or equal):

1. General Veneer Co.
2. Weyerhauser
3. Curtis Door Division of Georgia-Pacific
4. V. T. Industries
5. Permaclad

2.2 SOLID CORE PLASTIC FACED DOORS

A. Core: Kiln-dried, low-density, 2-1/2" wide, random length wood blocks, edge-glued with joints well staggered or particle board conforming to CS 236, Type I, Density C, Class 1.

B. Cross Bands: 1/16" kiln-dried hardwood, full width of door, with grain perpendicular to face grain.

C. Glue: Use CS35 Type II for bonding core blocks; use Type I (fully waterproof) for all other work.

D. Facing: 0.050" thick high pressure plastic laminate, product of Formica, Laminart, Nevamar, Wilsonart, Micarta, or equal, color and pattern as selected by Architect. Finish stiles to match faces.

E. Tops and Bottoms of Doors: Provide a positive sealer applied after completion of machining and fitting.

F. On Both Vertical Edges of Doors: Provide matching laminate plastic or when specifically approved in advance in writing by the Architect, provide prefinished hardwood.

2.3 FACTORY PREFITTING AND PREMATCHING

A. Prefitting: All doors shall be factory prefitted to the scheduled frame opening size as follows:

1. To 1/8" clearance.
2. Width: 1/4" (1/8" clearance at lock side: 1/8" clearance at hinge side)
3. Bottom: 3/8" or as detailed to scheduled threshold or finished floor.
4. Lock edges shall be beveled 1/8" in 2".

2.4 CUTOUTS

A. Openings for Louvers and Glass where indicated: Fully frame cutouts in core prior to applying face veneers. Locate as indicated, but not closer than 5" from any edge. Provide stops and moldings to match faces as closely as possible; permanently attach to one side only.

2.5 DOOR LOUVERS

A. Louvers for exterior doors shall have not less than No. 12 grille welded to No. 18 gage steel blades, and shall have removable bronze insert screen on inside. Install louver with tamperproof head through-bolts.

1. Fusible Link Louvers: Shall be approved and listed by the State Fire Marshal, UL, labeled and shall be installed with tamperproof head through-bolts.
2. Light Proof Louvers: Shall be type DRDL by Anemostat-West, Carson, CA or equal.

B. Louvers for interior doors shall have not less than No. 18 gage cold rolled steel frames and No. 20 gage blades; type CHDL, by Anemostat-West, or equal.

1. Fusible Link Louvers: Shall be approved and listed by the State Fire Marshal, UL, labeled and shall be installed with tamperproof head through-bolts.
2. Light Proof Louvers: Type DRDL by Anemostat-West, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fitting and Machining Laminated Plastic Faced Doors:
   1. Using measurements obtained in the field from installed frames, machine the doors at the factory to fit the prescribed frames with proper clearance at top, bottom, and vertical edges.
   2. Replace or rehang doors which are hinge bound and do not swing or operate freely.

B. Finish Hardware:
   1. Install finish hardware in accordance with its manufacturers' recommendations.

3.4 ADJUST AND CLEAN

A. Upon completion of the installation, inspect each component.
   1. Verify that each item has been fabricated and installed in accordance with the specified requirements.
   2. Make necessary adjustments.
   3. Touchup as necessary to make surface blemishes permanently invisible to the unaided eye from a distance of five-feet.

3.5 COMPLIANCE

A. The District reserves the right to request and pay for an inspection by a representative of the referenced organization to determine that the work of this Section has been performed in accordance with the specified requirements.

B. In the event such inspection determines the work of this Section does not comply with the specified requirements, immediately remove the non-complying items and immediately replace them with items complying with the specified requirements, all at no additional cost to the District, and reimburse the District for the cost of the inspection.

END OF SECTION

SECTION 08 30 70

ACCESS PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install steel access panels as indicated on the drawings and specified.

1.2 SUBMITTALS

A. Submit in accordance with Section 013400: Submittals.

1. Shop Drawings: Show sizes, materials, thickness, joining methods, panel door and frame reinforcement, anchorage and installation details.

1.3 QUALITY ASSURANCE

A. Manufacture all labeled panel doors and frames in accordance with Specifications of Underwriter's Laboratory, (UL). Panels shall have UL listing and label when delivered to job site.

1.4 PRODUCT HANDLING

A. Panels and Frames: Provide wrapping as required to protect panels during shipping and handling and storage.

PART 2 - PRODUCTS

2.1 GENERAL

A. Access panels and frames shall be product of same manufacturer.

B. All products must be vandal-proof. Provide keyed lock if requested by College.

2.2 MATERIALS

A. Access Panels:

Non-Rated	Milcor	Karp	Nystrom
Ceramic Tile	MS	DSC214M	APTM
Drywall-Veneer	DW	DSC214M	APWB

B. Provide stainless steel finish at Ceramic Tile.

C. Provide prime coat finish on materials at other areas and finish paint on all access panels.

D. Match special access panels indicated in Mechanical trades to those specified above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set panels accurately in location, in perfect alignment, plumb, straight and tune. Brace to prevent displacement by adjacent work.

B. Coordinate location of panels with the trades that require panels.

C. Examine panels after installation for proper opening, closing and clearances. Replace damaged panels and those that are not in proper working order.

D. For keyed panels, obtain sign off from College locksmith before final acceptance.

END OF SECTION

SECTION 08 41 13

ALUMINUM WINDOWS, DOORS AND FRAMES (STOREFRONT)

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. Furnish and install aluminum windows, doors, and frames (storefront) as indicated, on the drawings and specified,

B. The aluminum sunshades that are an integral part of the windows shall be coordinated and harmonize with the stand-alone sunshades specified in Section 10 71 12.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Drawings indicate locations, sizes, profiles and general details of aluminum windows, door and frame construction and installation.

B. Air Infiltration: When system is tested according to NAAMM TM-1-68T, Section 4.3, air infiltration at perimeter of operating doors shall not exceed 0.25 cubic feet per minute per foot of sash perimeter, with air infiltration from other sources, including fixed doors and windows, not exceeding 0.06 cubic feet per minute per square foot of wall area, except the more restrictive requirements of governing laws and codes shall determine the maximum allowable infiltration. In computing wall area, areas of operating doors is not included.

C. Water Penetration Under Static Pressure: Provide aluminum storefront systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 10 lb/sq. ft.

D. Regulatory Requirements: Comply with CBC requirements.

1.4 SUBMITTALS

A. Shop Drawings: When practicable, as a prerequisite to preparing shop drawings, the window openings and weep system shall be field measured and verified. Reflect field measurement in the shop drawings. Submit Shop Drawings for the Work of this section, prepared and reviewed before fabrication. Include plans, elevations, opening, identification symbols, sizes, and complete details for materials, finishes, sizes, profiles, moldings, dimensioned locations of hardware items with reinforcement, methods of anchoring, assembly, installation, isolation, glazing procedure as well as reglazing procedures, materials, sealants, and gaskets.

1. In-Place Dimensions: Where field measurements cannot be made without delaying the Work, establish accurate theoretical dimensions and proceed with the shop drawings without field measurements. Provide for adjustments at site,

and coordinate construction to ensure that actual in-place dimensions correspond to theoretical dimensions.

2. Shop drawings shall show all associated flashing and sealant joints, even the flashing and joints to be installed by other trades.

B. Product Data: Submit manufacturer's Product Data.

C. Material Samples: Submit the following:

1. Window, door and frame sections with specified finish, fasteners and accessories.
2. Cured sealant colors.
3. Submit samples of organic colors.

D. Calculations: Provide structural calculations, signed and sealed by a structural engineer licensed in the State of California, indicating that materials furnished for installation conform to structural and expansion/seismic requirements per building codes and industry standards specified.

E. Certificates: Submit signed statements attesting that windows and doors comply with the air filtration and water penetration test requirements.

F. Mock-ups: Provide mock-up of one typical door and window unit for review by the Architect. Installer shall be wholly and solely responsible for water-tight installation/product of mockup and all other windows, doors, and storefront.

1.5 QUALITY ASSURANCE

A. Quality Standards: Provide aluminum Work so that glass installation conforms to ANSI Z97, as applicable.

B. All aluminum windows and doors shall be from the same source and the product of a single manufacturer. This same source shall be wholly responsible for preventing water penetration.

1.6 WARRANTY

A. Manufacturer shall provide a 20 year material warranty for aluminum storefront.

B. Manufacturer shall provide a 10 year material warranty for doors.

PART 2 – PRODUCTS

2.1 ALUMINUM WINDOWS, DOORS AND FRAMES (STOREFRONT)

A. Manufacturers: Subject to compliance with requirements, provide the products indicated on the drawings, or "or equal" products by one of the following:

1. Kawneer.
2. Arcadia Inc.
3. EFCO Corporation.
4. United States Aluminum.

B. Framing system shall have the following attributes:

1. Framing sections shall be of the dimensions and profiles indicated on the drawings.
2. Provide end dams at sills.

3. Provide internal corner diverters within mullions.
4. Provide weep system to allow condensate to drain to daylight.

C. Extrusions shall be 6063-T5 alloy and temper, ASTM B 221 alloy G.S. IDA-T5. Fasteners, where exposed, shall be aluminum, stainless steel, or zinc-plated steel in accordance with ASTM B 663. Perimeter anchors shall be aluminum or steel. Steel anchors shall be isolated from the aluminum as required.
1. Major portions of door sections, except glazing beads, shall be nominal 0.125 inch.
2. Wall thickness of frame members shall be nominal 0.093 inch.

D. Glazing gaskets shall be EPDM elastomeric extrusions or vinyl reinforced with fiberglass cord, cut to fit, continuous without gaps.

E. Door stiles and rails shall be tubular sections, accurately joined at corners with heavy concealed reinforcement brackets secured with bolts and screws, and shall be MIG-welded. Doors shall be furnished with snap-in stops with bulb glazing gasket both sides of glass. Exposed screws are not permitted. Each door leaf shall be furnished with an adjusting mechanism, located in the top rail near the lock stile, which provides for minor clearance adjustments after installation. A hard-backed poly-pile weatherstrip (adjustable per hardware specifications) shall be installed in both stiles of center hung single doors.
1. The top surface of the door stile (rail) head shall be a sealed unit. No hollowed out sections will be permitted. Provide infill caps and sealants as required to produce watertight assemblies.

F. Hardware: Finish hardware shall be as specified in Section 08710: Door Hardware.

G. The framing system shall provide continuous head and sill channels spliced together with formed brake metal sleeves at center of vertical mullions. Vertical and horizontal framing members shall have a nominal face dimension and overall depth shall be as noted on the drawings. Door framing members shall match glass framing appearance.

2.2 ALUMINUM FINISHES

A. Powder Coated Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure nonmovement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   6. Seal joints watertight and per industry standards.
   7. Doors that have an open still at the top will not be acceptable. The top stile of all doors shall be sealed watertight to prohibit any intrusion of water.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full elastomeric sealant bed, over metal flashing as indicated on the architectural drawings, and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Entrances: Install to produce smooth operation and tight fit at contact points.
   1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
   2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Install perimeter joint sealants and to produce weathertight installation.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 FIELD QUALITY CONTROL

A. Water Spray Test: After the installation of minimum area of 100 square feet but not less than one full bay at each building and after the glazed aluminum; fixed windows, storefront, and fixed doors have been completed but before installation of interior finishes has begun. Test areas shall be randomly selected and as determined by the by Architect. Testing shall be performed according to AAMA 501.2., and by an independent testing agency acceptable to the Owner and Architect.
   1. Invite the Owner and Architect 5 days in advance to be present at the performance of testing. Schedule testing to accommodate their presence.
   2. Repair or remove work where test results indicate water penetration of systems.
   3. Perform additional testing to determine resistance to water penetration of replaced or additional work.
   4. Report test results to the Architect and Owner.

3.4 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
   1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION

SECTION 08 4126

ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. All-glass entrances.
B. All-glass storefronts.
C. Swinging doors.
D. Interior sliding doors.
E. Interior multi-folding doors.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Supplementary supports.
B. Section 08 7100 - Door Hardware.
C. Section 09 2116 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
D. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2010 (Reapproved 2017).
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
F. ASTM C1036 - Standard Specification for Flat Glass; 2016.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
H. BHMA A156.3 - American National Standard for Exit Devices; 2014.
I. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
J. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.
K. BHMA A156.17 - American National Standard for Self Closing Hinges & Pivots; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, documenting compliance of exterior assemblies with wind pressure criteria.

1.05 QUALITY ASSURANCE

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. All-Glass Entrances and Storefronts:
   1. Substitutions: See Section 01 6000 - Product Requirements.

B. Fittings and Hardware:
   1. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ALL-GLASS ENTRANCES AND STOREFRONTS ASSEMBLIES

A. Entrances and Storefronts: Factory fabricated assemblies consisting of frameless glass panels fastened with metal structural fittings in configuration indicated on drawings.
   1. Exterior Assemblies: Designed to resist the following wind pressures:
      a. Positive Pressure: ___ psf (___ Pa).
      b. Negative Pressure: ___ psf (___ Pa).
   2. Operational Loads: Designed to withstand door operation under normal traffic without damage, racking, sagging, or deflection.
   3. Prepared for all specified hardware whether specified in this section or not.
   4. Finished metal surfaces protected with strippable film.
   5. Factory assembled to greatest extent practicable; may be disassembled to accommodate shipping constraints.

B. Swinging Door Fittings and Hardware:
   1. Top and bottom pivots concealed in full width rails top and bottom.
   2. Floor Closer.
   3. Push/pulls: _____.
   4. Deadbolt mounted in bottom rail.
   5. Pairs: Overhead mounted door stop.
   6. Single Doors: Floor mounted door stop.

C. Interior Top Hung Sliding Door Fittings and Hardware:
   1. Top Track: Box channel, designed for support of panels of size and weight required.
   2. Hangers: Overhead mounted twin roller assembly, concealed within top track, with concealed clamps.
   3. Pulls Both Sides: _____.
   4. Floor guides.
   5. Deadbolt mounted in bottom rail.

D. Interior Bottom Roller Sliding Door Fittings and Hardware:
   1. Top and bottom box tracks, designed for support of panels of size and weight required.
   2. Roller Assembly: Tandem rollers, concealed within bottom fitting.

3. Pulls Both Sides: _____.
4. Positive stops, both ends.

E. Interior Multi-Folding Door Fittings and Hardware:
1. Top Track: Box channel, design for support of panels of size and weight required.
2. Hangers: Overhead mounted twin roller assembly, attached to pivots concealed in full width top and bottom rails.
3. Pulls Both Sides: _____.
4. Deadbolt mounted in bottom rail.

2.03 BASIS OF DESIGN - ALL-GLASS ENTRANCES AND STOREFRONTS

2.04 FITTINGS AND HARDWARE

A. Rail Style Fittings for Swinging Doors and Related Fixed Glazing:
1. Top Rails: 4-7/8 inch (124 mm) high with matching end caps.
2. Bottom Rails: 4 inch (102 mm) high with matching end caps.
3. Sidelite Rails: Match door rail sightlines.
4. Exposed Edge Profile: Square.

B. Patch Style Fittings for Swinging Doors and Related Fixed Glazing:
1. Top Fittings: 4-1/2 by 4-1/2 inch, square (114 by 114 mm, square), nominal.
2. Bottom Fittings: 3-9/16 inch high (90 mm high), nominal.
3. Exposed Edge Profile: Square.

C. Headers for Swinging Doors and Related Fixed Glazing:
1. Dimensions: 1-3/4 inch deep by 4-1/8 inch high (44.4 mm deep by 104.7 mm high).
2. Glass Thickness: 3/8 inch (9.5 mm).
3. Aluminum Finish: As indicated.

D. Pivot Systems for Glass Swinging Doors:
1. Pivots: Comply with BHMA A156.17.

E. Overhead Concealed Closers and Bottom Pivots for Glass Swinging Doors: Non-handed closer for both single and double-acting doors with mechanical backcheck, and meeting requirements of BHMA A156.4, Grade 1.
1. Application: Center hung, with swing as indicated on drawings.
2. Hold Open: Fixed.
3. Opening Force: Comply with requirements of authorities having jurisdiction.
4. Door Weight: Maximum 200 lbs (91 kgs) for exterior doors, and 250 lbs (113 kgs) for interior doors, including hardware.
5. Closer Dimensions: Compact closer body designed to fit 1-3/4 inch by 4 inch (44.5 mm by 101.6 mm) or smaller header, with aluminum cover plate.
6. Cover Plate Finish: As indicated.
7. Provide accessories as required for complete installation, including wall/floor stop.

F. Floor Mounted Concealed Door Closers and Top Pivots for Glass Swinging Doors: Non-handed closer for both single and double-acting doors with mechanical backcheck, and meeting requirements of BHMA A156.4, Grade 1.
   1. Application: Center hung, with swing as indicated on drawings.
   2. Hold Open: Fixed.
   3. Opening Force: Comply with requirements of authorities having jurisdiction.
   4. Door Weight: 660 lbs (299 kgs), maximum.
   5. Closer Dimensions: 3-1/4 inch wide by 11-1/4 inch long by 2 inch deep (82.6 mm wide by 286 mm long by 50.8 mm deep) with stainless steel cover plate.
   6. Cover Plate Finish: As indicated.
   7. Provide accessories as required for complete installation.

G. Exit Devices (Panic Hardware) for Glass Swinging Doors: Bolt action mechanism hidden within interior of door handle, and meeting requirements of BHMA A156.3, Grade 1, Type 2.
   1. Latching bolt with manual and electric strikes.
   2. Glass Thickness: 1/2 to 3/4 inch (12.7 to 19 mm).
   3. Top locking bolt with interchangeable core cylinders.
   4. Finish: As indicated.
   5. Provide accessories as required for complete installation.

H. Auxiliary Locks (Deadbolts) for Glass Swinging Doors:
   1. Locking Functions: As defined in BHMA A156.5, and as follows:

I. Mortise Locksets for Glass Swinging Doors:
   1. Locking Functions: As defined in BHMA A156.13, and as follows:

J. Ladder Pulls for Glass Swinging Doors: Lockable.
   1. Mounting: Vertical.
   2. Diameter: 1 inch (25.4 mm).
   3. Length: 49 inch (1245 mm).

2.05 BASIS OF DESIGN - FITTINGS AND HARDWARE

A. Rail Style Fittings for Swinging Doors and Related Fixed Glazing:
   1. Basis of Design: C.R. Laurence Company, Inc; CRL Wedge-Lock Dry Glaze Door Rail System: www.crl-arch.com/#sle.
      a. Full Length Top Rails: 2-5/16 inch (59 mm) high, tapered edge.
      b. Full Length Bottom Rails: 2-5/16 inch (59 mm) high.
      c. Sidelite Rails: Match door rail sightlines.
      d. Aluminum Finish: Satin anodized.
      e. Integral Lock: Top rail only.
   2. Basis of Design: C.R. Laurence Company, Inc; CRL Slender Profile Door Rail System: www.crl-arch.com/#sle.
      a. Top Rails: 1 inch (25.4 mm) high.
      b. Bottom Rails: 1 inch (25.4 mm) high.

c. Sidelite Rails: Match door rail sightlines.
d. Cladding Finish: Brushed stainless steel.
e. Integral Lock: Top rail only.

3. Basis of Design: C.R. Laurence Company, Inc; CRL Wet Glaze Door Rail System: www.crl-arch.com/#sle.
   a. Full Length Top Rails: 3-5/16 inch (84 mm) high, tapered edge.
   b. Full Length Bottom Rails: 3-5/16 inch (84 mm) high, tapered edge.
   c. Sidelite Rails: Match door rail sightlines.
   d. Aluminum Finish: Satin anodized.
   e. Integral Lock: Top rail only.
4. Basis of Design: DORMA USA, Inc; DRS Rail System: www.dorma.com/#sle.
   a. Full Length Top Rails: 3-5/16 inch (84 mm) high, tapered edge.
   b. Full Length Bottom Rails: 2-5/16 inch (59 mm) high.
   c. Sidelite Rails: Match door rail sightlines.
   d. Aluminum Finish: Satin anodized.
   e. Cladding Finish: Polished brass.
   f. Integral Lock: Top rail only.

B. Patch Style Fittings for Swinging Doors and Related Fixed Glazing:
1. Basis of Design: C.R. Laurence Company, Inc; CRL Wedge-Lock Dry Glaze Patch System: www.crl-arch.com/#sle.
   a. Height: 2-5/16 inch (59 mm), tapered edge.
   b. Length: 8 inch (203 mm).
   c. Sidelite Rails: Match door rail sightlines.
   d. Aluminum Finish: Satin anodized.
   e. Integral Lock: Top rail only.
2. Basis of Design: C.R. Laurence Company, Inc; CRL Wet Glaze Patch System: www.crl-arch.com/#sle.
   a. Height: 3-5/16 inch (84 mm), tapered edge.
   b. Length: 10-1/2 inch (267 mm).
   c. Sidelite Rails: Match door rail sightlines.
   d. Aluminum Finish: Satin anodized.
   e. Integral Lock: Top rail only.
3. Basis of Design: DORMA USA, Inc; ARCOS Patch Fittings: www.dorma.com/#sle.
   a. Height: 3-5/16 inch (84 mm), tapered edge.
   b. Length: 10-1/2 inch (267 mm).
   c. Sidelite Rails: Match door rail sightlines.
   d. Aluminum Finish: Satin anodized.
   e. Cladding Finish: Satin brass.
   f. Integral Lock: Top rail only.
4. Basis of Design: DORMA USA, Inc; Universal Patch Fittings: www.dorma.com/#sle.
   a. Height: 3-5/16 inch (84 mm), tapered edge.

b. Length: 10-1/2 inch (267 mm).
c. Sidelite Rails: Match door rail sightlines.
d. Aluminum Finish: Satin anodized.
e. Cladding Finish: Satin brass.
f. Integral Lock: Top rail only.

C. No-Rail, No-Patch Style Fittings for Swinging Doors:
D. Track and Hanger Fittings for Top Hung Interior Single-Slide, Bypass, and Bi-Parting Sliding Doors and Related Fixed Glazing:
E. Track and Roller Fittings for Bottom Rolling Interior Single-Slide and Bi-Parting Doors and Related Fixed Glazing:
F. Track and Hanger Fittings for Multi-Folding Glass Doors:
G. Head Rails for Interior Glass Doors and Transom Panels:
H. Hinge and Pivots for Interior Glass Doors:
I. Locksets and Exit Devices for Glass Doors:
J. Closers for Glass Doors:
K. Locking and Non-Locking Ladder Pulls for Glass Doors:
L. Full Height Handles, Hinges, and Door Closure Hardware:
M. Acoustic Double Glazed Handles, Hinges, Pivots, and Door Closure Hardware:
N. Glazing Accessories for Related Fixed Glazing:
O. Other Manufacturers: Not permitted; provide the product identified as "Basis of Design".

2.06 MATERIALS

A. Glass: Flat glass meeting requirements of ASTM C1036, Type I - Transparent Flat Glass, Quality Q3, and Kind FT, fully tempered, in accordance with ASTM C1048, and as follows:
1. Thickness: 3/8 inch (9.5 mm).
2. Color: Class 1, Clear.
3. Prepare glazing panels for indicated fittings and hardware before tempering.
4. Polish edges that will be exposed in finished work to bright flat polish.
5. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.

B. Aluminum Components: Comply with ASTM B221 (ASTM B221M), Alloy 6063, Temper T5.
C. Stainless Steel Components: Comply with ASTM A666, Type 304.
D. Brass Components: Comply with ASTM B455, UNS C38500, Architectural Bronze.
E. Sealant: One-part silicone sealant, comply with ASTM C920, clear.

2.07 ACCESSORIES

A. Exposed Fittings and Hardware: Stainless steel, brushed finish.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that openings are acceptable.
B. Do not begin installation until substrates and openings have been properly prepared.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.
B. Prepare substrates using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Installation of cold-formed metal framing for openings as specified in Section 05 4000.
B. Installation of metal framing for openings as specified in Section 09 2116.
C. Install in accordance with manufacturer's installation instructions.
D. Tolerances:
    1. Horizontal Components and Sight Lines: Not more than 1/8 inch in 10 feet (3.2 mm in 3 m) variation from level, non-cumulative.
    2. Vertical Components and Sight Lines: Not more than 1/8 inch in 10 feet (3.2 mm in 3 m) variation from plumb, non-cumulative.
    3. Variation from Plane or Indicated Location: Not more than 1/16 inch (1.6 mm).
E. Installation of door hardware not supplied by entrance/storefront manufacturer as specified in Section 08 7100.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

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

END OF SECTION

SECTION 08 71 53

DOOR HARDWARE

PART 1 - GENERAL

1.1 General

A. The purpose of this document is to support Los Angeles Community College District building standards for door hardware. The products listed in this specification are to be used without substitution on new construction and modernization projects unless products are listed in this package as an alternate. It is the Design Professional of Record's responsibility to coordinate these products to meet the applicable building codes, life safety codes, and ADA requirements. LACCD has the following design criteria requirements:

1. Lock systems are sole-sourced – no substitutions:
   a. East Los Angeles College - Best
   b. Los Angeles City College-Schlage Everest Primus
   c. Los Angeles Harbor College- Schlage -l90000 OGA Series 626
   d. Los Angeles Mission College - Best - 4SH Series 3H-High Security Privacy
   e. Pierce College- Schlage-Mortise l9070 Series and NO Rhodes Series
   f. Los Angeles Southwest College - Best
   g. Los Angeles Trade-Technical College - Best - 4SH Series 3H - Privacy and KS
   h. Los Angeles Valley College - Sargent Signature Series
   i. West Los Angeles College - Best
2. Door Hardware, Lockset, Electronic
   a. All lock submittals shall be approved by the Facilities Director prior to ordering the locks.
   b. Lockset shall be (by college - manufacturer) with key override.
   c. Exterior and interior access must be card compatible. New construction - all ADA accessible exterior entrance doors shall have power assisted door openers, for all buildings, mounted on the wall, exceptions must be approved by the Facilities Director.
   d. Only one key override on all entrance per building
   e. All classrooms, labs, offices and conference rooms shall have a lever handle on the inside and outside, lockable from the inside and be able to use the lever handle for egress.
      1) Inside locks shall be ADA compliant and be able to open and lock with a single hand operation.
      2) Shall be able to be opened from the outside with a key (key override).
   f. Systems must be compatible with and operate with the Lenel (key card) system.
   g. All locks and locking systems must be installed by a certified installer. All locks and locking systems must be installed to manufacturer's specifications. Documentation must be provided as to certification.
   h. All hardware attached to hollow metal doors shall be properly marked, drilled and tapped for a standard machine thread application. No self-tapping screws shall be used in the installation of any hardware.

i. The college shall receive a minimum of two (2) days training on operation of locking devices from manufacturer trainer directly. All training must include: trainer's contact information, customer services telephone number, written instruction material and references material in hard copies or electronic format.
j. Provide three (3) years warranty on all locks and locking system. The warranty commences at substantial completion.

3. Locks, Latches, Cylinders and etc.
   a. Cylinders and keys for all devices shall be delivered to the college, unless otherwise directed by the college.
   b. Cylinders shall be the interchangeable core type as defined in the Campus Standard
4. Panic Hardware
   a. All panic hardware shall be college standard rim panic device.
   b. Pairs of doors shall use a key removable mullion.
   c. All panic hardware on automated doors, must be of a type that can be manually and electronically "dogged down".
   d. In classrooms, labs and conference rooms that have panic hardware, the doors must have interior lockable capabilities with key access from the outside.
   e. All classrooms, labs, offices and conference rooms shall have a lever handle on the inside and outside, lockable form the inside and be able to use the lever handle for egress.
      1) Inside locks shall be ADA compliant and be able to be opened with a single hand operation.
   f. Must able to be opened from the outside with a key (key override).
5. Automatic Door Systems
   a. Power supply shall be hard wired to the buildings electrical system.
   b. Power supply shall be wired into the emergency electrical system panel.
   c. A five (5) year warranty on all doors and door operation shall be provided. The warranty shall begin with Substantial Completion.
   d. No sliding power doors.

B. Reference Standards:
1. The following are intended to be references standards for hardware and installation:
   A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
   B. BHMA (CPD) - Certified Products Directory; 2017.
   C. BHMA A156.1 - American National Standard for Butts and Hinges; 2016.
   D. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2017.
   E. BHMA A156.3 - American National Standard for Exit Devices; 2014.
   F. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
   G. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
   H. BHMA A156.6 - American National Standard for Architectural Door Trim; 2015.
   I. BHMA A156.7 - American National Standard for Template Hinge

Dimensions; 2016.

J. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2015.

K. BHMA A156.12 - American National Standard for Interconnected Locks; 2013.

L. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

M. BHMA A156.14 - American National Standard for Sliding and Folding Door Hardware; 2013.

N. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2015.

O. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2013.

P. BHMA A156.17 - American National Standard for Self-Closing Hinges & Pivots; 2014.

Q. BHMA A156.20 - American National Standard for Strap and Tee Hinges, and Hasps; 2006 (Reaffirmed 2012).

R. BHMA A156.21 - American National Standard for Thresholds; 2014.

S. BHMA A156.22 - American National Standard for Door Casketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2017.

T. BHMA A156.23 - American National Standard for Electromagnetic Locks; 2010.

U. BHMA A156.24 - American National Standard for Delayed Egress Locking Systems; 2012.

V. BHMA A156.25 - American National Standard for Electrified Locking Devices; 2013.

W. BHMA A156.26 - American National Standard for Continuous Hinges; 2012.

X. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems; 2013.

Y. BHMA A156.30 - American National Standard for High Security Cylinders; 2014.

Z. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.

AA. BHMA A156.36 - American National Standard for Auxiliary Locks; 2016.

AB. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.

AC. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.

AD. DHI (KSN) - Keying Systems and Nomenclature; 1989.

AE. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

AF. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.

AG. California Building Code Chapter 11; Most Recent Edition Adopted By Authority Having Jurisdiction.

AH. ITS (DIR) - Directory of Listed Products; current edition.

AI. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

AJ. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
AK. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, including All Applicable Amendments and Supplements.
AL. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
AM. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2018.
AN. UL (DIR) - Online Certifications Directory; Current Edition.
AO. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
AP. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.
AQ. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.2 DOOR AND FRAME PREPARATION

Before hardware installation, verify that all doors and frames are properly prepared to receive the specified hardware. Hollow metal frames shall be prepared for ANSI strike plates per A115.1-2 (4-7/8" high), hinge preps will be mortised and reinforced with a minimum of 8 gauge reinforcement material for closer installation. Hollow metal doors shall be properly prepared and reinforced with a minimum or 16 gauge material for either mortised or cylindrical locks as specified. It is preferred that all hollow metal doors receiving door closers have 12 gauge reinforcement. If this is not possible, the use of sex bolts is mandatory. Wood doors shall be factory prepared to receive the scheduled hardware.

1.3 HARDWARE INSTALLATION

The manufacturer's representative for the locking devices and closing devices must inspect and approve, in writing, the installation of their products. Hardware installed incorrectly must be reported to the architect prior to the architect's final punch list.

PART 2 - PRODUCTS

2.1 Scheduled hardware is noted below solely for purposes of establishing type and quality.

A. Hanging Devices
Continuous Hinge Select SL-11HD Mortise (All new construction exterior doors)
SL-21HD Surface (All exterior existing doors)
Butt Hinge Hagar BBI199 x NRP (Typical at exterior)
B81168 x NRP (Typical at interior)

B. Securing Devices
Note: See separate Campus "Preferences" Matrix for specific campus preferences and guidelines. Use deadbolt function on all exterior doors. Provide double-cylinder deadbolt and all toilet room and shower room entry/exit doors, for use solely by maintenance personnel. See Section 17920.100 regarding Access Control System requirements. See Division 28 regarding Access Control System requirement.

C. MISC. DOOR HARDWARE

Description Manufacturer Model / Series

1. Exit Device Von Duprin CD99NLx990NL"Trim Pull" (at exterior single doors)
2. CD99NLx990NL"TrimPull" xCD99DTx990DT "DummyTrim". Donotuse CDpanic

devices on electronic exterior doors.

3. Von Duprin KR4954 Removeable Mullion (not for electric strike or fire rated doors)
4. Panic hardware - 99L-F-994L (Fire-rated single doors)
5. Panic hardware 99L-F-994L x 99EO-F x KR9954 Removable Mullion x 154 (Fire rated pairs)

   Note regarding all door mullions: Los Angeles Community College District - local campus Lock Shop to verify all door mullion locations. Mullions should only be included door hardware design if required by code.

   All KR mullions ta be provided with MTS4 storage mount

   Los Angeles Community College District Lock Shop to verify location of MT54 storage mounts

   All cylinders to be Schlage 6 pin I.C. Core 1 bitted E keyway.

6. Auxiliary Lock5 Schlage CL & KS Series (Cabinets, Drawers & Padlocks)

   Key System - Schlage

7. Coordinator Trimco 3092 (Storage & Utility rooms) Use coordinator only where required by fire code
8. Flush Bolts Ives FB31P (Automatic) (metal doors) (Storage & Utility rooms) FB41P (Automatic) (wood doors) (Storage & Utility rooms)

   FB51P (Manual) (metal doors) (Storage & Utility rooms)

   FB61P (Manual) (wood doors) (Storage rooms)

9. Closing Device
   a. Closer LCN 4041 - TB
   b. 4041 EDA - TB
   c. Stanley or Besam (ADA Auto Operator)
10. Stops & Holders

    Door Holder – Glynn-Johnson100ADJ series (Overhead)

    280 Series (Overhead) (F-rated doors)

    Ives WS45 (Wall Automatic Holder)

    Floor Stop - FS41 (Floor) (allow for max swing of door)

    Door Stops Ives FS436/FS43S (Interior floor)

    FS18S (Exterior Floor) (allow for max swing of door)

11. WS401/WS402 (Wall Bumpers)

    Accessories

12. Kick Plate Ives 8400 10" x 2" LDW x .050" Thick x B3E (Single doors) 10" x 1" LDW x .050" Thick x B3E (Pair doors)
13. Mop Plate Ives B400 10" x 2" LDW x .050" Thick x B3E (Single doors)

10" x 1" LDW x .050" Thick x 83E (Pair doors)

14. Push/Pull Plates Ives 4 x 16
15. Threshold National Guard Prod. 496S (1/2" x S" Step threshold)
    R900 Series ramp thresholds at modernization projects
    Architect/Designer to coordinate with project conditions
16. Smoke Seal National Guard Prod. 2525 (1/4 x 3/8 Silicone bulb with adhesive tape)
17. Fire Seal National Guard Products 5020 (For use on positive pressure doors)
18. Weather Seal National Guard Prod. 162SA (Captured gasket raceway)
19. DCI Semi-automatic flush bolts (For use on fire doors) 700SA (1/4" solid bar) for modernization projects
20. Door Silencer Ives SR64
21. Astragal: National Guard Prod. 139SS (wood doors) Astragal by door manufacturer at HM door.
22. Drip Guard National Guard Prod. 17D x 4" PDW (Exterior doors exposed to rain)

    Note: Hardware finishes being determined per project.

Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

1. Hinges: (IVE) Ives, Bommer
2. Continuous Hinges: (IVE) Ives, Select
3. Key System: (SCH) Schlage, Best
4. Mechanical Locks: (SCH) Schlage, Best
5. Electronic Locks: (5CE) Schlage Electronics, LACCD standard
6. Exit Devices: (VON) Von Duprin, Sargent
7. Closers: (LCN) LCN, Sargent 281
8. Auto Flush Bolts: (IVE) Ives, DCI
9. Coordinators: (IVE) Ives DCI
10. Silencers: (IVE) Ives Rockwood, Trimco
11. Push & Pull Plates: (IVF) Ives Rockwood, Trimco
12. Kick plates: (IVE) Ives Rockwood, Trimco
13. Stops & Holders: (IVE) Ives Rockwood, Trimco
14. Overhead Stops: (GLY) Glynn-Johnson ABH
15. Thresholds: (ZER) Zero NGPo, Reese
16. Seals & Bottoms: (ZER) Zero NGP, Reese
17. Key Cabinets: (LUN) Lund TelKee

END OF SECTION

SECTION 08 87 00

GLAZING SURFACE FILMS – ANTI-GRAFFITI

PART 1 – GENERAL

1.1 This specification is for a graffiti resistant and abrasion resistant window film which, when applied to the interior or exterior window surface, will provide resistance to typical graffiti materials such as glass etchants, gauging, abrasion, and reduce the ultra-violet light that normally would enter through the window by 99%. The film shall be called 3M™ AG-4 or AG-6 Anti-Graffiti Window Film.

A. 3M™ Anti-Graffiti Film

B. Films shall applied to Restroom mirror, stainless finishes inside the elevator cab, and glazing surfaces selected by Campus Facility Director.

1.2 REFERENCES

A. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals, 1997 Edition.

B. ASTM D 1044 - Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).

C. ASTM D 4830 -- Standard Test Methods for Characterizing Thermoplastic Fabrics Used in Roofing and Waterproofing

D. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.

E. ASTM E 308 - Standard Recommended Practice for Spectophotometry and Description of Color in CIE 1931 System.

F. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

G. ASTM G 26 - Standard Practice for Performing Accelerated Outdoor Weatherizing for Nonmetallic Materials Using Concentrated Natural Sunlight.

H. ASTM D 882 (2009) – Standard Test Method for Tensile Properties of Thin Plastic Sheeting

1.3 PERFORMANCE REQUIREMENTS

A. Film Material:

The film material shall consist of an optically clear 4 mil (0.004 inches) or 6 mil (0.006 inches) polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive and liner on the other. The film color is clear and will not contain dyed polyester. There shall be no evidence of coating voids. The film shall be Identified as to Manufacturer of Origin (hereafter to be called Manufacturer).

B. Visible Light Transmission:

When applied to 1/4' (6mm) clear glass, the luminous transmittance shall be nominal when measured with an integrating sphere spectrophotometer as referenced by ASTM E-903 and calculated per ASTM E-308 using Standard Source 'C for average daylight.

C. Reflection - Visible:

When applied to 1/4' (6mm) clear glass, the total luminous reflection from the glass surface shall be nominal when measured with an integrating sphere spectrophotometer as referenced by ASTM E-903 and calculated per ASTM E-308 using Standard CIE Source 'C" for average daylight.

D. Transmission - Ultraviolet Light:

When applied to 1/4' (6mm) clear glass, the total transmission of solar ultraviolet radiation of air mass = 2 over the spectral range of 3000 to 3800 angstroms shall not exceed when measured with an integrating sphere spectrophotometer as referenced by ASTM E-903.

E. Adhesive System:

The film shall be supplied with a high mass pressure sensitive weatherable acrylate adhesive applied uniformly over the surface opposite the abrasion resistant coated surface. The adhesive shall be essentially optically flat and shall meet the following criteria:

a. Viewing the film from a distance of ten feet at angles up to 45 degrees from either side of the glass, the film itself shall not appear distorted.

F. Abrasion Resistance:

The Manufacturer shall provide independent test data showing that the film has a surface coating that is resistant to abrasion such that, less than 5% increase of transmitted light haze will result in accordance with ASTM D-1044 using 100 cycles, 500 grams weight, and the CS l OF Calbrase Wheel.

G. Flammability:

Surface burning characteristics when tested in accordance with ASTM E84:

a. Flame Spread Index: 25, maximum

b. Smoke Developed Index, 450, maximum

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

3. Installation methods.

B. Verification Samples: For each finished product specified, two samples representing the actual product, color and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: The installer shall provide documentation showing authorization by the Manufacturer of the window film to install said window film as per the Manufacturer's specifications and in accordance with specific requests as to be determined and agreed to by the customer. Authorization of dealership may be verified through the Manufacturer's assigned ID Number.

C. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous material, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Outdoor application should be done when the air temperature is not expected to fall below 32° F, or 0°C within 72 hours. Indoor application should be done when the glass temperature is not expected to fall below 32° F, or 0°C for 72 hours.

B. Preparation: The window and window framing will be cleaned thoroughly with a pH-neutral cleaning solution. The surface of the window glass shall be bladed with stainless steel razors to facilitate the removal of any foreign contaminants. Toweling or other absorbent material shall be placed on the window sill or sash to absorb moisture accumulation generated by the film application.

1.8 WARRANTY

A. 3M™ Anti-graffiti films are warranted for a period of 1 year when installed outdoors and for a period of 10 years when installed indoors.

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

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. 3M Window Film "Anti-Graffiti" www.3m.com/windowfilm

B. Solyx "SX-1950"

C. Madicoo "Graffiti Free"

2.2 Specified manufacturers:

The following specifications are referencing one manufacturer for purposes of prescriptive and performance characteristics only. Other manufacturers listed above are acceptable.

2.3 PERFORMANCE, 3M™ Anti-Graffiti 4 (AG-4)

A. Physical / Mechanical Performance Properties
   a. Film Color: Clear
   b. Thickness: Nominal 4.0 mils (0.10 mm)
   c. Tensile Strength (ASTM D 882): 34,900 psi
   d. Break Strength (ASTM D 882) (Per Inch Width): 136 lbs
   e. Elongation at Break (ASTM D 882): >100%
   f. Peel Strength: 1,000 g/inch
   g. Puncture Strength (ASTM D 4830): 93 lbs
   h. Abrasion Resistance (ASTM D1044): < 5% increase in haze

B. Solar Performance Properties -- film applied to 1/4 Inch (6.4 mm) thick clear glass:
   a. Visible Light Transmission (ASTM E 903): 86 percent.
   b. Total Solar Reflection (ASTM E 903): Not more than 10 percent
   c. Ultraviolet Transmission (ASTM E 903): Less than 1 percent
   d. Solar Heat Gain Coefficient (ASTM E 903): 0.81

2.4 PERFORMANCE, 3M™ Anti-Graffiti 6 (AG--6) – for additional impact resistance

A. Physical / Mechanical Performance Properties
   a. Film Color: Clear
   b. Thickness: Nominal 6.0 mils (0.15 mm)
   c. Tensile Strength (ASTM D 882): 32,200 psi
   d. Break Strength (ASTM D 882) (Per Inch Width): 190 lbs
   e. Elongation at Break (ASTM D 882): >100%
   f. Peel Strength: 1,000 g/inch
   g. Puncture Strength (ASTM D4830): 132 lbs
   h. Abrasion Resistance (ASTM D1044): < 5% increase in haze

B. Solar Performance Properties -- film applied to 1/4 Inch (6.4 mm) thick clear glass:
   a. Visible Light Transmission (ASTM E 903): 86 percent.
   b. Total Solar Reflection (ASTM E 903): Not more than 10 percent
   c. Ultraviolet Transmission (ASTM E 903): Less than 1 percent
   d. Solar Heat Gain Coefficient (ASTM E 903): 0.81

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Examination: Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance. Correct any and all such deficiencies before starting film application

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
C. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
D. Apply film to glass and lightly spray film with slip solution.
E. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
F. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
G. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
B. Touch-up, repair or replace damaged products before Substantial Completion.
C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 08 8723

SAFETY AND SECURITY FILMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Glazing film applied to existing and new glazing assemblies.

B. New Glazing: Factory or shop install film to glazing before installation in frames.

C. Glazing assemblies to receive film are indicated on drawings.

1.02 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018.

D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018a.

F. GSA TS01 - Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings; General Services Administration; 2003.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.

C. Specimen Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.

B. Installer Qualifications: Certified by glazing film manufacturer.

1.05 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

A. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. 3M Window Film; _____: www.solutions.3m.com/#sle.

B. Flexvue Films; _____: www.flexvuefilms.com/#sle.
C. Kuraray America, Inc; Trosifol Safety: www.kuraray.us.com/#sle.
D. Madico, Inc; _____: www.madico.com/#sle.
E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SAFETY AND SECURITY GLAZING FILM

A. Safety Glazing: Retrofit existing glazing assemblies to provide impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II.
   1. 1/4 inch (6 mm) thick clear annealed glass.
   2. Surface applied film.
   3. Requiring no supplemental anchoring devices.
B. Blast Resistant Glazing at Ground Level: Retrofit existing glazing assemblies to provide Level 2 blast resistance when tested in accordance with GSA TS01 at a peak pressure of ___ psi (___ kPa), and a positive phase impulse of ____; and impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II, as specified.
   1. 1/4 inch (6 mm) thick clear annealed glass.
   2. Surface applied film.
   3. Requiring no supplemental anchoring devices.
C. Blast Resistant Glazing at 10 to 20 Feet (3048 to 6096 mm) Above Ground Level: Retrofit existing glazing assemblies to provide Level 2 blast resistance when tested in accordance with GSA TS01 at a peak pressure of ___ psi (___ kPa), and a positive phase impulse of ____; and impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II, as specified:
   1. 1/4 inch (6 mm) thick clear annealed glass.
   2. Surface applied film.
   3. Requiring no supplemental anchoring devices.
D. Blast Resistant Glazing at 20 Feet (6096 mm) Above Ground Level and Higher: Retrofit existing glazing assemblies to provide Level 2 blast resistance when tested in accordance with GSA TS01 at a peak pressure of ___ psi (___ kPa), and a positive phase impulse of ____; and impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II, as specified:
   1. 1/4 inch (6 mm) thick clear annealed glass.
   2. Surface applied film.
   3. Requiring no supplemental anchoring devices.

2.03 MATERIALS

A. Glazing Film: Transparent polyester film for permanent bonding to glass.
   1. Thickness: 0.008 inch (0.2 mm), minimum.
   2. Color: Clear.
   3. Construction: Multi-ply laminate.
   4. Adhesive Type: Pressure sensitive acrylic.

5. Light Transmission of Film Applied on 1/4 inch (6 mm) Thick Clear Annealed Glass:
   a. Visible Light Transmittance: ___ percent.
   b. Ultra Violet Light Transmittance: 1 percent, maximum.
   c. Solar Energy:

PART 3 – EXECUTION

3.01 EXAMINATION

A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
C. Verify glass is not cracked, chipped, broken, or damaged.
D. Verify that frames are securely anchored and free of defects.
E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
C. Protect adjacent surfaces.
D. Do not begin installation until substrates have been properly prepared.

3.03 INSTALLATION

A. Do not apply glazing film when surface temperature is less that 40 degrees F (4 degrees C) or if precipitation is imminent.
B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (2 mm) to 1/8 inch (3 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.
D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
F. Remove labels and protective covers.

3.04 PROTECTION

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

END OF SECTION

SECTION 08 91 18

WALL LOUVERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fixed louvers, frames and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Louver: To permit passage of air at a velocity of 1072 ft / min without blade vibration or noise, with maximum static pressure loss of 0.21 inches.

B. Louver: To permit 50.4 percent free area.

C. Deviations must first be approved by the owner.

1.4 SUBMITTALS

A. Submit under provisions of Section 013400 - Submittals.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

C. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

D. Samples: Submit two samples 12 x 12 inch in size illustrating finish and color of exterior and interior surfaces.

E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers

1. Seiho, Model No. SXL.
2. Or equal.

B. Aluminum: ASTM B221 alloy, 6063-T5 alloy; extruded shape; prefinished with shop applied flouropolymer finish.

C. Insect Screen: 18 x 16 size aluminum mesh, set in aluminum frame.

D. Accessories.

1. Fasteners and Anchors: Stainless steel type.
2. Flashings: Of same material as louver frame.

E. Fabrication.

1. Louver Panel Thickness: Face measurements as indicated.

2. Louver Blade Design: Sloped at 45 degrees; reinforced with intermediate stiffeners, material thickness of .081 inch minimum, integral and lateral rain water stops positioned on blade.
3. Louver Frame: Channel shape, mechanically fastened corner joints, material thickness of .081 inch minimum.
4. Head and Sill Flashings: Roll formed to required shape, single length in one piece per location.
5. Screens: Install screen mesh in shaped frame, reinforce corner construction, shop install to louver with fasteners.
6. Blank-Out Sheeting on Interior of Louver: Same material as louver and frame, painted black:
    a. Configuration: Single sheet.
    b. Face Material: Aluminum.
7. Any deviations must first be approved by the owner.

F. Finishes.
1. Exterior Aluminum Surfaces: Prepainted finish, color as selected.
2. Interior Aluminum Surfaces: Unfinished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install louver assembly in accordance with acceptable manufacturer's instructions.
B. Install louvers level and plumb.
C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
D. Secure louvers in opening framing with concealed fasteners, removable for maintenance purposes.
E. Install bird and insect screen and frame to interior of louver. Hinge screens for access.
F. Install perimeter sealant and backing rod in accordance with Section 07900 – Joint Sealers.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Broadloom carpet.
   3. Carpet tile.
   4. Thin-set ceramic tile and stone tile.

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

E. Testing of existing concrete floor slabs for moisture and alkalinity (pH) has already been conducted; test report is attached.

F. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

G. Patching compound.

H. Remedial floor coatings.

I. Remedial floor sheet membrane.

J. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

1.02 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.

F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Include certification of accuracy by authorized official of testing agency.
   8. Submit report directly to Owner.
   9. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

E. Copy of RFCI (RWP).

F. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
   3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   4. Manufacturer's installation instructions.
   5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.05 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.

2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Owner when specified ambient conditions have been achieved and when testing will start.

D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
3. Products:
   a. TEC, an H.B. Fuller Construction Products Brand; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle .

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Use product recommended by testing agency.
3. Products:
   a. Allied Construction Technologies, Inc; AC Tech 2170: www.actechperforms.com/#sle .
   b. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle .
   c. Custom Building Products; TechMVC Moisture Vapor and Alkalinity Barrier: www.custombuildingproducts.com/#sle .
   d. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle .
   e. Koster American Corporation; Koster VAP I 2000 with Koster SL Premium overlay: www.kosterusa.com/#sle .
   f. LATICRETE International, Inc; LATICRETE NXT Vapor Reduction Coating with LATICRETE NXT Level Plus: www.laticrete.com/#sle .
   g. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle .
   h. Maxxon Corporation; Aquafin SG2: www.maxxon.com/#sle .
   i. Proflex Products, Inc; Moisture Barrier 25 with DPU - Deep Pour Underlayment: www.proflex.us/#sle .
   j. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle .
   k. Stauf USA, LLC; ERP-270 Perma-Seal: www.staufusa.com/#sle .
   l. TEC, an H.B. Fuller Construction Products Brand; TEC LiquiDam EZ with TEC Level Set 200 SLU: www.tecspecialty.com/#sle .
   m. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle .
   n. UZIN, a division of UFLOOR Systems Inc; UZIN PE 460 with UZIN PE 280 and UZIN NC 170 LevelStar: www.ufloorsystems.com/#sle .

D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: 28 mil (0.028 inch) (0.711 mm).
   2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
   3. Products:
      a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle .

PART 3 – EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:

1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    b. Removal of existing floor covering.
2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
    a. Do not attempt to remove coating or penetrating material.
    b. Do not abrade surface.
3. Preliminary cleaning.
4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
7. Specified remediation, if required.
8. Patching, smoothing, and leveling, as required.
9. Other preparation specified.
10. Adhesive bond and compatibility test.
11. Protection.

C. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

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

3.03 PRELIMINARY CLEANING

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

3.04 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F1869 and as follows.
D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F2170 Procedure A and as follows.
D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

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

3.06 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

A. See individual floor covering section(s) for additional requirements.
B. Comply with recommendations of testing agency.
C. Comply with requirements and recommendations of floor covering manufacturer.
D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
E. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

A. Install in accordance with sheet membrane manufacturer's instructions.

3.11 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 10

MOISTURE RETARDER - DOUBLE BUILDING PAPER

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Work of this Section shall comply with provisions of current edition of California Building Code (CBC) and Title 24, CCR.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces.

PART 2 - PRODUCTS

2.1 BUILDING PAPER

A. Provide building paper that conforms to Federal Specifications UU-B-790, Type I, Grade D (breather style), No. 15.

B. Building paper shall be free from holes, or punctures, other than those created by fasteners, or those inherent in the exterior wall.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install building paper as recommended by the manufacturer and as required by the Code.

B. Building paper shall be installed in 2 layers, horizontally. The first layer shall be secured to the structure with side edges overlapped not less than 2 inches, shingle fashion. Ends shall overlap at least 6 inches.

C. The second layer shall be applied similarly to the first layer, except the second ply shall cover the side and end overlapped joints of the first ply. Cover flashings with 4-inch overlap.

END OF SECTION

SECTION 09 24 00

ENHANCED CEMENT THREE COAT STUCCO

PART 1 - GENERAL

1.1 REFERENCES
- A. ASTM C150 – Portland Cement
- B. ASTM C847 – Standard Specification for Metal Lath
- C. ASTM C1032 - Woven Wire Plaster Base
- D. ASTM C933 - Welded Wire Lath
- E. ASTM C144/C897 – Aggregate for Job-Mixed Portland Cement-Based Plaster
- F. ASTM C926 – Application of Portland Cement-Based Plaster
- G. ASTM C1063 – Installation of Lathing and Furring for Portland Cement Based Plaster
- H. PCA (Portland Cement Association) – Plaster (Stucco) Manual
- I. Plaster and Drywall Systems Manual, Third Edition
- J. ICC-ES Acceptance Criteria for Water-resistive Barriers (AC38)

1.2 SYSTEM DESCRIPTION
- A. General: The Enhanced Cement System is an enhanced three coat exterior stucco system and is comprised of an approved water-resistive barrier, sheathing, metal lath, enhanced cement scratch and brown coats, and a finish coat.
- B. Application Methods: The Enhance Cement system shall be applied directly to a structure at the construction site.

1.3 ACTION SUBMITTALS
- A. Product Data: Submit all product data sheets, evaluation reports, details, and warranty information that pertain to the project.
- B. Samples: Submit the following.
  1. Samples of the finish coat shall be of an adequate size as required to represent each color and texture to be utilized on the project and produced using the same techniques and tools required to complete the project.
  2. Retain approved samples at the construction site throughout the application process.

1.4 QUALITY ASSURANCE
- A. Qualifications:
  1. Manufacturer: System component materials shall be manufactured or approved by the acceptable manufacturer and shall be distributed by the same or its authorized dealers.
- B. Plastering Contractor:
  1. Shall specialize in cement plasterwork with documented experience.
  2. Shall provide proof of current contractor's license and bond where required.
- C. On-Site Mock-Ups: Produced upon request.
  1. Prior to commencement of work, provide a mock-up for approval.
  2. Mock-up suitable to represent the products to be installed for each color and texture constructed using the same tools and techniques to be utilized on the project.
  3. Retain approved mock-up at job site throughout the application process.
     a. Where acceptable to the Architect, approved mockups may become part of the completed Work if undisturbed at time of Substantial

Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver all materials to the construction site in their original, unopened packaging with labels intact.

B. Inspection: Inspect the materials upon delivery to assure that specified products have been received. Report defects or discrepancies to the responsible party according to the construction documents; do not use reported material for application.

C. Storage: Store all products per manufacturer's recommendations. Generally, store materials in a cool, dry location; away from direct contact with the ground and/or concrete; out of direct sunlight; and protect from weather and other damage.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Follow product manufacturer's recommendations for environmental conditions and surface preparation.

1. Temperatures: Before, during and following the application of the enhanced cement system, the ambient and surface temperatures must remain above 40°F (4°C) for a minimum period of 24 hours. Protect stucco from uneven and excessive evaporation, especially during hot, dry and/or windy weather. Protect enhanced cement from freezing for a period of not less than 24-hours after set has occurred.

2. Substrates: Prior to installation, inspect the wall for surface contamination or other defects that may adversely affect the performance of the materials,and shall be free of residual moisture. Do not apply enhanced cement to substrates whose temperature are less than 40°F (4°C).

3. Inclement Weather: Protect applied material from inclement weather until dry.

B. Existing Conditions:

1. Jobsite Resources: Provide access to electrical outlets, clean, potable water, and a suitable work area at the construction site throughout the application ofthe enhanced cement system.

1.7 SEQUENCING AND SCHEDULING

A. Sequencing: Coordinate the installation of the enhanced cement system with all other construction trades. To reduce the likelihood of the stucco cracking, it is recommended the building carry a minimum of 90 percent of the dead building load and the interior gypsum be installed prior to installation of the stucco.

B. Staffing: Provide sufficient manpower to ensure continuous operation, free of cold joints, scaffolding lines, variations in texture, etc.

1.8 WARRANTY

A. System Warranty: Submit documentation on the enhanced cement's standard system warranties. At completion of work, provide written system warranty documentation.

B. Warranty Length: Fifteen (15) years commencing at the time of substantial completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to the Architect's review of action submittals, provide products indicated on the drawings (Omega Super Cement), or acceptable substitution by one of the following:

1. Omega Stucco, Inc.

2. California Stucco.

3. La Habra.
4. Shamrock Stucco.
5. Merlex.
6. Expo Stucco.
7. Spec Mix.
8. Or other manufacturer offering the required Warranty.

2.2 SCRATCH AND BROWN COAT

A. Enhanced Cement Fibered: A mixture of portland cement complying with ASTM C150 that has an additional mixture of proprietary ingredients manufactured to improve physical properties and performance.

B. Sand:

1. Sand must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter.
2. Sampling and testing must comply with ASTM C144 or C897.

C. Water: Clean and potable without foreign matter.

D. A 100% acrylic polymer bonder or admixture as standard with the manufacturer.

2.3 WATER-RESISTIVE BARRIER (AS INDICATED ON THE DRAWINGS)

2.4 LATH (AS INDICATED ON THE DRAWINGS)

2.5 SHEATHING

2.6 ACCESSORIES

A. Caulking: Polyurethane, polyurethane modified, or silyl-terminated polyether elastomeric sealant complying with ASTM C920.

B. Vapor Retarder: A vapor retarder complying with the International Energy Conservation Code (IECC) Section 402.5 or 502.5 or IRC Section R318.1 must be provided. Provide a vapor retarder per California Building Code (CBC).

C. Flashing: Flashing complying with UBC Section 1404.2, IBC Section 1405.3 or IRC Section R703.8, as applicable, must be provided.

D. Fasteners: Nails, staples, or screws used to rigidly secure lath and associated accessories shall be corrosion-resistant and meet the minimum requirements of ASTM C1063.

E. Zinc and Zinc-Coated (Galvanized) Accessories: The following accessories shall be fabricated from zinc or zinc-coated (galvanized) steel.

1. Corner Beads: Minimum 26-gauge thick; profiles as indicated on the drawings, expanded flanges shaped to permit complete embedding in plaster.
2. Strip Mesh: Metal Lath, 3.4 lb/yd2 expanded metal; 6 in. wide x 18 in. long.
3. Vent Screed: Minimum 26-gauge thick; thickness governed by plaster thickness; minimum 4-inch (102 mm) width, double “V” profile, with perforated expanse between “V’s” of longest possible lengths.
4. Casing Bead: Minimum 26-gauge thick; thickness governed by plaster thickness; maximum possible lengths; expanded metal flanges, with square edges.
5. Drip Screed: Minimum 26-gauge thick, depth governed by plaster thickness, minimum 3-1/2 in. high flange, maximum possible lengths.
6. Control and Expansion Joints: Depth to conform to plaster thickness; use maximum practical lengths.
   a. Control Joints: One-piece-type, folded pair of unperforated screeds in profiles indicated on the drawings; removable protective tape on plaster face of control joint.
   b. Expansion Joints: Two-piece-type formed to produce a slip-joint.

2.7 PRIMER

A. Provide primer as standard with the manufacturer of the plaster and as required to provide the required warranty

2.8 FINISHES (AS REQUIRED TO PROVIDE THE WARRANTY)

A. Color and Texture: Color and finish texture shall be as selected by the Architect.

2.9 MIXES

A. Enhanced Cement: Mix and proportion cement plaster in accordance with ASTM C926, PCA Plaster (Stucco) Manual.

B. Finishes: Mixing and tinting instructions as required by the manufacturer of the product.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prior to the application of the enhanced cement system the plastering contractor shall ensure that:
   1. Surface and site conditions are ready to receive work.
   2. Grounds and Blocking: Verify that the items within the walls for other sections of work have been installed.

B. Substrates:
   1. Acceptable substrates must be securely fastened per applicable building code requirements.
   2. Acceptable substrates and adjacent materials must be dry, clean, and sound. Substrate surface must be flat, free of fins or planar irregularities greater than ¼-nch in 10-feet (6mm in 3m).

C. Flashings: All flashing around windows, at deck attachments, utility penetrations, roof lines, etc. and all kick-out flashing must be properly installed prior to application of the enhanced cement system.

D. Unsatisfactory conditions shall be reported to the general contractor and/or builder and/or architect and/or owner. Do not proceed until all unsatisfactory conditions have been corrected. Beginning of installation means acceptance of existing conditions.

3.2 PREPERATION

A. Substrate: Clean the substrate to which the enhanced cement system is to be applied, ensuring that there are no foreign materials present; including, but are not limited to, oil, dirt, dust form release agents, efflorescence, paint, wax, water repellants, moisture, frost, and or extended nails that may rupture the water-resistive barrier.

B. Surrounding Areas: Protect surfaces near the work of this section from damage, disfiguration, and overspray. Mask off all dissimilar materials.

3.3 INSTALLATION, GENERAL

A. General Installation: Refer to CBC, ASTM C926, ASTM C1063, and/or the appropriate manufacturer's product data sheet for additional installation requirements and recommendations.

3.4 INSTALLING WEATHER PROTECTION

A. Water-Resistive Barrier: Apply water-resistive barrier complying with Section 1404.2 of the IBC, Section R703.2 of the IRC or Section 1402.1 of the UBC.

B. Flashing: Install flashing and trim per CBC.

3.5 INSTALLING LATH

A. General: Installed per ASTM C1063.

3.6 INSTALLING ENHANCED CEMENT

A. Application Over Metal Lath: Apply per ASTM C926 and C1063. Apply enhanced cement by hand-troweling or machine-spraying to a nominal thickness of 3/8-inch (9.5mm)

scratch coat and to a nominal thickness of 3/8-inch (9.5 mm) brown coat.

B. Leveling Coat: Over concrete or concrete block using no wire lath shall be a maximum of 1/2-inch (13mm) thick

C. Moist Curing: Provide sufficient moisture by fog or moist curing to permit proper hydration of the cementitious materials. The length of time and most effective procedure for curing will depend on climatic and job conditions.

3.7 INSTALLING FINISH COAT

A. General: Apply per manufacturer's product data sheet and recommendations.

B. Verification: Verify the desired color and texture match the approved sample and/or mock-up prior to installation.

3.8 CLEANING

A. Cleaning: Remove any and all materials used, overspray from adjacent surfaces, and all protective masking.

3.9 PROTECTION

A. Protection: Protect applied material from inclement weather until dry and prevent it from freezing for a minimum of 24-hours after set and/or until dry. Refer to manufacturer's product data sheet for additional requirements.

END OF SECTION

SECTION 09 27 00

GYPSUM BOARD SHAFT WALL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Furnish and install gypsum board shaft wall systems as indicated on the drawings and specified.

1.3 SYSTEM DESCRIPTION

A. Gypsum board shaft wall systems shall have been are pretested assemblies of gypsum boards and other components designed for erection from room-side of shaft.

B. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies, including those incorporating elevator door and other framing, whose fire resistance has been determined per ASTM E119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

C. Sound Attenuation Performance: Provide gypsum board shaft systems designed and pretested to achieve a minimum STC Rating of 50.

1.4 SUBMITTALS

A. Product data from manufacturers for the gypsum board shaft wall system specified.

B. Product test reports indicating and interpreting test results relative to compliance of gypsum board shaft wall systems with fire resistance, and acoustical performance requirements.

C. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction which evidence system's compliance with requirements and with the Los Angeles City Building Code.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain products for gypsum board shaft wall systems from a single manufacturer for each type of system indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with specified requirements, provide products by one of the following (or equal):

1. Georgia Pacific Corporation.
2. Gold Bond Building Products Div., National Gypsum Co.
3. United States Gypsum Co.

2.2 BASIC SYSTEM MATERIALS

A. General: Provide standard materials and components listed in manufacturer's published product literature for gypsum board shaft wall systems of type and application indicated.

1. Provide gypsum boards in maximum lengths available to eliminate or minimize end-to-end butt joints and in thickness required to produce assemblies complying with structural and other performance requirements.

B. Steel Framing: ASTM C 645, of profile, size, and base metal thickness required to produce assemblies complying with structural performance requirements, with

sectional properties computed to conform with AISI "Specification for Design of Cold-Formed Steel Structural Members."

C. Gypsum Shaftwall Board: ASTM C 442, Type X liner panel or coreboard designed for shaft wall construction, with moisture-resistant paper facings.

D. Gypsum Wallboard: ASTM C 36, Type X, 1 inch thick, tapered and featured edges for prefilling.

E. Trim Accessories: Provide cornerbeads, edge trim and control joints of material and, for edge trim, shapes complying with ASTM C 1047 and gypsum board shaft wall manufacturer's recommendations.

F. Gypsum Wallboard Joint Treatment Materials: Provide materials complying with ASTM C 475, ASTM C 840, recommendations of gypsum board shaft wall manufacturer for the application indicated.

G. Miscellaneous Materials: Provide auxiliary materials for gypsum board shaft wall systems of the type and grade recommended by the manufacturer of the system and as follows:

1. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum boards of type indicated.
2. Gypsum Board Screws: ASTM C 1002.
3. Runner Fasteners: Low-velocity tool-driven fasteners of type, size and material required to withstand loading conditions imposed on shaft wall system without exceeding allowable design stress of runner, fastener or structural substrate.
4. Concealed Acoustical Sealant: As Specified in Section 07920.
5. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
6. Sound Attenuation Blankets: Unfaced mineral fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).

PART 3 - EXECUTION

3.1 INSTALLATION OF GYPSUM BOARD SHAFT WALL SYSTEMS

A. Install gypsum board shaft wall systems to comply with performance and other requirements indicated as well as with manufacturer's installation instructions.

B. At penetrations in shaft wall, maintain fire rating of entire shaft wall assembly by installing supplementary fire protection behind boxes containing wiring devices, and similar items.

C. Isolate shaft wall system from transfer of structural loading to system, both horizontally and vertically. Provide slip type joints to attain lateral support and avoid axial loading.

D. Seal gypsum board shaft walls at perimeter of each section which abuts other work and at joints and penetrations within each section. Install acoustical sealant to withstand dislocation by air pressure differential between shaft and external spaces; comply with manufacturer's instructions and ASTM C 919.

END OF SECTION

SECTION 09 29 00

GYPSUM DRYWALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.3 PROJECT CONDITIONS

A. Environmental Conditions: Maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements provide products of one of the following:

1. Steel Framing and Furring:
    a. Bostwick Steel Framing Co.
    b. Gold Bond Building Products Div., National Gypsum Co.
    c. United States Gypsum Co.
2. Grid Suspension Systems:
    a. Chicago Metallic Corp.
    b. National Rolling Mills Co.
3. Gypsum Boards and Related Products:
    a. Georgia-Pacific Corp.
    b. Gold Bond Building Products Div., National Gypsum Co.
    c. United States Gypsum Co.

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

A. General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.

B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating soft temper.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle-Type Hangers: Angles shall be as indicated on the drawings and formed from galvanized steel sheet complying with ASTM A 466, Coating Designation G90.

F. Channels: Cold-rolled steel, 0.0598 inch minimum thickness of base (uncoated) metal and 7/16 inch wide flanges, protected with rust-inhibitive paint, and as follows:
   1. Carrying Channels: 1-1/2 inch deep, 475 lbs per 1000 ft., unless otherwise indicated.
   2. Furring Channels: 3/4 inch deep, 300 lbs per 1000 ft., unless otherwise indicated.

G. Steel Studs for Furring Channels: ASTM C 645, with flange edges bent back 90 deg and doubles over to form 3/16 inch minimum lip (return), minimum thickness of base (uncoated) metal and minimum depth as follows:
   1. Thickness: 0.0329 inch, unless otherwise indicated.
   2. Depth: As indicated.

H. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 7/8 inch, and minimum thickness of base (uncoated) metal as follows:
   1. Thickness: As indicated on drawings.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS

A. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 deg and doubled over to form 3/16" minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
   1. Thickness: 0.0329 inch, unless otherwise indicated.
   2. Depth: 3-5/8 inches, unless otherwise indicated.

B. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:
   1. Depth: 7/8 inch, unless otherwise indicated.
   2. Thickness: 0.0179 inch, unless otherwise indicated.

C. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

D. Fasteners: Provide fasteners of type indicated on the drawings, or if not so indicated, the fastener material, size, and holding power shall be of the quality required to fasten steel framing furring power members securely to substrates involved; complying with the recommendations of gypsum drywall manufacturers for the applications indicated.

2.4 GYPSUM BOARD

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.
   1. Thickness: Provide gypsum board in 5/8 inch thickness to comply with ASTM C 840 for application system and support spacing indicated.

B. Gypsum Wallboard: ASTM C 36, and as follows:
   1. Type: Type X, unless otherwise indicated.
   2. Edges: Tapered.
   3. Subject to compliance with requirements, provide one of the following products where Type X gypsum wallboard is indicated:
      a. "Gyprock Fireguard 'C' Gypsum Board"; Domtar Gypsum Co.
      b. "Fire-Shield G"; Gold Bond Building Products Div., National Gypsum Co.
      c. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; United States Gypsum Co.

C. Water-Resistant Gypsum Backing Board: ASTM C 630, and as follows:
   1. Type: Type X, unless otherwise indicated.
   2. Thickness: 5/8 inch, unless otherwise indicated.

D. Impact Resistant Gypsum Wallboard: Provide mold and moisture resistant face and back papers. Provide fire resistance ratings as required by code and building design.
   1. For areas subject to extreme abuse (typically classrooms and public areas, commercial kitchen, delivery corridor and serveries where push carts are used), meet ASTM D4977 classification level 3 for surface abrasion, ASTM E695 classification level 2 for soft body impact, ASTM C1629 Annex A.1 classification level 1 for hard body impact, and ASTM D5420 classification level 1 for Gardner Impact.
   2. For areas subject to extreme impact (typically gymnasiums), meet ASTM D4977 classification level 3 for surface abrasion, ASTM E695 classification level 3 for soft body impact, ASTM C1629 Annex A.1 classification level 3 for hard body impact, and ASTM D5420 classification level 1 for Gardner Impact.

2.5 TRIM ACCESSORIES

A. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:
   1. Material: Formed metal, plastic or metal combined with paper, with metal complying with the following requirement:
      a. Sheet steel zinc-coated by hot-dip process.
   2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 1047:
      a. "LC Bead", unless otherwise indicated.
   3. One-Piece Control Joints: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

2.6 GYPSUM BOARD JOINT TREATMENT MATERIALS

A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.

C. Setting-Type Joint Compounds: Factory-prepackaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
   1. Where setting-type joint compounds are indicated for use as taping and topping compounds, use formulation for each which develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.
   2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.
   3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base of ceramic tile, use products recommended by gypsum board manufacturer for this purpose.
   4. All-purpose compound formulated for use as both taping and topping compound.

2.7 MISCELLANEOUS MATERIALS

A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum boards.
C. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
D. Fastening Adhesive for Wood: ASTM C 557.
E. Gypsum Board Screws: ASTM C 1002.
F. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division-7 section "Joint Sealers."

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CEILING ANCHORAGE
A. Coordinate installation of ceiling suspension system with installation of overhead structural system to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

3.3 GENERAL
A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.
B. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by USG.
C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on Drawings:
    1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.
    2. Where partitions and wall framing abuts overhead structure.
D. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.4 INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS
A. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by UBC. Do not use powder actuated fasteners on the underside of concrete slabs.
    1. Wire Hangers: 0.1620 inch diameter (8 gage), 4 ft. on center.
    2. Carrying Channels (Main Runners): 1-1/2 inch, 4 ft. on center.
    3. Rigid Furring Channels (Furring Members): 16 inches on center.
B. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 ft.

as measured both lengthwise on each member and transversely between parallel members. See drawings.

C. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

D. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross furring members to each other and butt-cut to fit into wall track. See Drawings.

3.5 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS

A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other construction.

1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch from plane of faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board. See drawings.

D. Install steel studs and furring in sizes and at spacings indicated but not less than that required by the UBC and ICBO.

1. For single layer construction: 16 inches on center.

E. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

F. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws to jamb anchor clips on door frames; install runner track (for cripple studs) at head and secure to jamb studs.

1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. Frame openings other than door openings to comply with details indicated or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

H. Coordinate with other trades to provide backing and support for wall hung and suspended items.

3.6 APPLICATION AND FINISHING OF GYPSUM BOARD

A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840.

B. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed.

C. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

D. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.

E. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells, install board horizontally with end joints staggered.

F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

G. Locate either edge or end joints over supports, except in horizontal applications or where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill- cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

H. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open edge of stud flange first.

I. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

J. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.

K. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.

L. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings), except in chase walls which are properly braced internally. Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75 percent of full coverage. Fit gypsum board tightly around ducts, pipes, and conduits.

M. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

N. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum board over wood framing, with "floating" internal corner construction.

O. Space fasteners in gypsum boards in accordance with the manufacturer's recommendations.

3.7 METHODS OF GYPSUM BOARD APPLICATION

A. Single-Layer Application: Install gypsum wallboard as follows.

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.
2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
3. On partitions/walls 8'-1" or less in height, gypsum board may be applied horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.

B. Wall Tile Base: Where drywall is base for thin-set ceramic tile and similar rigid applied wall finishes, install gypsum backing board.

1. In "dry" areas install gypsum backing board or wallboard with tapered edges taped and finished to produce a flat surface.
2. At sinks, toilet fixtures and similar "wet" areas, install water-resistant gypsum backing board to comply with ASTM C 840 and recommendations of gypsum board manufacturer.

C. Double-Layer Application: Install gypsum backing board for base layer and gypsum wallboard for face layer.

1. On ceilings apply base layer prior to application of base layer on walls/partitions; apply face layers in same sequence. Offset joints between layers at least 10 inches. Apply base layers at right angles to supports unless otherwise indicated.

D. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:
   1. Fasten with screws.
   2. Fasten to steel framing with adhesive and screws.

E. Double-Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:

1. Fasten both base layers and face layers separately to supports with screws, or fasten base layers with screws and face layer with adhesive and supplementary fasteners.

3.8 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U-bead" (semi-finishing type) is indicated.
   1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
   2. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

D. Install control joints at locations indicated, or if not indicated at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

3.9 FINISHING OF DRYWALL

A. General: Apply joint treatment at gypsum board joints (both directions), flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat:
   1. Embedding and First Coat: Setting-Type Joint Compound.
   2. Fill (Second) Coat: Setting-type joint compound.
   3. Finish (Third) Coat: Ready-mix drying-type all-purpose or topping compound.
   4. Painting of exterior gypsum soffit board after finish coat has dried is specified in Division-9 Section "Painting."

E. Water-Resistant Gypsum Backing Board Base for Ceramic Tile: Comply with ASTM C 840 and manufacturer's recommendations for treatment of joints behind tile.

F. Partial Finishing: Omit third coat and sanding on concealed drywall work which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating.

3.10 DRAFT STOPS

Draft stops shall be erected in accordance with the approved shop drawings, and UFC requirements. Where access through the draft stop is required, provide a self-closing door or panel that is hinged at the top.

END OF SECTION

SECTION 09 29 17

CEMENTITIOUS TILE BACKERBOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Furnish and install cementitious tile backerboard as indicated on the drawings and specified.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Cementitious Backer Board: High density, cementitious, glass fiber reinforced, and thickness as indicated on the drawings.
   1. Acceptable Manufacturers (or equal) are as follows:
      a. Modulars, Inc., Wonderboard.
      b. USG, Durock.
      c. Georgia-Pacific, Dens-Shield.

B. Joint Reinforcing Tape: Coated glass fiber mesh tape; minimum 2 inch width.

C. Fasteners: 1-1/4 inch long roofing nails, or Type W nails, with rust resistant finish "Climaseal," or hot dip galvanized finish.

D. Washers: Stainless steel; 3/4 inch round, countersunk.

E. Dry-Set Grout: ANSI A118.6; commercial or latex portland cement.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify existing conditions are satisfactory for installation.

3.2 INSTALLATION

A. Install building paper over studs before installing backerboards.

B. Install boards horizontally, with end joints over framing members. Fasten panels to studs, maximum 8 inch fastener spacing. Install nail heads flush with the surface of the board.

END OF SECTION

SECTION 09 30 10

CERAMIC TILING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Referenced Specifications and Standards:

1. Material, installation and workmanship shall conform to the Tile Council of America Specifications and A137.1.

B. Grade Certificate and Labeling: With each delivery of tile, furnish manufacturer's "Master Grade Certificate."

C. Ceramic tile is only allowed for indoor use.

1.2 SUBMITTALS

A. Provide submittals to document material selection as follows:

1. Complete Materials Cost Tracking Sheet.
2. Data from manufacturer to certify recycled content, manufacture location and harvest location (i.e. cut sheets and/or manufacturer certification letters)

B. Product Data: Submit the following:

1. Manufacturer's list of items proposed to be used or provided under this Section.
2. Manufacturer's standard palette showing the various tile colors and textures available.
3. Manufacturer's data, specifications and installation instructions for all products of this Section.

C. Certificates:

1. Furnish a Master Grade Certificate signed by this tile manufacturer at time of shipping stating type and quantities and by the Contractor who has installed the tile.
2. Furnish certification by the grout manufacturer that the products used meet or exceed the standards of the American National Standards Institute.
3. Certificate of Grade: "Standard Grade" tile in accordance with American National Standards Institute Specifications for Ceramic Tile, A137.1-1967 (ANSI-AN-4).

D. Samples:

1. Required: Two pieces of each type, size and color of tile, to be submitted to the Architect for acceptance.
2. Porcelain Tile: Wall and cove base as indicated on the drawings.
3. Provide samples of standard grout colors by manufacturer. Each sample shall bear the manufacturer's name and color designation.

1.3 PRODUCT HANDLING

A. Deliver materials in manufacturer's original unbroken containers with legible labels identifying brand name and contents.

1. Tile cartons shall be grade-sealed by manufacturer in accordance with ANSI A137 with grade-seals unbroken.
2. Grout shall contain hallmarks certifying compliance with referenced standards.

B. Deliver mastic grout in containers ready for use.

C. Store all materials in a dry location under cover in a manner to prevent damage or contamination.

D. All tile materials shall be free from chips, cracks, scratches, pits, discoloration or other defects. Damaged or defective materials will be rejected.

E. Deliver ceramic tile as customary for this product.

1.4 JOB CONDITIONS

A. Install mortar and set and grout the tile, only when the temperature is at least 50oF and rising.

B. Protection: Protect adjacent surfaces against damage during progress of the work of this Section.

C. Coordination and Cooperation: Coordinate work of this Section with work of other trades. Perform work without delay to the work in progress.

PART 2 - PRODUCTS

2.1 CERAMIC TILE

A. General: Provide porcelain tile and accessories complying with Tile Council of North America Specification 137.1, and by the manufacturers, and in colors and patterns as noted on the drawings.

B. Through-Body Tile: Standard grade, square edge, dust pressed, machine made, and matching base with integral corners and terminals. Tile shall be of the sizes and finishes indicated on the drawings.

C. Acceptable manufacturers:
1. American Olean Corp.
2. Dal-Tile Corp.
3. Emser Tile, LLC

D. Moisture absorption: 0 to 0.5% per ASTM C373.

2.2 SETTING AND INSTALLATION MATERIALS

A. Portland Cement: ASTM C150, type I or II.

B. White Portland Cement: Trinity, Medusa or Riverside.

C. Hydrated Lime: ASTM C207, type S, high-calcium type.

D. Sand: ASTM C144, clean, washed, sharp and fine aggregates. Sand for mortar setting beds shall be well graded to pass a No. 8 sieve with not more than 5 percent passing a No. 100 medi-screen.

E. Water: Clean potable water from a supply distributed for domestic use.

F. Grout Materials:

1. For Ceramic Wall Tile: Hydroment Dry Tile Grout by Laticrete International, Inc., Sno-Brite Grout by Technical Adhesives, Inc., or an acceptable substitute.
2. Colors shall be as selected by the Architect.

G. Reinforcing Fabric: Welded wire 2-inch x 2-inch, 16/16 wire or 3-inch x 3-inch mesh, 13/13 wire or 1 1/2-inch x 2-inch mesh, 16/13 wire conforming to ASTM A82 and ASTM A185, galvanized finish.

H. Divider Strips: White metal alloy, 5/16-inch thick, with provisions for keying to mortar setting bed.

I. Portland cement Mortar Bed: Sand-cement mortar mix gauged with Laticrete Acrylic Admix or Custom building Products thin-set mortar Admix, or acceptable substitute.

J. Portland Cement Mortar Bed for Shower Areas: Laticrete 226 Thick Bed Mortar Mix gauged with Laticrete 3701 Mortar and Grout Admix or on site mix per ANSI A108.1A with Custom building Products Thin-Set Mortar Admix, or acceptable substitute.

K. latex Portland Cement bond Mortar: Laticrete 317 Floor & Wall thinset gauged with Laticrete 3701 Admix, or Custom building Products Master Blends mixed with thin-Set Mortar Admix, or acceptable substitute.

L. Waterproof Membrane: cold-applied, single component liquid with embedded reinforcing fabric where recommended by manufacturer: Laticrete Hydro Ban Waterproof Membrane or Custom building Products red Guard Waterproof Membrane, or acceptable substitute.

M. Latex Portland Cement Grout: Laticrete Sanded Grout (1500 Series), custom Polyblend Sanded Grout or Laticrete Unsanded Grout 1600 Series (for joints smaller than 1/8”), Custom Polyblend Unsanded Grout, or acceptable substitute.

N. Epoxy Grout: Provide Laticrete Spectralock Pro Epoxy Grout for Floors and Walls or Custom 100% Solids Epoxy Grout, that is capable of withstanding power-washing with chemical graffiti removal.

O. Furan Grout: ANSI A118.5 chemical resistant furan resin grout: Laticrete Spectralock 2000 IG.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND APPLICATION

A. Workmanship: In accordance with best practice; work performed by skilled workers; jointings, intersections and returns well formed; drilling and cutting neatly done without marring the material; joints straight and solidly filled conforming to applicable "Standard Specifications" of the American National Standards Institute, Inc. ANSI A108.1 and ANSI A108.2.

B. Application: In accordance with manufacturer's directions and American National Standard Institute, Inc. Specification.
1. Maintain minimum temperature limits and installation practices recommended by the material manufacturers.
2. Apply bond coat to mortar bed while the setting bed is still plastic.

C. Alternative: As an alternative to bond coated setting bed, dry set mortar or latex portland cement mortar may be used on a cured bed.

3.2 INSPECTION

A. Surface Conditions: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until detrimental conditions are corrected at no added cost to the City.

B. Surfaces to be Tiled: Surfaces shall fall within the following maximum variations. Report such unacceptable conditions and do not install tile until they are corrected.
   1. Walls: 1/4 inch in 8 feet.

3.3 TILE INSTALLATION

A. General: Slope to drain as existing built conditions allow.
   1. Symmetrical, avoid small cuts; no tile to be cut to a length or width less than 1/2 of the full length or width of the tile.
   2. Rub cuts smooth with a fine stone.
   3. Surfaces in even planes; corners and lines straight and true.

B. Tile Setting: Apply wall setting beds not sooner than 24 hours after application of scratch coat in areas to be tiled.

C. Divider Strips Installation: Placed prior to placing mortar setting bed; securely anchored; top to be flush with finish floor level or adjoining resilient flooring. Divider strips not to be installed where adjoining finish floor is concrete.

D. Accessories: Locate and properly mark prior to start of any tile laying exact locations of accessories, anchoring devices for equipment, toilet stall partitions, and similar items which penetrate through tile finish.

E. Joints:
   1. Wall tile joints shall be uniform 1/16-inch wide.
   2. Expansion Joints: As per American National Standards Institute or where indicated on the Contract Drawings.
   3. Joints as juncture of ceramic tile floor and adjoining concrete finish floor to be same as floor tile joints.
   4. Butt joints required between tile and divider strips; make joints flush and hairline, not to be grouted.

F. Grouting and Pointing: Grout all tile joints full and neatly point. Finish grouting for ceramic tile flush with surface of square-edge tile and to be recessed to the depth of the edge for all purpose edge.

G. Seal ceramic tile with a penetrating sealer.

3.4 REPAIR WORK

A. Required: Wherever necessary to join to existing tile work.

B. Material: Tile trimmers and tile shapes to match existing work in kind, color, size and finish or texture.

C. Installed in full mortar setting bed, set flush with plumb or level and in pattern matching that of adjoining existing work, with same joints widths and joints aligned. Completed repair work shall show no visible demarcation line between existing and new work.

3.5 CLEANING

A. Remove mortar and grout prior to hardening during progress of work.

B. Clean surfaces thoroughly after grouting and pointing have set sufficiently; remove all cement, dust and other foreign matter with plain water or mild alkaline cleaner. Sandblasting of exposed surfaces is prohibited.

C. Cleaning with a solution not stronger than 10 percent muriatic acid to 90 percent water permitted only on unglazed tile; thoroughly wash afterwards with clean water. Completely protect hardware and fittings metal surfaces, cast iron and vitreous items from acid and fumes.

D. Cleaning shall be done in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 09 30 13

PORCELAIN TILING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Referenced Specifications and Standards:

1. Material, installation and workmanship shall conform to the Tile Council of America Specifications and A137.1.

B. Grade Certificate and Labeling: With each delivery of tile, furnish manufacturer's "Master Grade Certificate."

1.2 SUBMITTALS

A. Provide submittals to document material selection as follows:

1. Complete Materials Cost Tracking Sheet.
2. Data from manufacturer to certify recycled content, manufacture location and harvest location (i.e. cut sheets and/or manufacturer certification letters)

B. Product Data: Submit the following:

1. Manufacturer's list of items proposed to be used or provided under this Section.
2. Manufacturer's standard palette showing the various tile colors and textures available.
3. Manufacturer's data, specifications and installation instructions for all products of this Section.

C. Certificates:

1. Furnish a Master Grade Certificate signed by this tile manufacturer at time of shipping stating type and quantities and by the Contractor who has installed the tile.
2. Furnish certification by the grout manufacturer that the products used meet or exceed the standards of the American National Standards Institute.
3. Certificate of Grade: "Standard Grade" tile in accordance with American National Standards Institute Specifications for Ceramic Tile, A137.1-1967 (ANSI-AN-4).

D. Samples:

1. Required: Two pieces of each type, size and color of tile, to be submitted to the Architect for acceptance.
2. Porcelain Tile: Wall and cove base as indicated on the drawings.
3. Provide samples of standard grout colors by manufacturer. Each sample shall bear the manufacturer's name and color designation.

1.3 PRODUCT HANDLING

A. Deliver materials in manufacturer's original unbroken containers with legible labels identifying brand name and contents.

1. Tile cartons shall be grade-sealed by manufacturer in accordance with ANSI A137 with grade-seals unbroken.
2. Grout shall contain hallmarks certifying compliance with referenced standards.

B. Deliver mastic grout in containers ready for use.

C. Store all materials in a dry location under cover in a manner to prevent damage or contamination.

D. All tile materials shall be free from chips, cracks, scratches, pits, discoloration or other defects. Damaged or defective materials will be rejected.

E. Deliver ceramic tile as customary for this product.

1.4 JOB CONDITIONS

A. Install mortar and set and grout the tile, only when the temperature is at least 50oF and rising.

B. Protection: Protect adjacent surfaces against damage during progress of the work of this Section.

C. Coordination and Cooperation: Coordinate work of this Section with work of other trades. Perform work without delay to the work in progress.

PART 2 - PRODUCTS

2.1 PORCELAIN TILE

A. General: Provide porcelain tile and accessories complying with Tile Council of North America Specification 137.1, and by the manufacturers, and in colors and patterns as noted on the drawings.

B. Through-Body Tile: Standard grade, square edge, dust pressed, machine made, and matching base with integral corners and terminals. Tile shall be min 3/8” thick and of the sizes and finishes indicated on the drawings.

C. Acceptable manufacturers:
1. American Olean Corp.
2. Dal-Tile Corp.
3. Emser Tile, LLC.

2.2 SETTING AND INSTALLATION MATERIALS

A. Portland Cement: ASTM C150, type I or II.

B. White Portland Cement: Trinity, Medusa or Riverside.

C. Hydrated Lime: ASTM C207, type S, high-calcium type.

D. Sand: ASTM C144, clean, washed, sharp and fine aggregates. Sand for mortar setting beds shall be well graded to pass a No. 8 sieve with not more than 5 percent passing a No. 100 medi-screen.

E. Water: Clean potable water from a supply distributed for domestic use.

F. Grout Materials:

1. For Porcelain Wall Tile: Hydroment Dry Tile Grout by Laticrete International, Inc., Sno-Brite Grout by Technical Adhesives, Inc., or an acceptable substitute.
2. Colors shall be as selected by the Architect.

G. Reinforcing Fabric: Welded wire 2-inch x 2-inch, 16/16 wire or 3-inch x 3-inch mesh, 13/13 wire or 1 1/2-inch x 2-inch mesh, 16/13 wire conforming to ASTM A82 and ASTM A185, galvanized finish.

H. Divider Strips: White metal alloy, 5/16-inch thick, with provisions for keying to mortar setting bed.

I. Portland cement Mortar Bed: Sand-cement mortar mix gauged with Laticrete Acrylic Admix or Custom building Products thin-set mortar Admix, or acceptable substitute.

J. Portland Cement Mortar Bed for Shower Areas: Laticrete 226 Thick Bed Mortar Mix gauged with Laticrete 3701 Mortar and Grout Admix or on site mix per ANSI A108.1A with Custom building Products Thin-Set Mortar Admix, or acceptable substitute.

K. latex Portland Cement bond Mortar: Laticrete 317 Floor & Wall thinset gauged with Laticrete 3701 Admix, or Custom building Products Master Blends mixed with thin-Set Mortar Admix, or acceptable substitute.

L. Waterproof Membrane: cold-applied, single component liquid with embedded reinforcing fabric where recommended by manufacturer: Laticrete Hydro Ban Waterproof Membrane or Custom building Products red Guard Waterproof Membrane, or acceptable substitute.

M. Latex Portland Cement Grout: Laticrete Sanded Grout (1500 Series), custom Polyblend Sanded Grout or Laticrete Unsanded Grout 1600 Series (for joints smaller than 1/8”), Custom Polyblend Unsanded Grout, or acceptable substitute.

N. Epoxy Grout: Provide Laticrete Spectralock Pro Epoxy Grout for Floors and Walls or Custom 100% Solids Epoxy Grout, that is capable of withstanding power-washing with chemical graffiti removal.

O. Furan Grout: ANSI A118.5 chemical resistant furan resin grout: Laticrete Spectralock 2000 IG.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND APPLICATION

A. Workmanship: In accordance with best practice; work performed by skilled workers; jointings, intersections and returns well formed; drilling and cutting neatly done without marring the material; joints straight and solidly filled conforming to applicable "Standard Specifications" of the American National Standards Institute, Inc. ANSI A108.1 and ANSI A108.2.

B. Application: In accordance with manufacturer's directions and American National Standard Institute, Inc. Specification.
1. Maintain minimum temperature limits and installation practices recommended by the material manufacturers.
2. Apply bond coat to mortar bed while the setting bed is still plastic.

C. Alternative: As an alternative to bond coated setting bed, dry set mortar or latex portland cement mortar may be used on a cured bed.

3.2 INSPECTION

A. Surface Conditions: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until detrimental conditions are corrected at no added cost to the City.

B. Surfaces to be Tiled: Surfaces shall fall within the following maximum variations. Report such unacceptable conditions and do not install tile until they are corrected.
   1. Walls: 1/4 inch in 8 feet.

3.3 TILE INSTALLATION

A. General: Slope to drain as existing built conditions allow.
   1. Symmetrical, avoid small cuts; no tile to be cut to a length or width less than 1/2 of the full length or width of the tile.
   2. Rub cuts smooth with a fine stone.
   3. Surfaces in even planes; corners and lines straight and true.

B. Tile Setting: Apply wall setting beds not sooner than 24 hours after application of scratch coat in areas to be tiled.

C. Divider Strips Installation: Placed prior to placing mortar setting bed; securely anchored; top to be flush with finish floor level or adjoining resilient flooring. Divider strips not to be installed where adjoining finish floor is concrete.

D. Accessories: Locate and properly mark prior to start of any tile laying exact locations of accessories, anchoring devices for equipment, toilet stall partitions, and similar items which penetrate through tile finish.

E. Joints:
   1. Wall tile joints shall be uniform 1/16-inch wide.
   2. Expansion Joints: As per American National Standards Institute or where indicated on the Contract Drawings.
   3. Joints as juncture of ceramic tile floor and adjoining concrete finish floor to be same as floor tile joints.
   4. Butt joints required between tile and divider strips; make joints flush and hairline, not to be grouted.

F. Grouting and Pointing: Grout all tile joints full and neatly point. Finish grouting for ceramic tile flush with surface of square-edge tile and to be recessed to the depth of the edge for all purpose edge.

G. Seal porcelain tile with a penetrating sealer.

3.4 REPAIR WORK

A. Required: Wherever necessary to join to existing tile work.

B. Material: Tile trimmers and tile shapes to match existing work in kind, color, size and finish or texture.

C. Installed in full mortar setting bed, set flush with plumb or level and in pattern matching that of adjoining existing work, with same joints widths and joints aligned. Completed repair work shall show no visible demarcation line between existing and new work.

3.5 CLEANING

A. Remove mortar and grout prior to hardening during progress of work.

B. Clean surfaces thoroughly after grouting and pointing have set sufficiently; remove all cement, dust and other foreign matter with plain water or mild alkaline cleaner. Sandblasting of exposed surfaces is prohibited.

C. Cleaning with a solution not stronger than 10 percent muriatic acid to 90 percent water permitted only on unglazed tile; thoroughly wash afterwards with clean water. Completely protect hardware and fittings metal surfaces, cast iron and vitreous items from acid and fumes.

D. Cleaning shall be done in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 09 51 16

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install acoustical panel ceilings as indicated on the drawings and specified.

B. Preferred products from Armstrong Industries, USG, Stratford.

C. Products furnished, but not installed under this Section, may include anchors, clips, shims, and other ceiling accessory devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of full-size or 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.

2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150- mm-) long Samples of each type, finish, and color.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which suspension systems will be attached.

3. Size and location of initial access modules for acoustical panels.

4. Items penetrating finished ceiling including the following:

a. Lighting fixtures.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

5. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
E. Field quality-control reports.
F. LEED related documentation per Materials and Resources credit MR 2.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical ceiling area as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7, Seismic Zone 4.
B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 50 or less.
C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PRODUCTS

A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
   2. Suspension System: Obtain each type from single source from single manufacturer.
B. Manufacturers: Refer to Campus Preferences Matrix for preferred manufacurers and products. Subject to compliance with specified requirements, provide products named on the drawings, or “or equal” products of one of the following:
   1. Armstrong World Industries.
   2. USG Interiors, Inc.
   3. Stratford.
C. Urea Free Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL UNITS

A. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as indicated on the drawings.
B. Color: As selected from manufacturer's full range or Match Architect's sample.
C. LR: Not less than 0.65.
D. NRC: Not less than 0.10.
E. CAC: Not less than 20.
F. AC: Not less than 170.
G. Thickness: As indicated on Drawings.
H. Thickness: As indicated on Drawings.
I. Modular Size: As indicated on Drawings.
J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
   1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

B. Manufacturers: Subject to compliance with specified requirements, provide the products indicated on the drawings.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
      a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
   3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
   4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

G. Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 02/11-inch- (24-mm-) wide metal caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Steel or aluminum cold-rolled sheet.
   5. Cap Finish: Painted in color as selected from manufacturer's full range or Plated with metallic finish as selected from manufacturer's full range.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
   1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
   1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   3. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.6 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. USG Corporation; SHEETROCK Acoustical Sealant.
   2. Acoustical Sealant for Concealed Joints:
      a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
      b. Pecora Corporation; AIS-919.
      c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
   2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
   3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire- rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
   1. Arrange directionally patterned acoustical panels as follows:
      a. As indicated on reflected ceiling plans.
      b. Install panels with pattern running in one direction parallel to long or short axis of space.
      c. Install panels in a basket-weave pattern.
   2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
   3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
   5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   6. Install hold-down and impact clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
   7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 – GENERAL

1.01 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

C. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

D. Section 26 0526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

1.02 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.

B. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2018).

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

D. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2017.

E. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).

F. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.

G. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2013a.

H. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).

I. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015, with Editorial Revision (2016).

J. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.

K. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

L. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

C. Verification Samples: Submit two samples, ___ by ___ inch (___ by ___ mm) in size illustrating color and pattern for each resilient flooring product specified.

D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.

E. Concrete Testing Standard: Submit a copy of ASTM F710.

F. Concrete Sub-floor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.05 FIELD CONDITIONS

A. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 – PRODUCTS

2.01 TILE FLOORING

A. Vinyl Composition Tile - Type ____: Homogeneous, with color extending throughout thickness.

1. Manufacturers:
   a. Armstrong World Industries, Inc; _____: www.armstrong.com/#sle .
   b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Size: 12 by 12 inch (305 by 305 mm).
5. Thickness: 0.125 inch (3.2 mm).
6. Pattern: _____.
7. Manufacturers:
   a. Armstrong World Industries, Inc; Product ____: www.armstrong.com .

b. Mannington Mills, Inc; Product ____: www.mannington.com .
c. Tarkett Inc; Product ____: www.tarkett.com .
d. Substitutions: See Section 01 6000 - Product Requirements.

B. Vinyl Tile - Type ____: Printed film type, with transparent or translucent wear layer.
1. Manufacturers:
a. Amtico Company; _____: www.amtico.com/#sle .
b. Burke Flooring; Luxury Vinyl Tiles: www.burkeflooring.com/#sle .
c. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
d. Shannon Specialty Floors, Inc; Tuf Stuf T3 Luxury Vinyl Tile: www.shannonspecialtyfloors.com/#sle .
2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
3. Wear Layer Thickness: 0.020 inch (0.50 mm).
4. Total Thickness: 0.125 inch (3 mm).

C. PVC-Free Resilient Tile - Type ____: Mineral and thermoplastic polymer construction; ionomer-impregnated wear surface.
1. Manufacturers:
a. Shannon Specialty Floors, Inc; barenaked LT Plank: www.shannonspecialtyfloors.com/#sle.
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. Thickness: 0.080 inch (2.0 mm) nominal.
4. Static Load Resistance: 250 psi (1725 kPa) minimum, when tested as specified in ASTM F970.

D. Rubber Tile - Type ____: Homogeneous, color and pattern throughout thickness.
1. Manufacturers:
a. Burke Flooring; Endura Line: www.burkeflooring.com/#sle .
b. Flexco, Inc; _____: www.flexcofloors.com/#sle .
c. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Total Thickness: 0.125 inch (3.2 mm).

E. Rubber Tile: - Type ____ Recycled SBR (styrene butadiene rubber) and colored EPDM (ethylene propylene diene monomer) granules with urethane binder.
1. Manufacturers:
a. Burke Flooring; EcoFitness Athletic Rubber Flooring: www.burkeflooring.com/#sle .
b. Dinoflex Group; Evolution Commercial Flooring: www.dinoflex.com/#sle .
c. Ultimate RB; Ultimate Design: www.ultimaterb.com/#sle .
2. Backing: Recycled black rubber, laminated to colored top layer.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

4. Thickness: 5/16 inch (8 mm) minimum.

F. Rubber Tile - Type ____: Recycled rubber tires heat bonded to a reinforced backing, carpet-like surface texture.
1. Manufacturers:
a. Burke Flooring; BurkeTurf Rubber Flooring: www.burkeflooring.com/#sle .
b. U.S. Rubber Recycling, Inc; SureStep Tire Tiles: www.usrubber.com/#sle .
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. VOC Content Limits: As specified in Section 01 6116.
4. Size: 12 by 12 inch (305 by 305 mm).
5. Thickness: 5/16 inch (8 mm) minimum.

G. Exterior Rubber Tile - Type ____: Recycled SBR (styrene butadiene rubber) and colored EPDM (ethylene propylene diene monomer) granules with urethane or water-based polymer binder; interlocking installation.
1. Backing: Same material as top layer, raised design for water drainage.
2. Interlocking Pins: Manufacturer's standard type.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Size: 24 by 24 inch (610 by 610 mm) nominal.

H. Static Control Tile - Type ____: Homogeneous; color and pattern throughout thickness.
1. Minimum Requirements: Solid vinyl tile complying with ASTM F1700, Class 1, Type A.
2. Minimum Requirements: Vinyl composition tile complying with ASTM F1066, Class 2.
3. Minimum Requirements: Rubber tile complying with ASTM F1344, Class 1, Type B.
4. Electrical Resistance:
a. Conductive Tile: Resistance between 25 kiloohms and 1.0 megohms as tested in accordance with ASTM F150.
b. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with ASTM F150.
5. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
6. VOC Content Limits: As specified in Section 01 6116.

2.02 STAIR COVERING

A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.
1. Manufacturers:
a. Burke Flooring; Endura Stair Treads: www.burkeflooring.com/#sle .
b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
c. Roppe Corp; _____: www.roppe.com/#sle .

2. Minimum Requirements: Comply with FS RR-T-650 requirements corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Nominal Thickness: 0.1875 inch (4.75 mm).
5. Nosing: Square.
6. Striping: 2 inch (24 mm) wide contrasting color abrasive strips.
7. Style: Contrasting color abrasive grit strips full width.
8. Color: Solid.
9. Manufacturers:
   a. Burke Flooring; Product ____: www.burkemercer.com .
   b. Johnsonite, Inc; Product ____: www.johnsonite.com .
   c. Roppe Corp; Product ____: www.roppe.com .
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
1. Manufacturers:
   a. Burke Flooring; Ascend Risers: www.burkeflooring.com/#sle .
   b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
   c. Roppe Corp; _____: www.roppe.com/#sle .
2. Thickness: 0.080 inch (2.0 mm).

C. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
1. Manufacturers:
   a. Burke Flooring; Rouleau Stair Treads with Integral Risers: www.burkeflooring.com/#sle .
   b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com .
   c. Roppe Corp; _____: www.roppe.com .
2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Nominal Thickness: 0.1875 inch (4.75 mm).
5. Nosing: Square.
6. Striping: 2 inch (24 mm) wide contrasting color abrasive strips.

D. Stair Stringers: Full height in one piece and in maximum available lengths, matching treads in material and color.
1. Manufacturers:
   a. Burke Flooring; Linear Series Stair Stringers: www.burkeflooring.com/#sle .
   b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
   c. Roppe Corp; _____: www.roppe.com/#sle .
2. Nominal Thickness: 0.080 inch (2.0 mm).

2.03 RESILIENT BASE

A. Resilient Base - Type ____: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.

1. Manufacturers:
   a. Burke Flooring; Commercial Wall Base - TS: www.burkeflooring.com/#sle .
   b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle .
   c. Roppe Corp; _____: www.roppe.com/#sle .
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
3. Height: 4 inch (100 mm).
4. Thickness: 0.125 inch (3.2 mm).
5. Finish: Satin.
6. Length: Roll.
7. Color: Color as selected from manufacturer's standards.
8. Accessories: Premolded external corners and internal corners.
9. Manufacturers:
   a. Burke Flooring; Product ____: www.burkemercer.com .
   b. Johnsonite, Inc; Product ____: www.johnsonite.com .
   c. Roppe Corp; Product ____: www.roppe.com .
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

D. Copper Grounding Strips: Type and size as recommended by static control flooring manufacturer.

E. Floor Polish for Static Control Flooring: Fluid-applied polish, intended to protect electrical properties of flooring, as recommended by static control flooring manufacturer.

F. Filler for Coved Base: Plastic.

G. Sealer and Wax: Types recommended by flooring manufacturer.

H. Sound Control Underlayment: Membrane consisting of cork granules and ground ethylene vinyl acetate (EVA) with polyurethane binder.

1. Manufacturers:
   a. Proflex Products, Inc.; LV-100 Sound Control Underlayment: www.proflex.us/#sle.
2. Thickness: 0.08 inch (2.0 mm).

I. Sound Control Underlayment: Non-woven fabric composed of PET/Nylon polymer fibers.
   1. Manufacturers:
      a. Maxxon Corporation; Acousti-Top: www.maxxon.com/#sle .
   2. Thickness: 1/16 inch (1.6 mm), nominal.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
D. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
D. Prohibit traffic until filler is fully cured.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Adhesive-Applied Installation:
   1. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring

manufacturer's instructions. Refer to Section 26 0526 for grounding and bonding to building grounding system.

2. Fit joints and butt seams tightly.
3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Loose-Laid Installation: Set flooring in place in accordance with manufacturer's instructions.

E. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
2. Resilient Strips: Attach to substrate using adhesive.

G. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

H. Install flooring in recessed floor access covers, maintaining floor pattern.

I. At movable partitions, install flooring under partitions without interrupting floor pattern.

J. Spread only enough adhesive to permit installation of materials before initial set.

K. Fit joints and butt seams tightly.

L. Set flooring in place, press with heavy roller to attain full adhesion.

M. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

N. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

O. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SOUND CONTROL UNDERLAYMENT

A. Install in accordance with underlayment manufacturer's instructions.

3.05 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.

C. Cut sheet at seams in accordance with manufacturer's instructions.

3.06 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Install loose-laid tile using interlocking pins to secure tiles to each other.

3.07 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.
D. Scribe and fit to door frames and other interruptions.

3.08 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.
B. Install stringers configured tightly to stair profile.
C. Adhere over entire surface. Fit accurately and securely.

3.09 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 67 90

WALL BASE

PART 1 - GENERAL

Not used.

PART 2 PRODUCTS

2.1 WALL BASE

A. Subject to compliance with specified requirements, base shall be the product of the manufacturer indicated on the drawings or an "or equal" product of one of the following:
   1. Roppe Corp.
   2. Burke Co.

B. Base shall conform to ASTM F1861, 1/8-inch thickness and of the profile and height as indicated on the drawings.
   1. Furnish premolded exterior and interior corner units.
   2. Color shall be as selected by the Architect.

C. Adhesive shall be as recommended by the manufacturer of the base materials. Adhesive shall be waterproof and stabilized type. Asphalt emulsions will not be acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials as recommended by the product manufacturer, and only after finishing operations, including painting, have been completed.

B. Bond the top-set base to wall surface with adhesive, use preformed base sections at all internal and external corners. Install running base tightly on top of flooring with top edge exactly even with top edges of premolded corners.

END OF SECTION

SECTION 09 68 13

CARPET TILE

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:
   1. All materials shall comply with the recommendations of the ADA Accessibility Guide.

B. Requirements of Regulatory Agencies: Carpeting shall meet requirements of federal, state and local regulatory agencies for flammability, static control, or other propertiesas specified.

C. Carpet Installation: Comply with CRI 104 - Standard for Installation of Textile Floor Covering Materials.

D. Each color of carpet shall be of the same dye lot.

1.2 WARRANTY

A. Provide 10 year workmanship installation warranty tied to manufacturer's installation recommendations and improper installation technics (Latent Defects). See Union 1247 Installation Certificate (TC2016-0002.

B. Manufacturer shall provide a 20 year material warranty.

C. Manufacturer shall provide a 10 year material warranty for colorfastness and texture retention.

PART 2 - PRODUCTS

2.1 CARPET (GLUE DOWN)

A. Subject to compliance with specified requirements, carpet shall be the product indicated on the drawings or an "or equivalent" product by one of the following:
   1. C&A Tandus
   2. Tarkett, Inc.
   3. Mannington Carpets, Inc.
   4. Mohawk Industries, Inc.
   5. J & J Commercial.
   6. Bentley Prince Street.
   7. Or equivalent as approved by the Owner and meeting CHPS requirements as a system.

B. Furnish first quality carpet; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ)

Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria.

C. Carpet shall meet the following minimum standards:

1.	Dye Method:	100 percent Solution Dyed Method
2.	Construction:	Tufted textured loop with UPS backing (no cut or cut loop accepted)
3.	Pile / Yarn weight:	Minimum 20 oz per square yard.
4.	Anti-Microbial Protection	Required both and top bottom.
5.	Moisture impermeable:	Carpet shall be unaffected by water and moisture.
6.	Static Protection:	The manufacturer warrants that the carpet will not static discharge in excess of 3.5 KV or under when tested under the AATCC Test Method 134 for the life of the carpet.
7.	Calcium Chloride:	Carpets shall be able to be installed with 5 lbs. hydrostatic pressure or better (pounds) per 1000 square feet per 24 hours with a written documentation from manufacturer, per CRI-104.
8.	Stain and Soil Protection:	10 year stain removal guarantee.
9.	Zippering Warranty:	Carpet will not zipper or develop continuous pile yarn runners in the body of the carpet for a minimum of 20 years from the date of Substantial Completion.
10.	Edge Ravel:	Carpet will not have continuous pile yarn coming out at seams for a minimum of 20 years from the date of Substantial Completion.
11.	Texture Retention Warranty:	The manufacturer warrants that the carpet will substantially maintain its physical surface texture against crushing, matting and walking out for 10 years from the date of Substantial Completion.
12.	Color fastness to light:	Carpet will not fade for 10 years due to exposure to sunlight.
13.	Color fastness to atmospheric	Carpet will not fade for 5 years due to
14.	Contaminants:	No atmospheric contaminants.
15.	NBS Smoke Density:	Less than 450 per test ASTM E 662; NFPA-258

16.	Flame Resistant:	Shall pass Methenamine pill test ASTM E 662.
17.	Run Resistant Strength:	Guarantee period shall be the length of the product material warranty period.
18.	Indoor Air Quality:	Carpet shall meet or exceed CRI & EPA guidelines (green label certified and labeled).
19.	Recycling Program:	Carpet shall be eligible to qualify for a close-loop recycling program (close-loop is a carpet that upon recycling is turned back into carpet and no part of the reclaimed carpet enters a landfill) either through the carpet manufacturer or fiber manufacturer.

D. Carpets shall be from one dye lot, unless otherwise reviewed by the Architect.

E. Metal Edge Strips: A-600-SH Silver Clamp Down manufactured by Universal Metals, or equivalent.

F. Transition strips and other accessories shall be by Johnsonite (or equivalent), heavy duty with floor flange not less than 2 inches wide.

G. Stair Nosing: Universal Moldings # A-544-BA 1 commercial (butt to nosing) type or equivalent, installed with recommended sized screws.

H. Adhesive: Water-resistant latex-based adhesive recommended by carpet manufacturer for direct glue-down carpet installation. Where primers or sealers are furnished, verify their compatibility with adhesive.

I. Patching Compounds: Cementitious type, Ardex SD-F, Durabond's Webcrete #95, or equivalent, as recommended by carpet manufacturer.

END OF SECTION

SECTION 09 77 20
FIBERGLASS REINFORCED PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished surfaces.
   1. Aluminum trim.
   2. PVC Wall base.

1.2 REFERENCES

A. American Society for Testing and Materials: Standard Specifications (ASTM)
   1. ASTM D 256 - Izod Impact Strengths (ft #/in)
   2. ASTM D 570 - Water Absorption (%)
   3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
   4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
   5. ASTM D 2583- Barcol Hardness
   6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
   7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)

B. Sanitary Standards: System components and finishes to comply with:
   1. United States Department of Agriculture (USDA) requirements for food preparation facilities, incidental contact.
   2. Food and Drug Administration (FDA) 1999 Food Code 6-101.11.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Scheduled manufacturer is noted solely for purposes of establishing type and quality: Marlite; www.marlite.com. Refer to campus-specific preferences for more information.

B. Products:
   1. Standard FRP
   2. Induro FRP
   3. Artizan FRP with Sani-Coat
   4. Envue with Sani-Coat
   5. Symmetrix with Sani-Coat
   6. Laminated FRP

2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
   1. Coating: Multi-layer print, primer and finish coats or applied over-layer.
   2. Dimensions:
      a. Thickness – 0.090 " (2.29mm) nominal
   3. Tolerance:

a. Length and Width: +/-1/8 " (3.175mm)
b. Square - Not to exceed 1/8 " for 8 foot (2.4m) panels or 5/32 " (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
1. Flexural Strength - 1.0 x 10^4 psi per ASTM D 790. (7.0 kilogram-force/square millimeter)
2. Flexural Modulus - 3.1 x 10^5 psi per ASTM D 790. (217.9 kilogram-force/square millimeter)
3. Tensile Strength - 7.0 x 10^3 psi per ASTM D 638. (4.9 kilogram-force/square millimeter)
4. Tensile Modulus - 1.6 x 10^5 psi per ASTM D 638. (112.5 kilogram-force/square millimeter)
5. Water Absorption - 0.72% per ASTM D 570.
6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256

C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.

2.3 BASE (if other base is not specified)

A. Marlite Base Molding for 0.090" (2.29mm) thick FRP Panels
1. Profiles:
a. M 612 FRP Base Molding, 10' length
b. M 651 Inside Corner
c. M 660 Outside Corner
d. M 620 LH End Cap
e. M 625 RH End Cap

B. Marlite Cove Base Molding for .090" (2.29mm) thick FRP Panels
1. Profile: V65 Base Cove

2.4 MOLDINGS

A. Aluminum Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
1. Profiles :
a. F 550 Inside Corner
b. F 561 Outside Corner
c. F 565 Division
d. F 570 Edge
e. Color: Brite Anodized

B. Aluminum Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
a. A551Inside Corner
b. A560 Outside Corner
c. A565 Division
d. A570 Edge

C. PVC Trim: Thin-wall semi-rigid extruded PVC.
1. M 350 Inside Corner,
2. M 360 Outside Corner
3. M 365 Division
4. M 370 Edge
5. V 177 135° Inside Corner
6. V 179 135° Outside Corner

D. SaniSeal Trim: Co-extruded, dual-durometer polypropylene/monprene profiles with Dual-Seal Technology and high-performance pressure sensitive adhesive.
   1. S650 Inside Corner
   2. S660 Outside Corner
   3. S665 Division
   4. S670 Edge

E. Outside Corner Guard:
   1. F 560SS Stainless Corner Guard
   2. Finish: #4 brushed satin
   3. M 961 PVC Outside Corner Guard

2.5 ACCESSORIES

A. Fasteners: Non-staining nylon drive rivets.
   1. Match panel colors.
   2. Length to suit project conditions.

B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
   1. Marlite C-551 FRP Adhesive - Water- resistant, non-flammable adhesive.
   2. Marlite C-915 Construction Adhesive - Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
   3. Titebond Advanced Polymer Panel Adhesive – VOC compliant, non-flammable, environmentally safe adhesive.

C. Sealant:
   1. Marlite Brand MS-250 Clear Silicone Sealant.
   2. Marlite Brand MS-251 White Silicone Sealant.
   3. Marlite Brand - Color Match Sealant.

END OF SECTION

SECTION 09 90 00
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Exposed work specified in other Sections that are specified or scheduled to be finished and are not finished as part of work of other Sections, shall be finished as specified under this Section.

B. Following items shall not be painted:

1. Brass valves, chromium or nickel-plated piping and fittings.
2. Fabric connections to fans.
3. Flexible conduit connections to equipment, miscellaneous name plates, stamping and instruction labels and manufacturer's data.
4. Mechanical and electrical utility lines, piping and heating and ventilation ductwork in tunnels, underfloor excavated areas or crawl spaces, attic spaces and enclosed utility spaces.
5. Products and equipment having a complete factory finish.
6. Brass, bronze, aluminum, lead, stainless steel, and chrome or nickel-plated surfaces.

1.2 WARRANTY

A. Materials and workmanship warranty shall be in accordance with requirements of the Contract Documents, except that warranty shall be furnished jointly by Contractor and materials manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Scheduled paint is Dunn-Edwards, noted solely for purposes of establishing type and quality Acceptable manufacturers are:

1. Dunn-Edwards
2. Sherwin Williams.
3. Glidden (formerly ICIC Dulux, Inc.)

B. Paint Schedule is based on “normal” environment. Coatings marked “high performance” are for campuses designated as subject to extreme environmental conditions (temperature swings, salt air, corrosive conditions, etc.). Coatings marked “high performance, high cleanability” are noted for areas subject to extensive handling (e.g. handrails), grime, soot or other deposits.

2.2 Schedule:

A. Exterior Systems:

1. Masonry Concrete, Plaster, Masonry, Stucco

a. Flat -

Spot Prime: EFF-STOP Masonry Primer/Sealer (ESPR00)
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)

Second Coat: EVERSHIELD, Exterior Flat Paint (EVSH10)
Third Coat: EVERSHIELD, Exterior Flat Paint (EVSH10)

b. Semi-Gloss –
Spot Prime: EFF-STOP Masonry Primer/Sealer (ESPR00)
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
Second Coat: EVERSHIELD, Exterior Semi-Gloss Paint (EVSH50)
Third Coat: EVERSHIELD, Exterior Semi-Gloss Paint (EVSH50)

2. Wood - Paint Finish:
   a. Semi-Gloss –
   Spot Prime: EZ-PRIME Premium, Exterior Wood Primer (EZPR00)
   First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
   Second Coat: EVERSHIELD, Exterior Semi-Gloss Paint (EVSH50)
   Third Coat: EVERSHIELD, Exterior Semi-Gloss Paint (EVSH50)
3. Ferrous Metal: Paint Finish
   a. Semi-Gloss
   Spot Prime: ENDURAPRIME Rust Prev. Metal Primer (ENPR00)
   First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
   Second Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
   Third Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
   b. Semi-Gloss - High Performance
   First Coat: CARBOLINE, CARBOMASTIC 15
   Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
   Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
   c. Gloss – High Performance
   First Coat: CARBOLINE, CARBOMASTIC, Epoxy 15
   Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC
   Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC
4. Non-Ferrous Metal
   a. Semi-Gloss -
   Spot Prime: ULTRASHIELD, Galvanized Metal Primer (ULGM00)
   First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
   Second Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
   Third Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
   b. Semi-Gloss - High Performance
   First Coat: CARBOLINE, CARBOMASTIC 15
   Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
   Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
   c. Gloss - High Performance, High Cleanability
   First Coat: CARBOLINE, CA EPOXY 15
   Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
   Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC

B. Interior Systems:
1. Gypsum Board, Plaster, Concrete
   a. Flat -
   First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
   Second Coat: SUPREMA, Interior Flat Paint (SPMA10)

Third Coat: SUPREMA, Interior Flat Paint (SPMA10)

b. Semi-Gloss
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
Second Coat: SUPREMA, Interior Semi-Gloss Paint (SPMA50)
Third Coat: SUPREMA, Interior Semi-Gloss Paint (SPMA50)

2. Wood - Paint Finish:
a. Semi-Gloss
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
Second Coat: SUPREMA, Interior Semi-Gloss Paint (SPMA50)
Third Coat: SUPREMA, Interior Semi-Gloss Paint (SPMA50)

3. Ferrous Metal:
a. Semi-Gloss
Spot Prime: ENDURAPRIME Rust Preventive Primer (ENPR00)
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
Second Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
Third Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
b. Semi-Gloss - High Performance
First Coat: CARBOLINE, CARBOMASTIC 15
Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
c. Gloss – High Performance High Cleanability
First Coat: CARBOLINE, CARBOMASTIC, Epoxy 15
Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC
Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC

4. Non-Ferrous Metal:
a. Semi-Gloss
First Coat: ULTRA-GRIP Multi-Surface Primer (UGPR00)
Second Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
Third Coat: ARISTOSHIELD, Semi-Gloss Paint (ASHL50)
b. Semi-Gloss - High Performance
First Coat: CARBOLINE, CARBOMASTIC 15
Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 133MC
c. Gloss – High Performance High Cleanability
First Coat: CARBOLINE, CARBOMASTIC, Epoxy 15
Second Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC
Third Coat: CARBOLINE, CARBOTHANE, Polyurethane 134MC

PART 3 EXECUTION

3.1 PREPARATION

A. Examine surfaces to receive paint finish. Surfaces which are not properly prepared, sandpapered and cleaned or which are not in condition to receive the finish specified, shall be corrected before prime coat is applied. No priming shall be done until surfaces are approved by the DeputyInspector.

B. Woodwork shall be thoroughly cleaned, hand sandpapered, and dusted off.

Nail holes, cracks or defects in all work shall be carefully filled. On stained woodwork fill shall be colored to match stain. Filling shall be done after the first coat of paint, shellac or varnish has been applied.

C. Plaster surfaces plaster shall be allowed to dry at least 3 weeks before painting.

D. Metal surfaces to be painted shall be thoroughly cleaned of rust, corrosion, oil, foreign materials, blisters, and loose paint removed.

E. Do not apply painting materials to wet, damp, dusty, dirty, fingermarked, rough, unfinished, or defective surfaces.

F. Concrete Surfaces shall be dry, cleaned of dirt and foreign materials and in proper condition to receive paint. Neutralize spots showing effects of alkali.

3.2 APPLICATION

A. Backpainting: Immediately upon delivery to building, finish lumber and millwork shall be backpainted on surfaces that will be concealed after installation. Items to be painted shall be backpainted with priming coat specified under "Priming".

B. Priming: New wood and metal surfaces specified to receive paint finish shall be primed. Surfaces of miscellaneous metal and steel not embedded in concrete, and surfaces of unprimed plain sheet metal work shall be primed immediately upon delivery to project site. Galvanized metal work, and interior and exterior woodwork shall be primed immediately after erection. Priming of surfaces and priming coat shall be as follows:

1. Knots, Pitch and Sap Pockets: Shellac before priming.
2. Exterior Woodwork and Wood Doors: Prime with one coat of exterior water borne emulsion wood primer.
3. Interior Woodwork: Where indicated to be painted, prime with one coat of water borne wood primer.
4. Stain: Woodwork indicated to receive a stain and varnish finish shall be stained to an even color with water borne stain. On open-grained hardwood, mix stain with paste filler and completely fill pores in wood.
5. Unprimed Iron, Steel, and Other Uncoated Metals: Where specified to be painted, prime with one coat of metal primer.
6. Shop Primed Metal Items: Touch up bare and abraded areas with metal primer prior to application of second and third coats.
7. Coats shall be applied evenly and with full coverage. Finished surfaces shall be free of sags, runs and other imperfections.

C. Allow at least 24 hours between coats of paint.

D. Rollers shall not be used on wood surfaces.

E. Each coat of painted woodwork and metal, except last coat, shall be sandpapered smooth when dry. Texture-coated gypsum board shall be sanded lightly to remove surface imperfections after first coat of paint has been applied.

F. Each coat of paint or enamel shall be a slightly different shade as directed. Each coat of paint, enamel, stain, shellac, and varnish will be examined by the Deputy Inspector before next coat is applied. Notify the Deputy Inspector that such work is ready for inspection.

G. Do not "paint-out" underwriters' labels, fusible links and identification stamps.

3.3 CLEANING

A. Remove rubbish, waste and surplus material and clean woodwork, hardware, floors and other adjacent work. Remove paint, varnish and brush marks from glazing material and, upon completion of painting work, wash and polish glazing material both sides. Glazing material which is damaged shall be removed and replaced. Clean hardware and other unpainted metal surfaces with approved cleaner. Do not use abrasives or edgedtools.

3.4 SCHEDULE

A. Interior:

1. See schedule in 2.2B.

B. Exterior:

1. See Schedule in 2.2A.

C. Mechanical and Electrical Work:

1. Except where interior mechanical and electrical work to be painted is specified to received another paint finish, work occurring in finished rooms and spaces shall be cleaned, pre-treated and painted with 3 coats. Items to be painted include, but are not limited to: steel and copper piping, pipes, vents, fittings, ducts, plenums, miscellaneous supports and hangers, electrical conduit, fittings, pull boxes, outlet boxes, unfinished surfaces of plumbing fixtures, miscellaneous metal cabinets, panels and access doors and panels.
   First: As specified under Priming.
   Second and Third: Interior enamel, semi-gloss or gloss to match adjacent wall or ceiling finish.
2. Insulation and Taping On Pipes and Ducts: 3coats.
   a. Finished Rooms:
      First: Interior water borne primer.
      Second and Third: Interior semi-gloss or gloss enamel to match adjoining wall or ceiling finish.
3. Inside surfaces of ducts, vents, dampers and louvers as far back as visible from room in which they open shall be painted with 2 coats of flat black paint.

D. Lettering: Where lettering and signs are indicated to be painted, lettering shall be doneby an experienced sign painter. Unless otherwise indicated, characters shall be 4" high, 3/4" wide stroke, black.

END OF SECTION

SECTION 09 98 62

CONCRETE FLOOR SEALER (ASHFORD)

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install concrete floor sealer as indicated on the drawings and specified, including the following:

1. In cases where concrete slabs do not pass moisture testing as a prerequisite to the application of finished flooring, the concrete shall be sealed.

B. Product Data: Submit floor sealer manufacturer's technical data and installation instructions covering installation conditions of the Work, with copies of code approvals.

C. Regulations: Materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous materials in sealers.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR SEALER (ASHFORD)

A. Subject to compliance with specified requirements the concrete sealer shall be the “Ashford Formula” by Curecrete or an “or equal” product of one of the following:

1. Thoro System Products.

2. ProSoCo, Inc. “Consolideck”.

3. Dependable Floor Products Co.

B. Sealer shall be water based, SCAQMD approved, clear acrylic or urethane coating, designed for installation on interior and exterior traffic surfaces. Sealer shall be designed to penetrate the pore surface of the concrete and inhibit moisture migration. Completed sealer shall have semi-gloss sheen, unless otherwise required.

C.

PART 3 - EXECUTION

3.1 APPLICATION

A. Sealer application: Prepare surfaces in accordance with the coating manufacturers printed instructions. Remove contaminants including loose mortar, rust and other products of corrosion, disintegrated concrete, and other substances that could interfere with adhesion of the coating system to the substrate.

B. Install by experienced mechanics with methods and spray or roller equipment recommended by coating manufacturer, after surfaces to be treated are dry.

C. Mix the components and install floor sealer in accordance with manufacturer's recommendations. Install evenly over the surface in minimum 2 coats at approximately

200 square feet per gallon per coat. Repeated application is necessary until surface remains wet for between 5-10 minutes after application; this will establish final coverage rate. Keep traffic from treated surfaces until the material is thoroughly dry.

D. Provide a 3-year warranty for repair of finish.

END OF SECTION

SECTION 10 10 00

VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in the business of manufacturing markerboards, chalkboards, tackwalls and tackboards for at least 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Dry Markerboards:

1. Markerboards shall be by Nelson-Adams Co., Greensteel, Inc., Multi-Visual Products, Inc. or approved equal.
2. Markerboards shall consist of #22 gage facing sheet, with porcelain enamel surface, laminated to 1/2" fiberboard core, with #26 ga. galvanized steel backing sheet. Color shall be white unless otherwise directed by the Architect. Chalkrail and metal trim shall be extruded aluminum alloy, matching configuration indicated on Drawings.
   a. Chalkrail shall be extruded aluminum alloy "Naco" CR-4 or equivalent.
   b. Aluminum frame shall be "Naco" C-1, or equivalent.
   c. Aluminum maprail and maphooks shall be "Naco" M-1B and H-1 respectively, or equivalent.
   d. Provide Garcy #1275 mounting clips, Garcy #1274 crossbar and related components, for attachment of markerboard to Garcy #1204 metal standards, as indicated on Drawings.
3. Sliding Panels: Same as for Chalkboards.

B. Chalkboards:

1. Chalkboards shall be by Claridge, Inc.; Greensteel, Inc.; Ghent Manufacturing Co.
2. System Performance:
   a. System shall comprise chalkboards and tackboards, in configurations and sizes indicated on Drawings.
   b. Laminations of panel components shall be by face sheet manufacturer.
   c. Frames and accessories shall be clear anodized, extruded 6063-T5 aluminum, including 2" angle hangers, chalkrails of type indicated and maprail equal to Claridge #74. Provide chalkrail and maprail for the entire length of chalkboards, except to Claridge #76M, 2 for rails under 6'-0" and 4 for rails 6'-0" and over.
   d. Sliding Panels:
      (1) Vertical: Panels shall be counterbalanced by lead weights moving over roller bearing sheaves at each end. Operating mechanism housing and trim shall be heavy gage aluminum.
      (2) Horizontal: Panels shall be top suspended and shall have moulded nylon rollers.
   e. Facing Materials: Vitreous porcelain enamel face sheet, #24 gage (minimum), as manufactured by Claridge Products, or approved equal.
   f. Core Materials:

(1) Chalkboards: 1/2" thick, 45 lb. particle board with 0.015 aluminum sheet backing.
(2) Sliding Boards: 3/8" minimum honeycomb core with 0.15" aluminum sheet backing.

C. Tackboards:
1. Tackwall panels shall be by A-1 Visual Systems, 213-728-2680 or approved equal.
2. Solvent-based adhesive shall be by W.W. Henry or approved equal.
3. Tackwall panels shall consist of single-face layer of cloth-backed vinyl film, factory - bonded to 1/2" wood fiberboard backing; weight of vinyl film to be 20 oz. per lineal yard. Panel edges shall be beveled and wrapped; ends shall be square and unwrapped. Color shall be as selected by the Architect from swatches provided by manufacturer.
a. Vinyl film shall comply with FS CCC-W-408 A, Type 1; backing shall comply with ASTM C2-8 and FS LLL-1-535B, Class A. Finished panel shall have a Fire Hazard Classification of Class II in accordance with ASTM E84 tunnel test, as administered by California State Fire Marshal - approved testing laboratory.
4. Frames and accessories shall be clear anodized, extruded 6063-T5 aluminum, including 2" angle hangers, chalkrails of type indicated and maprail equal to Claridge # 74. Provide chalkrail and maprail for the entire length of chalkboards, except to Claridge # 76M, 2 for rails under 6'-0" and 4 for rails 6'-0" and over.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install boards in accordance with manufacturer's directions and approved shop drawings and as detailed. Fasteners for assembly of trim and frame units shall be truss head aluminum or stainless steel self-tapping screws, as indicated. Anchorage to wall shall be as indicated. All fasteners shall have double cadmium plated finish.

B. Install tackwall panels in accordance with manufacturer's directions, approved shop drawings and as detailed. Panels shall be installed over gypsum board, using solvent based adhesive. 1-5/8" drywall screws, at 8" o.c. shall be used for fastening top and bottom edges of panels. Screw-heads shall be concealed with PVC molding to match panel color.

C. Install panels after finish painting of wall surfaces has been completed and paint is thoroughly dry. Set panels level, plumb and neatly assembled. At the completion of the work, trim shall be completely cleaned of dirt, fingermarks, or other foreign material. Adjust sliding panels for smooth operation.

3.2 CLEAN-UP

A. Upon completion, clean exposed surfaces soiled by the work, repair damage caused by the work, and remove debris and surplus materials from the project site.

END OF SECTION

SECTION 10 12 28

DISPLAY CASEWORK, GLASS DOORS AND SIDELIGHTS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data: For each type of display case indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.

B. Shop Drawings: For display cases. Include plans, elevations, sections, details, and attachments to other work.

1. Show location of seams and joints in visual display surfaces.

2. Include sections of typical trim members.

C. Samples for Initial Selection: For units with factory-applied color finishes, and as follows:

1. Actual sections of visual display surfaces.

2. Section of metal items for color selection.

3. Stain and transparent wood finishes.

1.2 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces, operating hardware, and illuminated units to include in maintenance manuals.

1.3 MOCKUP

A. Before installing casework, prepare mockup for glass doors, casework and finish required to verify selections made under sample submittals. Approved mockups will set quality standards for installation and aesthetic effect. Comply with the following requirements:

1. Locate mockups as directed by Architect.

2. Retain and maintain mockup during installation in an undisturbed condition as a standard for judging the completed Work.

a. Approved mockup in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.4 REFERENCE STANDARDS

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program, or Shop is a licensee of AWI's Certified Compliance Program.

1. Installer Qualifications: Certified participant in AWI's Quality Certification Program or Licensee of WI's Certified Compliance Program.

2. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

PART 2 - PRODUCTS

2.1 DISPLAY CASEWORK, GLASS DOORS AND SIDELIGHTS

A. Casework materials shall be as indicated on the drawings and as specified below:

1. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde, that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. Hardwood Plywood: HPVA HP-1 and of the species and finish indicated on the drawings.

3. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.

4. Vinyl Fabric: FS CCC-W-408D, Type II, color, texture and pattern as indicated on the drawings, and weighing not less than 13 oz./sq. yd.; with flame-spread index of 25 or less when tested according to ASTM E 84.

5. Extruded-Aluminum Bars and Shapes: ASTM B 221, Alloy 6063.

6. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.

7. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), colorless sheet with visible light transmittance of 92 percent measured per ASTM D 1003.

8. High-Pressure Plastic Laminate: NEMA LD 3, color and pattern as selected by the Architect.

9. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

10. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPONENTS

A. Glazed Hinged Doors: Tempered glass by the manufacturer indicated on the drawings; set in frame matching cabinet material and finish. Equip each door with cylinder lock with two keys.

B. Recessed Cabinet: Custom-fabricated cabinet; with tackboard assembly on back inside surface, operable glazed doors at front, and trim on face to cover edge of recessed opening.

C. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports. Fabricate with circular cutouts where indicated. Chamber, seam, and swipe edges.

D. Finishes shall be as selected by the Architect, verified samples, and approved mockups.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches o.c. Attach trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches o.c.

C. Install display case shelving level and straight.

3.2 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

B. Touch up deficient finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 10 14 83

DIGITAL SIGN DISPLAY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install electronic full color LED display signs as indicated on the drawings and specified

1.2 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.3 ACTION SUBMITTALS

A. Product Data: Submit descriptive literature and illustrations for each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, framing, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC FULL COLOR LED DISPLAY SIGNS

A. Subject to the Owner's evaluation of action submittals, signs shall be the product of the manufacturer named on the drawings (Optec Displays Model Intelligent-M2 16.0mm RGB), or an acceptable substitution by one of the following:
   1. Optec Displays Inc.
   2. Mega Signs Inc.
   3. Ad Vision Company.
   4. Digital Valley USA.

B. IMPORTANT & MANDATORY: Electronic Full Color LED Displays MUST conform to FCC Title 47, Part 15, Class A. The LED displays MUST have the FCC Compliance statement sticker affixed to the exterior of the product. Upon request, LED display manufacturer MUST provide an accredited Third-party Testing Lab Certificate of Compliance for the LED display model quoted for this project. The LED displays MUST showcase the following statement on the exterior of the LED displays, as required by 47 CFR Section 15.19(a)(3): "This device complies with part 15 of the FCC Rules. Operation is subject to the following two Conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation."

C. Electronic LED Display Specifications: Electronic LED Display MUST meet or exceed the minimum specifications described below.
   1. Pixel Pitch (Pixel Spacing): Center-to-Center pixel spacing MUST not exceed 16.0 mm (0.63 inch) TRUE pixel pitch (No Virtual pixel pitch or pixel sharing product will be accepted).
   2. Pixel Design: Each pixel MUST be an individual TRUE pixel, separate from each other consisting of three (3) discrete individual LEDs (1 Red, 1 Green and 1 Blue). Each TRUE pixel must be comprised of no more or less than 1 Red, 1 Green and 1 Blue individual LEDs. No Virtual Pixel Technology or SMD Type (3-in-1) Technology will be accepted.
   3. LED Panels / Tiles: Each LED panel / tile MUST be completely sealed (encapsulated) from the front and rear for protection from the environment.
   4. Intelligent LED panels / tiles (1 CPU per LED panel / tile): Each LED panel / tile MUST have its own individual CPU for precise diagnostics to improve performance & store diagnostic, calibration and run-time data of the pixels. Intelligent LED panels / tiles MUST have the design to improve color depth, refresh rate, uniformity in brightness & color settings.
   5. Cabinet Design: The LED display MUST be an Edge-to-Edge display. The display shall not have any borders. Pixels and LEDs MUST go all the way to the edges to utilize the entire available space for showing content. The cabinet size MUST be same as the actual viewing area or active display area.
   6. Colors: RGB 1.15 Quintillion Colors
   7. Color Processing: 20-Bit grayscale color processing.
   8. Color Calibrated Brightness: Maximum Color Calibrated Brightness MUST be no less than 10,000 NITs.
   9. Viewing Angles: 140 Degrees Horizontal; 70 Degrees Vertical.
   10. Video Frame Rate: 60 FPS. The display MUST have 60 Frames per Second Video Frame Rate for smooth full motion video playback.
   11. Refresh Rate: ± 3840 Hz (Adjustable) for optimized viewing experience.
   12. On-demand Diagnostics: The LED display MUST have On-demand Diagnostics as a standard feature for diagnosing of Display, Power, Data and Tile level issues.

Automated Diagnostic health alerts via email shall be available as an optional item. Automated Diagnostic health alerts via email would require DSL Internet connection or Cell Modem communication where as On-demand diagnostic shall be available even with Wireless Ethernet or Hard-wire Ethernet or Hard-wire Fiber communication besides DSL Internet connection and Cell Modem. The diagnostics shall have following features:

a. Tile Monitor: The display diagnostics MUST be capable of checking the LED tile status and outages.
b. Power Monitor: The display diagnostics MUST be capable of verifying the functionality of Power Supplies & connection status.
c. Data Monitor: The display diagnostics MUST be capable of Inspecting the quality & status of data signals between LED tiles, displays & components.
d. Media Player Monitor: The display diagnostics MUST be capable of verifying link between player & display.
e. Display Readiness: The display diagnostics MUST be capable of checking the status of power & data signals to all components of the display.
f. Hours of Operation: The display diagnostics MUST be capable of keeping a record of operation. If a tile is replaced, it can be adjusted to maintain uniformity.

13. Advanced 5-Pin Single-Point Connectors: The LED panels / tiles used in both displays MUST have advance 5-Pin Single-Point Connectors and MUST provide Redundant Power and Independent Data. The display and the LED panels / tiles MUST NOT use any Ribbon Cables to provide low EMI & less failure points in the display.
14. RSS Feed: LED displays MUST have the ability to display RSS feeds.
15. Amber Alert: LED displays MUST have the ability to display Amber Alerts.
16. Graphics Capability: The display MUST be able to support JPEG, BMP, AVI, MPG, GIF file formats. The display MUST be able to display text, pictures, graphics, animations and pre-recorded videos. The display MUST be able to show pre-recorded videos at no less than 60 frames per second.
17. Color Calibration: LED panels and the entire display MUST have the factory pre-setting of true color calibrated white-balance prior to getting shipped out.
18. Contrast Enhancement: LED Pixels shall have Louvers with black textured mask to block direct sun for better display contrast.
19. Brightness Dimming: Display shall have minimum 100 dimming levels through automatic dimming with the help of Light Sensor and manual dimming with the help of software scheduling.
20. Temperature Sensor: Display shall have a Temperature Sensor for real time display of temperature.
21. Radiation Shield for Light & Temperature Sensor: LED displays shall be supplied with Light Sensor for brightness dimming and Temperature Sensor for real time display of temperature. Light Sensor and Temperature Sensor shall be enclosed in a white color honeycomb type radiation shield. The wedge-shaped plates of the honeycomb type radiation shield shall provide maximum airflow around the sensor while at the same time minimizing direct exposure to sunlight. The passive shield is shaped to allow natural air convection around the sensor so that the air temperature inside the shield is a good representation of the

outside air. The radiation shield shall also provide protection from rain and snow.

22. LED Lifetime: The LEDs must be rated at 100,000 hours of lifetime. Lifetime is defined as the point at which the LED degradation reaches 50% of its original brightness.
23. Power Supplies: LED displays shall have Energy Efficient - UL Green Leaf standard Power Supplies: Minimum ± 88% efficient Fan-less power supplies. Power supplies MUST be Fan-less Power Supplies and MUST use heat-sink technology for heat dissipation.
24. Color Temperature: 6500K (Adjustable)
25. Operating Temperature / Humidity: ± -30°~140°F / ±10~90%
26. Service / Maintenance Access: LED display MUST have full front service access for maintenance and repair.
27. Weather Proofing (Front/Rear): LED displays MUST have minimum IP67 / IP54 weather proofing ratings.
28. Manufacturing Quality Standard: ISO 9001
29. Certifications: LED displays MUST be ETL / UL 48 Listed and MUST be FCC compliant - Title 47, Part 15, Class A.
30. AC Power Required: LED displays shall have Single Phase 120V AC 50/60 Hz
31. Wind Load: LED Displays shall be engineered to withstand wind load requirements set by the codes.

D. Communication: Both LED displays shall be supplied with Fiber Optic Converters by the manufacturer for communication from the programming computer to the LED displays. Fiber cable will be supplied, run and brought to the sign by the customer's electrician. Fiber cable needs to be Multi-mode, 2 Strands with ST-Connectors.

E. Software: Display software must be provided with the display. Software must be capable of running on Windows Vista, Windows 7, Windows 8 and Windows 10. Software shall support all True Type Fonts and shall be capable of making it compatible with Open Type Fonts. Software shall have following features: Create, import, layer, edit, manage and preview with intuitive content creation tools. Manage effects, apps, variable data and frame duration. Layer content to create messages with impact. Key text over images, animations and video. Utilize a variety of transition effects like scale, rotate, and fade in/out to create dynamic content. Display customized time, temperature, date, numerals/characters and variable data. Schedule down to the minute, for one or multiple displays. Control, network and adjust displays and settings. Group scheduling and upload, log played files, and view display communication status. Create and schedule a variety of content layouts with up to 9 user defined media zones. Mix static, variable, and dynamic content on one display. Create or import/export play lists for one or multiple zones and log playback. Edit and preview play lists. Save individual content files to the content library for future use. There shall be up to 100 available hot keys for instantaneous content playback. Create, edit, and customize each hot key including naming and play duration. Monitor and adjust display connectivity, temperature, and brightness.

F. WARRANTY: Both LED displays MUST carry manufacturer's 90 Months (7 1/2 Years) Parts & 90 Months (7 1/2 Years) On-site Labor Warranty (Subject to registration & installation approval and acceptances of program's terms and conditions).

G. Parts Availability: LED displays MUST carry parts availability guarantee for 10 years.

H. Software Upgrade: LED Display software MUST include 5 Years Software Upgrades

I. On-site Tech Support, Supervision & Software Training at the time of Installation: The LED display manufacturer shall provide an on site technician for One (1) day per display (total of Two (2) days) of supervision and in-person software training at the time of installation.

J. Software Webinar Training: The LED display manufacturer shall provide unlimited weekly software training webinars at no charge for the lifetime of the LED Displays.

K. M. Tech Support: The LED display manufacturer shall provide unlimited phone tech support.

2.2 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. Sign Mounting Fasteners:
   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
   b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
   c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 10 21 13.13

METAL TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Metal toilet compartments.

B. Urinal and Vestibule screens.

1.02 REFERENCE STANDARDS

A. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.03 SUBMITTALS

A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Metal Toilet Compartments:

1. All American Metal Corp - AAMCO.
2. General Partitions Mfg. Corp.
3. Global Steel Products Corp.
4. Metpar Corp.

2.02 COMPONENTS

A. Toilet Compartments: 5WL (dimpled) stainless steel, floor-mounted unbraced.

B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.

1. Panel Faces: 20 gage, 0.0359 inch (0.91 mm).
2. Door Faces: 22 gage, 0.0299 inch (0.76 mm).
3. Pilaster Faces: 20 gage, 0.0359 inch (0.91 mm).
4. Reinforcement: 12 gage, 0.1046 inch (2.66 mm).
5. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.

C. Door and Panel Dimensions:

1. Thickness: 1 inch (25 mm).
2. Door Width: 24 inch (610 mm).
3. Door Width for Handicapped Use: 36 inch (915 mm), out-swinging.
4. Height: 58 inch (1473 mm).

D. Pilasters: 1-1/4 inch (32 mm) thick, of sizes required to suit compartment width and spacing.

E. Urinal Screens: Wall mounted with two panel brackets, and floor-to-ceiling vertical upright consisting of pilaster anchored to floor and ceiling.

F. Urinal Screen Splash Panels: Stainless steel sheet 30 inch (76 mm) wide by 42 inch (1,066 mm) high mounted on partitions adjacent to urinals. Fasten with stainless steel screws spaced 8 inches (20 mm) on center.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed chromed steel with polished finish, 3 inch (175 mm) high, concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.

B. Head Rails: Hollow chrome-plated steel tube, 1 by 1-5/8 inch (25 by 41 mm) size, with anti-grip strips and cast socket wall brackets.

C. Brackets: Polished chrome-plated non-ferrous cast metal.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Polished chrome plated non-ferrous cast metal:
1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
2. Nylon bearings.
3. Thumb turn or sliding door latch with exterior emergency access feature.
4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
5. Coat hook with rubber bumper; one per compartment, mounted on door.
6. Provide door pull for outswinging doors.

END OF SECTION

SECTION 10 21 14
PHENOLIC TOILET PARTITIONS

PART 1 - PRODUCTS

1.1 COLOR- THRU PHENOLIC STILES, PANELS, DOORS AND SCREENS

A. Scheduled components are noted below solely for purposes of establishing type and quality. Refer to campus standard preferences.

1. Bradley Corporation
2. Bobrick Inc.
3. ASI-Global

B. Color-thru phenolic material shall be comprised of compressed cellulose fibers impregnated with resins with a laminated finish. Materials shall meet National Fire Protection Association Class B, Uniform Building Code Class II, ASTM E-84 Fire Resistance Standards: flame spread 69, smoke density 93.

C. Finish Thickness

1. Stiles and doors shall be 3/4" (19 mm).

2. Panels and benches shall be 1/2" (13 mm).

D. Hardware

1. All hardware to be 18-8, type-304 stainless steel with satin finish.

2. All hardware shall be concealed inside compartments with the exception of out- swinging doors.

3. Hardware of chrome-plated "Zamac" is unacceptable.

E. Latches

1. Sliding door latch shall be 16 gauge (1.6 mm).

2. Sliding door latch shall require less than 5-lb force to operate. Twisting latch operation will not be acceptable.

3. Latch track shall be attached to door by flathead machine screws into factory-installed threaded brass inserts.

4. Latch handle shall have rubber bumper to act as door stop.

5. Latch shall allow door to be lifted over 16-gauge (1.6-mm) keeper for emergency access.

6. Metal-to-metal connection shall withstand a direct pull of over 1000 lb. per

screw.

F. Disabled Access Door: Provide slide latch with U-shaped and loop handle immediately beneath latch on both sides of the door.

G. Hinges

1. Cam shall be adjustable in the field to permit door to be fully closed or partially open when compartment is unoccupied.
2. Hinges shall be attached to door and stile by theft-resistant, one-way stainless steel machine screws into factory-installed metal inserts. Fasteners secured directly into the core are not acceptable.
3. Metal-to-metal connection shall withstand a direct pull of over 1000 lb. per screw.

H. Coat Hook shall be constructed of stainless steel and shall project no more than 1-1/8" (29 mm) from face of door. Coat hook shall be secured by theft-resistant, one-way stainless steel screws.

I. Mounting Brackets shall be constructed of stainless steel and shall be mounted inside compartment. Mounting brackets exposed on the exterior of the compartment will not be acceptable. Wall mounted urinal screen brackets shall be 11 gauge double thickness.

J. Leveling Device shall be 3/16" (5-mm) hot rolled steel bar; chromate-treated and zinc-plated; through-bolted to base of black-core and color-thru phenolic stile.

K. Stile Shoe shall be one-piece, 4" (102-mm) high, type-304, 22-gauge (0.8-mm) stainless steel with satin finish. Top shall have 90□ return to stile. Patented one-piece shoe capable of adapting to 3/4” or 1” stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

L. Headrail (Overhead Braced) shall be satin finish, extruded anodized aluminum (0.125”/ 5-mm thick) with anti-grip profile.

1. Stainless steel shall comply with ASTM A554, 300 Series and in the partition manufacturer’s standard finish.

END OF SECTION

SECTION 10 26 00

CORNER GUARDS, WALL GUARDS, AND PROTECTORS

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

A. ALUMINUM ASSOCIATION (AA)

AA DAF-45 ..... (Sep 1980; 7th Ed) Designation System for Aluminum Finishes \&&\

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 ..... (1991) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM B 221 ..... (1992a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

ASTM D 256..... (1990b) Impact Resistance of Plastics and Electrical Insulating Materials

ASTM D 635..... (1991) Rate of Burning and/or Extent and Time of Burning of Self- Supporting Plastics in a Horizontal Position

ASTM E 84 ..... (1991a) Surface Burning Characteristics of Building Materials

C. FEDERAL STANDARDS (FED-STD)

FED-STD 795..... (Basic) Uniform Federal Accessibility Standards

D. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM-01..... (1988) Metal Finishes Manual for Architectural and Metal Products

E. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) NFPA 80..... (1990) Fire Doors andWindows

F. SOCIETY OF AMERICAN AUTOMOTIVE ENGINEERS (SAE)

SAE J1545 ..... (1986) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Color Trim&\

G. UNDERWRITERS LABORATORIES (UL)

UL-01 ..... (1992) Building Materials Directory

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer: Scheduled hardware is noted below solely for purposes of establishing type and quality: Acrovyn models “SSM-27N and SSM-25N”, or approved equivalent products from one of the following:

1. Acrovyn
2. Pawling
3. IPC

B. Resilient Material: Resilient material shall consist of extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic and shall conform to the following:

1. Minimum Impact Resistance: Minimum impact resistance shall be 960.8 N.m/m (18 ft.lbf/in) (18 ft.lbs) when tested in accordance with ASTM D 256, (Izod impact, ft.lbs per inch notch).
2. Fire Rating: Fire rating shall be Class 1 when tested in accordance with ASTM E 84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D 635. Material shall be labeled and tested by Underwriters Laboratories or other approved testing laboratory. Resilient material used for protection on fire rated doors and frames shall be listed in UL-01 or equal listing by other approved independent testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door frame assemblies shall have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.
3. Integral Color: Colored components shall have integral color and shall be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE- LCH scales.

2.2 CORNER GUARDS

A. Resilient Corner Guards: Corner guard units shall be surface mounted type, radius formed to profile shown. Corner guards shall be five feet high. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from resilient material, minimum 0.078-inch thick, mounted on a continuous retainer. Extruded aluminum retainer shall conform to ASTM B 221, alloy 6063, temper T5 or T6. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards.

B. Stainless Steel Corner Guards: Stainless steel corner guards shall be fabricated of 0.0625-inch thick material conforming to ASTM A 167, type

302 or 304. Cornerguards shall be five feet high. Corner guard shall be formed to 4” x 4” profile.

2.3 WALL GUARDS (BUMPER GUARDS)

A. Wall Guards, Combination Handrail/Wall Guards and Handrails: Wall guards, combination handrail/wall guards, and handrails shall be provided with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories standard with the manufacturer. Extruded aluminum retainers shall conform to ASTM B 221, alloy 6063, temper T5 or T6. End caps and corners shall be field adjustable to assure close alignment with handrails and wallguards.

B. Wall Guards: Wall guards shall consist of snap-on covers of resilient material, minimum 1.98 mm thick, mounted over 2-inch wide aluminum, minimum 0.062-inch thick retainer, anchored to wall at maximum 24 inches on center.

C. Combination Handrail and Wall Guards: Combination handrail and wall guards shall consist of snap-on covers of resilient material, minimum 0.078-inch thick, on a continuous, extruded aluminum retainer, minimum 0.072-inch thick anchored to wall at maximum 32 inches on center. Handrails shall be in accordance with FED-STD 795.

2.4 DOOR PROTECTORS

A. Door frame protection items shall consist of acrylic vinyl or polyvinyl chloride resilient material, minimum 0.060-inch thick for doors and 0.035-inch thick for door frames. Adhesive for resilient material shall be in accordance with manufacturer's recommendations.

2.5 FASTENERS AND ANCHORS

A. Fasteners and anchors shall be provided for each specific installation.

B. Shall be attached to studs or blocking inside the wall. Install all necessary blocks as required.

2.6 FINISH

A. Aluminum Finish: Finish for aluminum shall be in accordance with AA DAF-45. Exposed aluminum shall be designation AA-C22A31chemically etched medium matte, with clear anodic coating. Concealed aluminum shall be mill finish.

B. Stainless Steel Finish: Finish for stainless steel shall be in accordance with NAAMM-01, finish number 4.

C. Resilient Material Finish: Finish for resilient material shall be embossed texture with colors in accordance with SAE J1545.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install toilet accessories as indicated on the drawings and specified.

B. Provide keyed alike locks on all lockable accessories.

1.2 SYSTEM DESCRIPTION

A. Regulatory Requirements: Comply with CBC requirements and ADA recommendations for accessibility.

1.3 SUBMITTALS

A. Shop Drawings: Submit a schedule of accessories and Shop Drawings indicating installation methods and fasteners.

B. Submit samples for review and acceptance.

1.4 DELIVERY, STORAGE AND HANDLING

A. Protect accessories from damage.

PART 2 - PRODUCTS

2.1 TOILET ACCESSORIES

A. Accessories shall be provided with necessary anchoring devices and fasteners appropriate for surfaces on which items are to be fastened.

B. Anchors and Fasteners: Provide anchors and fasteners capable of developing a retaining force commensurate with the strength of the accessory to be mounted or installed and well suited for use with supporting construction. Where exposed fasteners are permitted, provide oval head fasteners (vandalproof type) with finish matching the accessory item.

C. See Campus Preferences for acceptable manufacturers. Note that in many cases, items that are dispensers (paper towels, toilet paper, sanitary napkins) or have a mechanical function (hand dryers, or items with keys) must be coordinated with Campus Preferences and standards for standard resupply of stocked items, and will supercede specified brands and models listed below.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Check openings in substrates to receive accessories. Verify openings are correctly located and sized to receive accessories, and that locations will comply with disability access requirements. Confirm that blocking, backing or support is properly located and adequate for the accessory installation.

B. Verify spacing of plumbing fixtures and toilet partitions. Confirm spacing and locations are compatible with proposed accessory locations and will allow compliance with disability access requirements.

3.2 INSTALLATION

A. Install toilet accessories in accordance with manufacturer's written recommendations and accessibility requirements. Fasten components firmly in place.

B. Drill holes to correct size and application that is concealed by item with ¼ inch tolerance.

C. Install recessed accessories into wall openings with sheet metal screws into metal frames.

D. Install surface-mounted accessories to backing plates with machine screws, plumb, and aligned.

E. Grab Bars:

1. Fasten to toilet partition with 3-inch diameter stainless steel back plates with studs, couplings, and stainless steel machine screws.

2. At metal stud walls, provide 1/8 inch cold-rolled steel plate, drilled and tapped for machine screws, or 16 gage cold-rolled steel plate complete with threaded sleeves for stainless steel machine screws. Weld plates to studs.

3. At concrete or masonry walls, install bars with sheet metal screws and expansion anchors.

4. At plaster or gypsum board walls, provide spacers of same thickness as wall material to prevent crushing of wall material.

F. Mirrors: Install mirror on manufacturer supplied concealed wall hanger and fasten with 2 theft-resistant locking screws.

G. Before Final Completion, deliver keys and maintenance instructions to the Owner.

3.3 SCHEDULE

A. Provide the following items. Note that model numbers are by Bobrick for reference purposes only.

1. Recessed toilet seat cover dispenser: Bobrick B3013.

2. Mirrors: Bobrick 290 series, theft resistant angle frame mirror, stain steel with satin finish.

a. Special sizes as noted on drawings Bobrick B-290 series from wall to wall or as noted.

3. Grab bars: Bobrick B6806 series, 1-1/2” diameter, 18 gage satin finish stainless steel, 3” diameter, stainless steel flange with vandal proof stainless steel screws and snap flange, 2561 series anchors plates for stud wall construction and 2581 anchor plates for metal partitions

4. Paper towel dispenser: Bobrick B4262 – at locations other than toilets – surface mounted.

5. Mop and broom holder: Bobrick B223 and 36 at all janitor closets.

6. Coat Hooks: Provide B2116, single prong one-piece cast brass with nickel plated finish. In accessible locations, mounted not more than 48” above the finished floor.

7. Lavatory-Mounted Liquid Soap Dispenser: Bradley Model 6326, manufactured of stainless steel, chrome plated brass and molded ABS plastic. Buna-N O-ring seals and duckbills. Valve shall dispense measured amount of vegetable or coconut oil liquid soap, synthetic detergents, or antiseptic solutions. Servicing is facilitated by use of special wrench. Requires less than 5 lbs. of force to activate plunger in accordance with ADA requirements.

8. Recessed Paper Towel Dispenser and Waste Receptacle: Bobrick Model B43944, recessed paper towel dispenser and waste receptacle shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin- finish. Front of paper towel dispenser door and waste receptacle shall have same degree of arc and match other Bobrick ConturaSeries accessories in the washroom. Radius on corners and edges of flange, door, and waste receptacle shall complement other Bobrick ConturaSeries washroom accessories. Flange shall be drawn, one-piece, seamless construction. Paper towel dispenser door shall be drawn, 18-gauge, one-piece, seamless construction; secured to cabinet with a full-length stainless steel piano-hinge; and equipped with a stainless steel cable door-swing limiter and flush tumbler lock keyed like other Bobrick washroom accessories. Paper towel dispenser shall dispense 600 C-fold or 800 multifold paper towels. Unit equipped with TowelMate consisting of a 90° return towel guide angle inside cabinet to prevent paper towels from falling forward out when door is opened for servicing and a Nylon Rod across the center of the towel tray to dispense paper towels one at a time. Waste receptacle shall have a formed, 18-gauge, one-piece, seamless, removable front panel with top edge hemmed. Unit equipped with LinerMate trash liner holder fabricated with molded plastic trash liner holder sleeve and a 20-gauge, U-shaped support strap; riveted construction. Liner holder shall have an arc at front and same shape as inside of waste receptacle area. LinerMate facilitates installation and removal of disposable trash liners and retains liner inside waste receptacle. Capacity of waste receptacle shall be 15.0-gal. (56.8-L).

9. Seat Cover and Dual Roll Tissue Dispenser and Waste Receptacle: Combination unit shall include toilet seat cover dispenser, toilet tissue dispenser, and napkin disposal, and be fabricated of heavy gauge stainless steel with seamless exposed surfaces in satin finish. Door and back panel shall be 18 gauge. Door shall have piano hinge and tumbler lock.

    a. Bradley Model 5912: Recessed

    b. Bradley Model 5912-10: Semi-Recessed (recesses 3-1/4”, Projects 1-1/4”)

    c. Bradley Model 5912-11: Surface-Mounted (projects 4-1/2”)

10. Surface-Mounted Multi-Roll Tissue Dispenser: Bobrick Model B2888, type-304 stainless steel with all-welded construction, including dispensing mechanism, inner housing and cam; exposed surfaces shall have satin fi nish. Front of toilet tissue dispenser door shall be drawn, onepiece, seamless construction and shall have same degree of arc and match other Bobrick Contura Series accessories in

the washroom. Radius on corners and edges of door and cabinet shall complement other Bobrick Contura Series washroom accessories. Door shall be secured to cabinet with two rivets and equipped with a fl ush tumbler lock keyed like other Bobrick washroom accessories. Unit shall dispense two standard-core toilet tissue rolls up to 5-1/4" diameter (1800 sheets). Extra roll shall automatically drop in place when bottom roll is depleted. Unit shall be equipped with two theft-resistant, heavy-duty, one-piece, molded ABS spindles.

11. Surface-Mounted Sanitary Napkin Disposal: Bobrick Model B270, type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Front of sanitary napkin disposal shall have same degree of arc and match other Bobrick Contura Series accessories in the washroom. Radius on corners and edges of sanitary napkin disposal shall complement other Bobrick Contura Series washroom accessories. Cover shall be drawn, one-piece, seamless construction and secured to container with a full-length stainless steel piano-hinge. Container shall have integral finger depression for opening cover. Manufacturer's service and parts manual shall be provided to the building owner in a 3-ring binder.

12. Surface-Mounted Toilet-Seat-Cover Dispenser: Bobrick Model B221, type-304, 20-guage stainless steel with drawn, one-piece, seamless construction; exposed surfaces shall have satin finish. Front of toilet-seat-cover dispenser shall have same degree of arc and match other accessories in the washroom. Radius on corners and edges of toilet-seat-cover dispenser shall complement other washroom accessories. Unit shall have a rectangular opening for dispensing toilet seat covers and a concealed opening in bottom for filling. Capacity shall be 250 paper toilet seat covers. Alternate: Sanitor Model #FH33SS Neatseat.

13. Surface-Mounted Soap Dispenser: Bobrick Model B2111, type-304 stainless steel with satin-finish. Corrosion-resistant valve shall dispense commercially marketed all-purpose hand soaps. To prevent corrosion, use only chloride-free pH-netural liquid soaps. Valve shall be operable with one hand and with less than 5 pounds of force to comply with barrier-free accessibility guidelines (including ADAAG in U.S.A.). Front of soap dispenser shall have same degree of arc and match other accessories in the washroom. Radius on corners and edges of soap dispenser shall complement other washroom accessories. Container body and back plate shall be epoxy-sealed to prevent warping and leakage. Soap dispenser shall have concealed, vandal-resistant mounting. Locked, hinged stainless steel lid for top filling shall require special key to open. Capacity shall be 40-fl oz (1.2-L). Manufacturer's service and parts manual shall be provided to the building owner in a 3-ring binder.

14. Touch-Free Soap Dispenser: GOJO 278912, features a skylight with an extra-large site window that makes it easy to see when it is time to reload. Uses high capacity 1200 mL refills.

    a. Dispenser Type: Foam

    b. Capacity (Volume): 1200 mL

    c. Color: Nickel

d. Mounting: Wall

15. Shower Seat Grab Bar: Bobrick 1-1/4” diameter, stainless steel ADA compliant shower seat grab bar.
16. Sanitary Napkin Dispenser: Bobrick Model 353, or partition mounted B-354, sanitary napkin dispenser.
17. Diaper Changing Station: Koala Kare Products, Model KB-110-SSWM, wall mounted, stainless steel finish.
18. Shower seats (folding): Bobrick Model B-5181 reversible solid phenolic.
19. Shower curtain rods: Bobrick B6107, heavy duty.
20. Shower curtain hooks: Bobrick 204-1, stainless steel.
21. Shower curtains: Bobrick 204-3 vinyl.
22. Shower soap dish: Bobrick B-4390, recessed heavy duty soap dish with bar.
23. Toilet Seat: Bemis Model 1955CT or equivalent to fit toilet bowl. Seats shall be heavy weight and injection molded of solid plastic. Seats shall be open front, less cover for elongated bowl, and feature large molded-in bumpers.
24. Undersink piping covers at ADA/CBC accessible lavatories: Truebro or LavGuard 2.
25. Utility shelves: Bobrick B-298 stainless steel shelf min. 24” long x 8” deep. Coordinate with design professional to locate shelf to meet CBC and ADA requirements for reach ranges and maximum limits of protruding objects at circulation paths.
26. Wall hook: Bobrick B-671 surface mounted single hook, bright polished stainless steel. Provide in all toilet stalls, and below or adjacent to utility shelves.
27. Waste receptacles (at staff and faculty restrooms only). Bobrick B-3644. Coordinate for required accessibility clearances.

END OF SECTION

SECTION 10 29 74

ALUMINUM SKATEBOARD DETERRENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide aluminum skateboard deterrents as indicated on the drawings and specified.

B. Anti-Skating Devices: Provide hardware devices designed to deter aggressive inline skaters, skateboarders, and other extreme sports athletes from using facilities as a platform for performing stunts that damage surfaces, and cause injurious accidents.

1.2 SUBMITTALS

A. Product Data: Submit descriptions of skateboard deterrents. Include physical characteristics, such as durability, resistance to pullout, and impact resistance.

B. Samples for Verification: Submit one sample of each item.

PART 2 - PRODUCTS

2.1 ALUMINUM SKATEBOARD DETERRENTS

Designer shall visit College Campus to see if existing skate deterring units can be incorporate into the new design. Other options to consider:

A. Skate deterring units shall be Gorilla Series, Skate Stoppers, or equal, and of the characteristics indicated on the drawings, or otherwise as recommended by the manufacturer and subject to approval of the Architect.

B. Aluminum shall be of the alloy 6061-T6 and finish as standard with the manufacturer. Products by NIIKLS Group, Traffic Safety Systems, and Barrier Group may be submitted for evaluation by the Architect.

C. Provide tamperproof nonmagnetic stainless-steel bolts, and other fasteners compatible with substrate, components, hardware, anchors, and other items being fastened.

D. Epoxy Adhesive: Two part type recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install aluminum skateboard deterrents as recommended by the product manufacturer, securely affixed in place, and in the proper position.

END OF SECTION

SECTION 10 41 80

TREAD STRIPING (CONTRASTING COLOR)

PART 1 - GENERAL

Not used.

PART 2 - PRODUCTS

2.1 TREAD STRIPPING (CONTRASTING COLOR)

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   1. 3M Company.
   2. Seton Name Plate Company.

B. Stripping for the Visually Impaired: The upper approach and lower tread of each stair shall be marked with a strip of tape in clearly contrasting color (as selected by the Architect), at least 2 inches wide, placed parallel to and not more than 1 inch from the nose of the step.
   1. The strip shall be slip resistant in compliance with CAL-OSHA regulations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with the product manufacturer's recommendations.

B. At completion of the installation, clean the tread and stripping. Remove excess adhesive. Protect the stripping from damage.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Principal work in this Section:

1. Single or [ ] tier metal lockers with sloped tops.
2. Supplementary parts and components, such as inserts, clips, fasteners, anchors, closure pieces, and other miscellaneous supports and accessories required for a complete installation.
3. Obtain locker size, number of tiers, features and design from College Building User Group (BUG) and sign of by the Department Chair or his/her representative.

1.2 SUBMITTALS

A. Data: Submit copies of manufacturer specifications giving sizes, materials, finishes, roughing-in diagrams and installation instructions.

B. Shop drawings: Submit dimensioned shop drawings show locker layout at each location.

C. Samples: Submit locker manufacturer's color chips.

1.3 HANDLING

A. Procedure: In accordance with the manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: One of the following.

4. Penco Lockers.
5. Republic Steel Corp.
6. Interior Steel Equipment Co.
7. Worley Lockers.

2.2 MATERIALS AND COMPONENTS

A. Type: Manufacturer’s standard and ADA compliant, single tier clothes lockers sized _____ wide x _____ tall x _____ deep. Provide latch and locking hardware that does not require twisting, pinching or grasping to operate. Provide shelf and pole placed a few inches below the ADA maximum so that the items on the shelf can be reached.

B. Material: Mild, cold-rolled, stretcher-leveled furniture steel free of surface imperfections and capable of taking a high grade baked enamel finish.

C. Body: Manufacturer’s standard construction, as follow.

1. 24 gage back, top and bottom.
2. Tops, bottoms shall be flanged on all sides; backs flanged on 2 sides.
3. Upright shall be offset at the front and flanged at the rear to provide a double lapped rear corner.
4. Bolts and nuts shall be zinc-plated.

D. Doors:

1. 18 gage steel (minimum) flanged on all sides for stiffness and reinforced as required to prevent racking and deformation.
2. Provide stamped louvers at the top and bottom of each door.

E. Hinges:

1. 2 in. high, 5-knuckle, full loop type, welded, or attached with tamper-proof fasteners, to both locker frame and door.
2. Provide 2 hinges for each door.
3. Hinge doors in the direction shown on the Drawings.

F. Lock: Positive automatic pre-locking type, so that the locker may be locked while door is open, then closed without unlocking and without damaging locking mechanism. Lock shall not require twisting, pinching or grasping to operate.

G. Latching:

1. Provide latch hardware that does not require twisting, pinching, or grasping to operate.
2. One-piece, pre-lubricated, self-contained spring steel latch, completely contained within the lock bar under tension to provide rattle-free operation and latching at 2 points in the frame.
3. The lock bar shall be of pre-painted, double-channel steel construction held laterally in the door channel by non-removable self-formed retainers, pierced from the door.
4. Provide provision for padlocking.

H. Handle: Sturdy zinc die cast material.

1. Attached fixed case to the door with screws or bolts and a shock absorbing stud.
2. The case must fully shield the lifting trigger from below.
3. The lifting trigger shall have 2 right angle lugs that insert into the lock bar.
4. Equip lifting trigger shall with rubber silencers at top and bottom to prevent metal- to-metal contact.
5. Make Padlock attachment through 3/8 in. diameter hole position.

I. Number Plate:

1. Polished aluminum plate with black numerals not less than ½ in. high.
2. Number as directed by the District.

3. Attach plates to exterior of doors with pop rivets.

2.3 FABRICATION

A. Fabricate components straight, clean cut and free from dents, scratches, oil-canning, pitting, seam marks, roller marks, trade names and roughness and other defects.

B. Remove blemishes by grinding before cleaning, treating and applying specified finishes.

C. Provide necessary cut-outs and reinforcement for hardware.

D. Finishing:

1. Hardware: Heavy chrome-plating with a mirror finish (US 26), and polished aluminum for number plates.

2. All other Ferrous Surfaces: Clean, phosphatize and seal, apply enamel finish coat and bake under controlled conditions. Color shall be one of the manufacturer's standards with a 55 to 60 sheen, as selected by the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers plumb, level and secure in compliance with their manufacturer's recommendations and Building Code seismic regulations. Conceal fasteners wherever possible.

B. Install trim to provide flush, hairline joints against adjacent construction. Adjust doors and hardware to operate freely without binding.

C. Touch-up minor damage, or replace damaged parts. Replace lockers damaged beyond satisfactory field repair, as determined by the Architect, at no cost to the District.

END OF SECTION

SECTION 10-51-53

LOCKER ROOM LOCKERS, BENCHES, CUBBIES

PART 1 – GENERAL

1.1 SECTION INCLUDES
- A. Phenolic lockers, hardware and accessories.
- B. Phenolic pedestal benches.
- C. Phenolic cubbies.

1.2 RELATED SECTIONS
- A. Section 06 10 00 - Rough Carpentry.
- B. Section 09 21 16.33 - Gypsum Board Area Separation Wall Assemblies.

1.3 REFERENCES
- A. ASTM International (ASTM):
  1. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
  2. ASTM D 790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  3. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Material.
- B. EN 438-2 - High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 2: Determination of properties.
- C. NEMA LD-3 - Standard Test, Chemical Resistance, Modulus of Elasticity, Shear Strength and Compression Strength.
- D. U.S. Green Building Council (USGBC), LEED Green Building Rating System for New Construction.
- E. ADA - Americans with Disabilities (ADA) Standards for Accessible Design.

1.4 SUBMITTALS
- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Detailed technical data for materials, fabrication, and installation, including anchors, hardware, fasteners, and accessories.
  2. Storage and handling requirements and recommendations.
  3. Installation instructions.
- C. Shop Drawings:
  1. Dimensioned plans detailing layout of lockers, cubbies and benches.
     a. Elevations sections, numbering, colors, details, and anchorages/ attachments to other work.
  2. Details of anchoring components and methods for project conditions.
     a. Identify components required for installation, but not supplied by locker manufacturer.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and finish.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Closeout Submittals: Provide manufacturer's executed warranty and manufacturer's maintenance instructions that include recommendations for periodic cleaning and maintenance of all components.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have been in the business of manufacturing phenolic lockers for a minimum of five years.

B. Installer Qualifications: Installers shall be certified by the manufacturer of the lockers being used on this project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's original unopened packaging in accordance with manufacturer's instructions until ready for installation.

B. Store materials indoors, protected from the elements and construction hazards.

C. Handle materials in a manner that will protect the finished product.

1.7 SEQUENCING

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

A. Field Measurements:

1. Verify dimensions for installation by field measurements prior to fabrication and indicate measurements on Shop Drawings.

2. If field measurements cannot be made without delaying the Work, establish dimensions and fabricate units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

A. Provide manufacturer's 20 year written limited warranty against breakage, corrosion, delamination and defects in workmanship and material. Warranties are to be signed by an authorized manufacturer representative.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Summit Lockers, which is located at: 138 McLeod Rd.; Columbia, SC 29203; Toll Free Tel: 888-310-7149; Tel: 803-403-8816; Fax: 877-828-2142; Email: info@summitlockers.com); Web: www.summitlockers.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

A. Physical Properties, Phenolic Lockers:
   1. Scratch Resistance per EN438-2:25: 4 or better.
   2. Impact Resistance per EN438-2:21: Indentation diameter of 0 from a height of 1800 mm.
   3. Resistance to Water Vapor per EN438-2:14: 3 or better.
   4. Screw Holding Strength: Withstand a direct pull force exceeding 500 pounds at 1/4 inch of material.
   5. Tensile Strength per ASTM D 638: Minimum 145 Mpa.
   6. Flexural Strength per ASTM D790: Minimum 82.7 Mpa.
   7. Light Resistance per NEMA 3.3: Slight effect.
   8. Cleanability per NEMA 3.4: 20.
   9. Accessibility Requirements: Comply with ADA and authorities having jurisdiction.

2.3 PHENOLIC LOCKERS

A. Provide the following configurations to the overall dimension as indicated on the Drawings.

B. Panel Material:
   1. Decorative papers impregnated with melamine resin on faces with a clear protective overcoat; integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
   2. Fire Rating: Choose One. Default is Class B. Core or panel material meeting fire Class B resistance per ASTM E84, Core or panel material meeting fire Class A resistance per ASTM E84.
   3. Standard Phenolic:
      a. Color: As determined by the Architect from manufacturer's selection of Wilsonart Colors.
   4. Solicor Phenolic:
      a. Color: As determined by the Architect from manufacturer's selection.

C. Locker Body Construction:
   1. Doors, End Panels, Filler Panels, Sloped Top, and Ancillary Panels:
      a. Material: 1/2 in (13 mm) thick solid phenolic composite material.
      b. Interior Locker Colors: Wilsonart 1573-60 Frosty White.
      c. Corners: Eased edges.
      d. Door Fastening: Blind fastening unless through bolts are requested.
      e. Panel Edges: Phenolic panel edges are black.

f. Joint Construction: Mortise and tenon. Tops, bottoms and shelves use mortised joints and are secured with mechanical fasteners.
g. Exposed Edges: Straight profile; eased edges to remove sharpness; machine polished and free from tooling imperfections.
h. Tops, Bottoms, and Intermediate Shelves: 3/8 in (9.5 mm) thick solid phenolic composite material with ventilation holes.
i. Locker Sides and Backs: 5/16 in (8 mm) thick solid phenolic composite material.
j. Wall Mounting Cleats: Minimum 1/2 in (12 mm) thick solid phenolic.

D. Ventilation
1. Vertical Ventilation: Six, 5/16 in (8 mm) diameter ventilation holes on tops, bottoms, and intermediate shelves. Three 5/16 in (8 mm) diameter ventilation holes on "Z" type intermediary shelves.
2. Horizontal ventilation: Ventilation around edge of door equal to 1.43 sq in (922.6 sq mm) of ventilation surface area per linear foot of door perimeter.
3. OPTIONAL: Additional Door Ventilation: Through door ventilation with 5/16 in (8 mm) holes drilled into a horizontal or vertical pattern. 50 or 100 percent additional ventilation.

E. Hardware:
1. Fasteners: Stainless steel.
a. Fastening: Concealed.
b. Fastening: Through bolt door.
2. Door Hinges: Concealed six knuckle butt hinge; 90 degrees stainless steel barrel hinge.
a. Two hinges: Doors up to and including 36 in (914 mm) tall.
b. Three hinges: Doors greater than 36 in (914 mm) tall.
3. Door Hinges: ADA concealed six knuckle butt hinge; 180 degrees stainless steel barrel hinge.
a. Two hinges: Doors up to and including 36 in (914 mm) tall.
b. Three hinges: Doors greater than 36 in (914 mm) tall.
4. Interior Side Hooks: Stainless steel.
a. One per opening, for openings up to 30 in (762 mm) tall.
b. Two per opening, for openings 30 in (762 mm) tall or greater.
5. Door Identification Plates: 1.75 x 6.25 in (44.5 x 159 mm) black plastic with reverse engraved numbers and surface mounted with permanent adhesive.
a. Fonts: 1/2 in (13 mm) high minimum; up to four characters.
b. Numbering Sequence: Provided by the Architect.
6. Door Locks: Choose from one of the following. Default is Stainless steel hasp bar for customer supplied padlock. Stainless steel hasp bar for customer supplied padlock, Built in combination lock, Built in key lock, Built in coin/token lock, Built in digital day use lock, Built in digital assigned use lock, Built in mechanical day use lock, Built in mechanical assigned use lock, Built in RFI lock.

F. Accessories and Options:
1. Finished Locker Top: Standard. 1573-60 Frosty White.
2. Finished Locker Top: Flat. 1/2 in (13 mm) thick. Top color to match lockers.
3. Finished Locker Top: Sloped. 1/2 in (13 mm) thick. Top color to match lockers. 20 degree rise from front to back, using an extruded aluminum channel across the front.
4. Finished Fascia: 1/2 in (13 mm) thick by 4 inch tall front fascia panel. Color to match lockers.
5. Door magnets. Latch height to keep doors closed when not locked.
6. Coat Rod: Stainless steel. Installed in locker openings greater than 30 in (762 mm) high and 18 in (457 mm) deep.
7. Adjustable Locker Base: Adjustable locker feet with 1/2 in (13 mm) solid phenolic kick plate. Color to match with lockers. Adjustable Range: 3-3/4 to 5 in (95 x 127 mm).

2.4 PHENOLIC PEDESTAL BENCHES

A. Panel Material:
1. Decorative papers impregnated with a melamine resin on faces with a clear protective overcoat and integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
2. Fire Rating: Core or panel material meeting fire Class A resistance per ASTM E84.
3. Fire Rating: Core or panel material meeting fire Class B resistance per ASTM E84.

B. Solid phenolic benches mounted on pedestals.
1. Bench (WxT): 12 x 3/4 in (305 x 19 mm) thick solid phenolic.
   a. Lengths: As indicated on the Drawings.
   b. Pedestals: Choose One. Default is Black Powder Coated Aluminum. Stainless steel, Black powder coated aluminum, Powder coated steel, Movable stainless steel (trapezoid).
2. ADA Bench:
   a. Dimensions (WxLxT): 20 x 42 x 3/4 in (508 x 1067 x 19 mm) thick solid phenolic.
   b. Dimensions (WxLxT): 24 x 48 x 3/4 in (610 x 1219 x 19 mm) thick solid phenolic.
   c. ADA Pedestals: 4, Choose One. Default is Black Powder Coated Aluminum. Stainless steel, Black powder coated aluminum, Powder coated steel,
   d. Solid phenolic back rests attached with matching brackets.

2.5 CUBBIES

A. Panel Material:

1. Decorative papers impregnated with a melamine resin on faces with a clear protective overcoat and integrally compression molded within a core consisting of solid phenolic impregnated kraft papers.
2. Fire Rating: Core or panel material meeting fire Class A resistance per ASTM E84.
3. Fire Rating: Core or panel material meeting fire Class B resistance per ASTM E84.

B. Configuration:
   a. Dimensions: As detailed on the Drawings.

C. Construction:
1. Mortised joints with mechanical fasteners. Butt joints not acceptable.
2. Tops, Bottoms, and Intermediate Shelves: 3/8 in (9.5 mm) minimum thick solid phenolic composite material.
3. Cubbie Sides and Backs: 3/8 in (9.5 mm) minimum thick solid phenolic composite material.
4. Cubbie Mounting Cleats: 3/8 in (9.5 mm) minimum thick solid phenolic.
   a. Mounting Cleats: 2, required for wall mounted installations.
5. Color: Single color available in a full range of colors from Wilsonart.
   a. Phenolic panel edges are black.
6. Exposed Edges: Straight profile; eased edges to remove sharpness; machine polished and free from tooling imperfections.

D. Hardware:
1. Interior Side hooks:
   a. Material: Stainless steel. Plastic and nylon hooks are not acceptable.
   b. Two per opening for all openings 30 in (762 mm) tall or greater.
2. Fasteners: Fasteners shall be stainless steel.

E. Accessories and Options:
1. Standard Top: Cubbie top is white body material.
2. Flat Top: Solid phenolic, color matched with cubbies and installed flat.
3. Sloped Top: Solid phenolic color matched with lockers and installed at a 20 degree rise from front to back, using an extruded aluminum channel.
4. Adjustable Base: Adjustable locker feet with matching solid phenolic kick plate. Adjustable from 3-3/4 to 5 in (95 to 127 mm).

2.6 FABRICATION

A. General: Provide factory pre-assembled units complete with all hardware and accessories listed above. Knock down units are unacceptable.
B. Slope Tops and End Panels: Provide as required to complete the installation indicated on the Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. Verify that field dimensions are in accordance with Locker Shop Drawings. Inspect walls to ensure that they are plumb and suitable for the Wall Brackets.
C. Check location of built up bases, built in framing or blocking, and wall openings to ensure that they comply with the approved Locker Shop Drawings.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals and in proper relationship with adjacent construction.
B. Install lockers rigid, straight, plumb, and level. No evidence of drilling, cutting and patching shall be visible in finished work.
C. Install all required trim, fillers, end panels, and closures per manufacturer's instructions.
D. Anchor lockers to the wall with provided anchor devices as recommended by manufacturer.
E. Attach number plates to doors as indicated on shop drawings.
F. Install sloped tops, end panels, filler strips and accessories in accordance with manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Adjust hardware according to manufacturer's written instructions for smooth operation without binding.
B. Lubricate door hinges and locks per manufacturer's instructions.

3.5 PROTECTION

A. Protect installed products until completion of project.
B. Clean all exposed surfaces of lockers and hardware and touch-up, repair or replace damaged products before Substantial Completion. Do not use abrasive cleaners.

END OF SECTION

SECTION 10 52 20

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Product Data:

1. Product data for each type of product specified.

2. For fire extinguisher cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

1.2 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain fire extinguishers and cabinets from one source from a single manufacturer.

B. Coordination: Verify that fire extinguisher cabinets are sized to accommodate fire extinguishers provided by City under separate contract of type and capacity indicated.

C. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

D. UL-Listed Products: Fire extinguishers UL-listed and bear UL “Listing Mark” for type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Manufacturers offering products that comply with specified requirements include:

1. J.L. Industries.

2.2 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet, in colors and finishes selected by Architect from manufacturer's standard, which comply with requirements of governing authorities.

2. Fill and service extinguishers to comply with requirements governing authorities and manufacturer.

3. Abbreviations indicated below identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

B. Multipurpose Dry Chemical Type: UL-rated 2-A:10-B:C,5-LB and 10-BC, 5-LB, nominal capacity.

2.3 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366, commercial quality, stretcher leveled, temper rolled.

2.4 FIRE EXTINGUISHER CABINETS

A. Construction: Manufacture's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames. Provide locks to all cabinets. Provide two (2) keys for each cabinet lock.

B. Cabinet Type: Suitable for semi-recessed or recessed mounting conditions as indicated on the drawings, of the following types:

1. Semi-Recessed: Cabinet box (tub) semi recessed in walls of sufficient depth to suit style of trim indicated. 4" max. recess into CMU where CMU wall occurs.

C. Identification: Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" applied to door. Provide lettering to comply with requirements indicated for letter style, color, size, spacing, and location or, if not otherwise indicated, as selected by the City Engineer.

1. Application Process: Silk screen. Color: Black letter.

D. Door Style: Manufacturer's standard design, with locking hardware.

1. Center-Glass Panel: Clear break glass, ASTM C 1036, Type I, Class 1, Quality q3, 1/8-inch thick.

E. Verify cabinets do not protrude farther than 4" into accessible paths of travels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated and at heights to comply with applicable regulations of governing authorities.

B. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions. Recess cabinet into stud wall. Do not increase metal stud or metal furring width to recess cabinet.

C. Maintain fire rated wall ratings at recessed cabinets.

3.2 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

3.3 DEMONSTRATION

A. Demonstrate proper installation and performance of fire extinguishers to the City Engineer and Local Fire Marshall.

END OF SECTION

SECTION 10 56 13

METAL STORAGE SHELVING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Four post shelving.
B. Case type shelving.
C. Case type cabinets.
D. Cantilevered shelving.
E. Shelving accessories.

1.02 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Four Post Shelving:
1. Hallowell; _____: www.hallowell-list.com/#sle .
2. List Industries, Inc; _____: www.listindustries.com/#sle .
3. Montel; SmartShelf: www.montel.com/#sle .
4. Penco Products, Inc; _____: www.pencoproducts.com/#sle .
5. SpaceSaver Corporation; _____: www.spacesaver.com/#sle .
6. Tennsco Storage; Z-Line Shelving: www.tennsco.com/#sle .

B. Case Type Shelving and Cabinets:
1. List Industries, Inc; Case Shelving: www.listindustries.com/#sle .
2. Penco Products, Inc; _____: www.pencoproducts.com/#sle .
3. SpaceSaver Corporation; _____: www.spacesaver.com/#sle .
4. Tennsco Storage; Q-Line Shelving: www.tennsco.com/#sle .

C. Cantilevered Shelving:
1. Montel; Aetnastak: www.montel.com/#sle.
2. SpaceSaver Corporation; _____: www.spacesaver.com/#sle .
3. Tennsco Storage; Estey Designer Series Library Shelving: www.tennsco.com/#sle

2.02 SHELVING - GENERAL

A. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
1. Provide hardware of type recommended by manufacturer for substrate.

2.03 FOUR POST SHELVING

A. Four Post Shelving: Steel post-and-beam type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
   1. Unit Width: 24 inches (610 mm), center to center of posts.
   2. Shelf Capacity: Uniform distributed load of 50 psf (2.4 kPa), minimum.
   3. Finish: Baked enamel, medium gloss.

B. Posts and Beams: Formed sheet members; perforations exposed on face of members are not acceptable.
   1. Metal Thickness: 16 gage, 0.0598 inch (1.52 mm).
   2. Post Shape: Tee intermediate posts, angle end posts forming corners.
   3. Post Face Width: 2 inches (51 mm), maximum.
   4. Connecting Hardware: Manufacturer's standard.

C. Bracing: Formed sheet members.
   1. Back Sway Bracing: Either strap or panel; at back of each unit.
   2. Side Sway Bracing: Either strap or panel; at each side of each unit.
   3. Strap Sway Bracing: One strap installed diagonally, 16 gage, 0.0598 inch (1.52 mm); welded, riveted, or bolted to uprights.
   4. Panel Sway Bracing: Formed sheet metal panels, 20 gage, 0.0359 inch (0.91 mm); welded, riveted, or bolted to uprights.

D. Shelves: Formed sheet, finished on all surfaces, with slots for dividers.
   1. Metal Thickness: 16 gage, 0.0598 inch (1.52 mm).
   2. Shelf Connection to Posts: Manufacturer's standard.

2.04 CASE TYPE SHELVING AND CABINETS

A. Case Construction: Formed sheet metal comprising vertical support members and enclosure panels.
   1. Shelf Support Members: 16 gage, 0.0598 inch (1.52 mm), minimum; manufacturer's standard profile.
   2. Face Width of Exposed Vertical Supports: 2 inches (51 mm), maximum.
   3. Panels: 24 gage, 0.0239 inch (0.61 mm), minimum.
   4. Connecting Hardware: Manufacturer's standard.

B. Shelves: Formed sheet metal, finished on all surfaces with slots for dividers.
   1. Thickness: 16 gage, 0.0598 inch (1.52 mm), minimum.
   2. Shelf Edge Profile: Extending 3/4 inch (19 mm), maximum, below top surface of shelf.
   3. Shelf Connection to Posts: Manufacturer's standard.

C. Cabinet Doors: Manufacturer's standard welded steel.
   1. Style: Solid panel.

2.05 CANTILEVERED SHELVING

A. Cantilevered Shelving: Freestanding formed steel post frame with slots for cantilevered shelving brackets, sufficiently rigid not to require sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
   1. Unit Width: 24 inches (610 mm), center to center of posts.
   2. Shelf Capacity: Uniform distributed load of 50 psf (2.4 kPa), minimum.
   3. Adjustability of Shelving: At intervals of 1 inches (25 mm) on center, minimum.
   4. Finish: Baked enamel, medium gloss.

B. Frame: Formed steel members comprising posts, horizontal spreaders at top and bottom, and base brackets resisting overturning; frame configuration providing full face height and width available for adjustable shelves.
   1. Sheet Metal Thickness: 16 gage, 0.0598 inch (1.52 mm), minimum.
   2. Base Brackets Height from Floor: 9 inches (229 mm), maximum.
   3. Connecting Hardware: Manufacturer's standard.
   4. Provide manufacturer's standard adjustable leveling devices.

C. Shelf Brackets: Combination shelf support and bookend, formed steel; full depth of shelves and minimum 6 inches (150 mm) height above shelf surface; rounded outer edges and corners for safety.
   1. Thickness: 16 gage, 0.0598 inch (1.52 mm), minimum.
   2. Connection to Posts: Two hooks at top, safety lug at bottom.

D. Shelves: Formed steel, finished on all surfaces.
   1. Thickness: 18 gage, 0.0478 inch (1.21 mm), minimum.
   2. Bottom Shelf Edge Profile: 1 inch (25 mm) with integral kickplate.
   3. Upper Shelves Edge Profile: Extending 3/4 inch (19 mm), maximum, below top surface of shelf.
   4. Shelf Connections: Tab interlock with brackets; positive bolt connection between shelf and bracket.

END OF SECTION

SECTION 10 56 29 16

PALLET STORAGE RACKS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Pallet storage racks.

B. Pallet decking.

1.02 RELATED REQUIREMENTS

A. Section 01 74 19 - Construction Waste Management and Disposal.

B. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

1.03 DEFINITIONS

A. Industrial Pallet Rack: Single or multi-level structural storage system used to support high stacking of single items or palletized loads. Configured to allow rapid access to stored or mounted materials.

B. Upright Frame: Columns, and bracing members between the columns.

C. Pallet Beam: Front and back shelf members that bear the weight of the load and transfer it to upright frames.

D. Pallet: A flat transport structure that supports goods in a stable fashion while being lifted by a forklift, pallet jack, front loader, work saver, or other jacking device, or a crane.

1.04 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

B. ANSI MH16.1 - Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks; 2012.

C. ANSI MH26.2 - Specification for the Design, Testing And Utilization of Welded Wire Rack Decking; 2017.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018a.
K. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
M. FM (AG) - FM Approval Guide; current edition.
N. ITS (DIR) - Directory of Listed Products; current edition.
O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
P. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
Q. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a one year period after Date of Substantial Completion.
1. Failures include, but are not limited to, the following:
a. Deterioration of metals, metal finishes, and other materials beyond normal wear.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Steel King Industries, Inc; _____: www.steelking.com/#sle .
B. Unarco Material Handling, Inc; _____: www.unarcorack.com/#sle .
C. Source Limitations: Obtain storage racks, including shelving, from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in California to design storage systems.
B. Structural Performance: Provide pallet systems capable of safely supporting loads as indicated below.
1. Design in compliance with applicable requirements of 2015 IBC, including any amendments made by California.
C. Seismic Performance: Pallet systems designed to withstand the effects of earthquake motions determined according to ASCE 7.
D. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
E. Safety and Loading Performance: Comply with requirements of ANSI MH16.1.
F. Welded Wire Decking Performance: Comply with requirements of ANSI MH26.2.
G. Contractor to obtain DSA approval without delaying to the project.

2.03 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard storage shelving systems and components.
B. Where components are not explicitly indicated, provide manufacturer's standard components as required for a complete system.

2.04 PALLET RACK TYPES

A. Single-Face Rack: One continuous row of units joined together and side-to-side, positioned along a wall, to be serviced by one service aisle, single-deep.
B. Double-Face Rack: One continuous row of units joined together and side-to-side, to be serviced from either front or back by two service aisles, single-deep.
C. Pushback Rack: One continuous row of units joined together and side-to-side, to be serviced by one service aisle, two pallets deep.

2.05 STEEL PALLET RACKS

A. Pallet Racks: Rack system consisting of upright frames, and beams with integral locking devices for bolted connection to frame columns.
    1. Roll-formed Columns: Bolted-beams application steel open-tube shape, 3 inches (76 mm) wide by 1-5/8 inches (41 mm) front-to-back, gage as determined by structural design calculations.
        a. Tapered keyholes on column sides, on 2 inch (51 mm) centers.
    2. Structural Columns: Bolted-beams application steel channel complying with ASTM A36/A36M; 3 inch (76 mm) nominal depth; weight-per-foot as required by structural design calculations.
        a. Connection holes on column face, on 2 inch (51 mm) centers for bolts and nuts complying with ASTM F3125/F3125M.
    3. Structural Columns: Bolted-beams application hollow structural steel tube complying with ASTM A500/A500M; 3 inch by 3 inch by 1/4 inch thick (76 mm by 76 mm by 6 mm thick) nominal minimum size; subject to structural design calculations.
        a. Connection holes on column face, on 2 inch (51 mm) centers for bolts and nuts complying with ASTM F3125/F3125M.
    4. Pallet Beams:
        a. Steel Structural Channel Beams: Manufacturer's standard, with fully-welded end-plates; size selected to safely carry design loads.
        b. Steel Step Beams: Manufacturer's standard, unslotted-style, continuously-welded tubing, with fully-welded end-plates; size and gage selected to safely carry design loads.
        c. Beam Locking Devices: Manufacturer's standard pins, bolts or other mechanisms that resist disengagement of beam from its supports.
    5. Bases: Manufacturer's standard-duty seismic bases; fully-welded to columns in compliance with requirements of AWS D1.1/D1.1M; size and thickness as required by loads.

6. Horizontal and Diagonal Bracing: Manufacturer's standard, sized and configured to provide required stability and minimize sway, selection of members determined by structural design calculations.

B. Storage Positions:
   1. Number of Aisles and Storage Lanes: As indicated on drawings.
   2. Maximum Loading:
   3. Decking: Welded-wire fabric; 6 gage wire diameter, 2-1/2 inch by 4 inch (64 mm by 102 mm) wire spacing. Manufactured in compliance with ANSI MH26.2 requirements.
   4. Pushback Cart System: Manufacturer's standard telescoped cart system designed for 'Last-in, First-out' picking.
      a. Inclined (3 percent) track rails, with lift-out prevention guides.
      b. Multi-Purpose Push Plates: One per loading lane. Designed to act as height gage, end stop, and full-lane indicator. Fastened to the frontmost cart.
      c. Nested Carts: Four-sided, rigid-box, heavy-duty construction.
      d. Guide Rail Support Beams: Angle- or tube-shaped. Front, intermediate and rear beams, as required for depth of system.

2.06 ACCESSORIES

A. Column Protector Guards: Manufacturer's standard, independently-mounted.
   1. Color: Safety Yellow, complying with requirements of 29 CFR 1910, Subpart J, Standard 1910.144(a)(3).

B. End-Aisle Protector Assembly: Manufacturer's standard.
   1. Color: Safety Yellow, complying with requirements of 29 CFR 1910, Subpart J, Standard 1910.144(a)(3).

C. Rack Safety Panels and Security Enclosure:
   1. Material: 6 gage, 0.192 inch (4.9 mm) steel welded wire mesh with 2 inch (50 mm) square openings; welded to steel framing members.
   2. Panel Sizes: As indicated on drawings.
   3. Panel Finish: Manufacturer's standard powder coat finish.
      a. Color: Black.
   4. Brackets: Manufacturer's standard steel bracket of shape and size for flush mounting wire mesh panels to pallet rack uprights.
   5. Panel Doors: Bi-parting hinged doors of same material as panels with pivot brackets for mounting to pallet rack uprights and padlock hasps for locking doors where they meet in the center.
   6. Products:
      a. Spaceguard Products; BeastWire Rack Safety Panels: www.spaceguardproducts.com/#sle .

D. Wall Ties: Welded or bolted, manufacturer's standard.

E. Row Spacers: Welded or bolted, manufacturer's standard.

F. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M.
   2. Anchors: Toggle bolt type for anchorage to hollow masonry.
   3. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
   4. Anchors: Bolt or ballistic fastener for anchorages to steel.

2.07 MATERIALS

A. Steel Sections and Plates: ASTM A36/A36M.
B. Steel Tubing: ASTM A500/A500M tubing.
C. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.08 FINISHES - STEEL

A. Galvanizing of Framing Items: Galvanize after fabrication to ASTM A123/A123M requirements.
B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard two-coat finish consisting of prime coat applied as per SSPC-Paint 15 or SSPC-Paint 20 requirements, and a thermosetting topcoat to achieve a minimum dry film thickness of 2 mils, 0.002 inch (0.05 mm).
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
D. Color and Gloss: As selected by Architect from manufacturer's full range.

END OF SECTION

SECTION 10 81 00

BIRD CONTROL DEVICES

PART 1 – GENERAL

1.1 SECTION includes Bird Control Spikes, Post and Wire Bird Deterrents, Bird Exclusion Netting, Electric Track Bird Deterrent, Surface Cleaners and Disinfectants.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum of 10 years' experience manufacturing bird control devices.

B. Installer Qualifications: Installer must be completely familiar with the proper installation procedures for bird control devices specified.

1.3 WARRANTY

A. Bird Barrier Spikes: Provide with a 20 year limited warranty.

B. K-Net Bird Netting: Provide with a 10 year limited warranty.

C. FliteLine Post & Wire: Provide with a 1 year limited warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Specified Manufacturer, for purposes of establishing general quality: Nixalite Architectural Bird Control.

B. Other manufacturers are acceptable on an equivalent basis.

2.2 BIRD SPIKES

A. Nixalite Premium All Stainless Steel Barrier Spikes:

1. Material:
   a. Wires: Stainless steel, 0.041 inch (1 mm) diameter, full-hard spring temper, 250,000 lbs. / in. (44,645 kg/cm) tensile strength.
   b. Base Strip: Stainless steel, 0.25 inch wide by 0.02 inch thick (6.3 mm by 0.5 mm), full anneal for flexibility, easy strip cutting and surface shape memory.
2. Strip Lengths: All Nixalite Premium Models are available in 24 inch (610 mm) and 48 inch (1220 mm) strip lengths.
3. Premium Model S: 4 inches high (102 mm), 4 inches wide (102 mm) with no less than 120 wire points per foot. Full 180-degree wire coverage. For all bird species on all types of surfaces. Use with Premium Model W Nixalite as a barrier to climbing animals and Mud Nest building birds.
4. Premium Model H: 4 inches high (102 mm), 2 inches wide (51 mm) with no less than 60 wire points per foot, 90 degree wire coverage. For surfaces less than 2

inches in depth (51 mm). Use with Premium Model S on wider surfaces to achieve proper surface coverage.

5. Premium Model W: 5-1/2 inches high (140 mm), 3 inches wide (76 mm) with no less than 120 wires per foot, 180-degree wire coverage. Wall mount model for vertical surfaces only, not for horizontal applications. Use above surfaces less than 2 inches in depth (51 mm) or over other Nixalite Models when specified. Use with Premium Model S as a barrier to climbing animals and Mud Nest building birds.
6. Premium Spikes Soft Tip Option: Available for Nixalite Premium Models S and H. Soft Tip models are the same as standard pointed wire models with the exception of flat tipped wires.
7. Natural stainless steel finish.
8. ColorCoat finish: standard color as selected by the designer.

B. Mounting Hardware: Hardware for Premium Nixalite or E-Spike Economy Spikes

1. Fabricated of stainless steel or non-corrosive materials.
2. Provide bird spike mounting hardware to allow for strip removal and reinstallation without causing damage to the installation surface, the strips or mounting system.
3. Provide bird spike mounting hardware that best suits the installation surface.
   a. Masonry, stone, concrete, etc.: Mounting clip, screw and drop-in anchor.
   b. Wood, plywood, shingles, etc.: Mounting clip, screw and washer
   c. Sheet metal, plastic, PVC, etc.: Mounting clip, screw and washer.
   d. Steel, cast iron, bronze, etc.: Mounting clip, drive screw and washer.
   e. Pipes, cables, conduit, etc.: Wire tie, wire tying tool, adhesive.
4. Optional Fastening for Premium Nixalite Spikes and E-Spike Economy Spikes
   a. Glue Clips and Adhesive: If surface conditions do not allow for the use of the supplied mounting hardware, use the Glue Clip and Adhesive installation method. Follow the Glue Clip installation instructions from manufacturer. Follow the adhesive surface preparation procedures provided on the adhesive packaging or literature.

2.3 POST AND WIRE BIRD DETERRENT

A. Post and Wire Bird Deterrent: FliteLine Post & Wire Bird Deterrent components are constructed of either high-grade stainless steel or non-corrosive materials.

B. System Components:

1. Posts:
   a. FliteLine Post with Nail Point: All stainless steel post with 2 line capacity. Use nail point posts for masonry and wood surfaces. Masonry application requires nylon anchors. Masonry application require appropriate drop in anchor.
      1) Height: 4-1/2 inches (115 mm).

2) Height: 6 inches (153 mm).

b. FliteLine Post with Base: All stainless steel posts with 2 line capacity welded to a stainless steel base. Base provides 4 mounting holes for the appropriate mechanical fasteners. Use on all installation surfaces. Match hardware to surface material.
   1) Height: 3-1/2 inches (89 mm).
   2) Height: 5 inches (127 mm).

c. FliteLine Post with Rail Clamps: All stainless steel posts with 1 line capacity welded to stainless steel hose clamps of varying sizes. Attaches to round rails, pipes, cables and other suspended objects.
   1) FliteLine Post on Rail Clamp 5/8 inch to 1 inch (1.6 cm to 2.5 cm) diameter.
   2) FliteLine Post on Rail Clamp 1 inch to 2 inches (2.5 cm to 5.0 cm) diameter.
   3) FliteLine Post on Rail Clamp 2 inches to 3 inches (5.0 cm to 7.6 cm) diameter
   4) 2 FliteLine Posts on Rail Clamp 3 inches to 4 inches (7.6 cm to 10.1 cm) diameter.
   5) FliteLine Post on Rail Clamp 5 inches to 6 inches (12.7 cm to 15.2 cm) diameter.

2. FliteLine Post with Horizontal Clamp: All stainless steel, 2 line capacity post welded to an all stainless steel saw-tooth clamp that fits over edges and objects up to 3/4 inch (1.9 cm) thick.
3. FliteLine Post with Vertical Clamp: All stainless steel, 1 line capacity post welded to an all stainless steel saw toothed clamp that fits over edges and objects up to 3/4 inch (1.9 cm) thick.
4. FliteLine Post with Hammer-On Flange: All stainless steel, 1 line capacity post welded to an all stainless steel hammer-on flange clip that fits flanges up to 1/4 inch (0.6 cm) thick.
5. Flite Cable: UV resistant poly-jacket over a 1x7 stainless steel aircraft cable 1/32 inch (0.8 mm) diameter, 110 lb. (50 kg) breaking strength. Available in 100 foot (30.5 m), 300 foot (91.4 m) and 600 foot (182.8 m) spools.
6. Flite Springs: 1/4 inch by 1/2 inch (6 mm by 12 mm) all stainless steel tension springs. Use 1 Flite Spring for every 10 running feet (3 meters) of Flite Cable.
7. Flite Ferrules: Nickel plated copper ferrules for quick and easy cable connections.

C. Mounting Hardware:
1. Fabricated of stainless steel or non-corrosive materials.
2. Provide appropriate mechanical fasteners to secure the FliteLine Posts to the installation surface.
3. Use the hardware system recommended by the manufacturer.

2.4 BIRD NETTING

A. K-Net HT Bird Netting System: K-Net HT Bird Netting is constructed of black high density polyethylene (HDPE) that is abrasion, flame, rot and UV resistant. K-Net HT uses a 3/4 inch (19 mm) square mesh to keep out all but the smallest of pest birds.

1. Netting Material: Black, high density polyethylene (HDPE) that is abrasion, UV, flame and rot resistant. Netting to be water proof. Meets ISO 9001 2000 Quality Management Standards.
    a. Construction: Knotted 3/4 inch (19 mm) square mesh netting. Netting comprised of 380 denier, 12 ply (4x3) strands with 75 pound (33.9kg) knotted breaking strength (KBS). Seamless full size mesh runs.
        1) Colors:
            a) Black
            b) Stone (Tan)
    b. Mesh size: 3/4 inch (19 mm) square, steam set knots.
    c. Netting Sizes:
        1) Widths: 25 feet (7.6 m) and 50 feet (15.2 m).
        2) Lengths: 25 feet (7.6 m) and 50 feet (15.2 m) and 100 feet (30.4 m).
    d. Thermal and Physical Properties:
        1) Softening point: 250 degrees F (122 degrees C).
        2) Melting point: 293 degrees F (145 degrees C).
        3) Flash point: 660 degrees F (349 degrees C).
        4) Remains flexible at very low temperatures.
        5) Specific gravity: 0.96 (it floats) - will not absorb water.
        6) Chemically inert. Resistant to acids and alkalis at room temperature.
2. Tensioned Cable Hardware:
    a. Connection hardware:
        1) Net Cable: Stainless steel, 7x7, 49 strand, 3/32 inch (2.2 mm) diameter aircraft cable with 900 pound (407 kg) breaking strength. Available in 250 foot (76.2 m) and 500 foot (152.4 m) spool lengths. Hardware spacing determines maximum cable run lengths.
        2) Turnbuckles: Stainless steel, hook and eye turnbuckles.
            a) Small: Maximum cable run: 25 feet (7.6 m).
            b) Medium: Maximum cable run: 50 feet (15.2 m).
            c) Large: Maximum cable run: 75 feet (22.9 m).
        3) Ferrules: Zinc plated copper ferrules for 3/32 inch (2.2 mm) cable. Acceptable connection for cable runs up to 25 feet (7.6 m) maximum. Always use 2 ferrules per connection. Always use in conjunction with Cable Thimble.
        4) Wire Rope Clamps: Galvanized or stainless steel for 3/32 inch (2.2 mm) diameter cable. Recommended connection for all cable runs. Mandatory connection for cable runs over 25 feet (7.6 m). Always use a

minimum of 2 clamps per connection. Always use in conjunction with Cable Thimble.

5) Cable Thimble: Stainless steel cable thimble for 3/32 inch (2.2 mm) diameter cable. Prevents cable fraying and creasing when tensioning cable system.

b. Cable Anchoring Hardware:
   1) Eyebolts: for steel, iron, and heavy gauge sheet metal. Extreme duty stainless steel eyebolt, 2 inches (51 mm) long, 9/16 inch I.D. (14.2 mm) with 1/4-20 stainless steel hex nut. Maximum spacing between eyebolts: 50 foot (15.2 m).
   2) Screw Eyes: for wood beams, heavy to medium gauge sheet metal and wood core surfaces. Extreme duty stainless steel screw eyes 2 inches (51 mm) long, 17/32 inch I.D. (13.5 mm). Pilot holes recommended for all surfaces. Maximum spacing between screw eyes: 50 foot (15.2 m).
   3) Eyebolts and Machine Screw Anchors: for concrete, stone, masonry block, brick and pre-cast surfaces. Eyebolt specs are same as above.
   4) Machine Screw Anchor: Zinc plated anchor, 1/2 inch (12.7 mm) diameter by 1 inch (25.4 mm) deep with 1/4-20 threads inside. Setting tool included with anchors.
c. Cable Guide Hardware:
   1) Small Screw Eyes: For wood, medium/light gauge sheet metal and wood core surfaces. Heavy duty, stainless steel, 1-3/16 inches long by 7/32 inch I.D. (31 mm long by 5.3 mm I.D.). Maximum spacing: 24 inches (610 mm) O.C.
   2) Small Eyebolts: For steel, iron, and heavy gauge sheet metal. Heavy duty, stainless steel, 1 3/8 inches long by 9/32 inch I.D. (35 mm long by 7.1 mm I.D.). Maximum spacing: 24 inches (610 mm) O.C.
   3) Sidewinders: For heavy gauge sheet metal, structural steel up to 1/2 inch (12.7 mm) thick and solid concrete surfaces. Sidewinders for steel are self-drill, self-tap items, no pilot required. Sidewinder for concrete requires pilot hole. Maximum spacing: 24 inches (610 mm) O.C. Sidewinders require the Driver Socket.
   4) Hammer-on Flange Clips: Black oxide finish spring steel hammer on flanges to guide Net Cable along outside flange edges of structural steel. Can fit over flanges up to 3/4 inch (19 mm) thick.
   5) Cable Guide Clamps and Brackets: Variety of stainless steel or weather resistant steel brackets, angles, J-brackets and clamps all designed to keep the Net Cable close to the installation surface.
d. Finishing Hardware:
   1) Net Rings: attaches the net mesh to the cables, closes seams, and fastens the Net Zippers to the bird netting mesh. There are manually operated Net Ring Tools and Air powered Net Ring Tools.

2) Net ring quantity requirements per attachment:
   a) Netting to cable: 1 Net Ring per mesh.
   b) Lapped seams: 1 Net Ring per mesh at both sides of seam.
   c) Zipper Installation: 1 Net Ring per mesh at both sides of zipper.
3) Poly Clip: can be used in place of Net Rings when attaching the netting to the cable system. Made from UV stabilized black polypropylene. Maximum spacing: 12 inches (305 mm) O.C.
4) Net Zipper: Allows for access to areas behind the bird netting installation. Available in black or stone (tan) color. Available in 24 inch (610 mm), 48 inch (1220 mm), 72 inch (1830 mm) and 96 inch (2440 mm) lengths. Heavy duty, marine-grade zipper with 3/4 inch (19 mm) fabric tape, open top and auto lock slider.

3. Poly Hardware: All poly hardware is made from UV stabilized black polypropylene. Hardware combinations can be mixed to suit changing surface materials and conditions. For best results, use the Poly Hardware with the PollyNet Bird Netting.
   a. Poly Clip: Perimeter fastening. Secure to perimeter with hardware recommended by manufacturer. Maximum spacing: 12 inches (305 mm) O.C.
   b. Twist Locks: Seam fastening. Twist Locks join two overlapped pieces of netting together at a seam. Maximum spacing: 3 inches (76 mm) O.C.
   c. Net Ties: Multi-purpose fastener. Quickly fastens the netting fabric to all types of objects. Use to prevent netting sag or loose fitting nets by securing the netting to objects above or behind netting installation. Three sizes to choose from.
   d. Poly Cord: Multi-purpose fastener. Reinforce seams, patch tears, close circular openings, use for overhead support, etc.

2.5 ELECTRIC BIRD DETERRENT SYSTEM

A. Shock Track: UV stabilized and flexible PVC track with 2 braided stainless steel conducting strips sewn into the track with a UV stabilized bonded polyester thread. Track is cut with #ST Scissors (sold as an accessory).
   1. Width: Bird-Zap Shock Track is 1-1/2 inch (3.7 cm) wide.
   2. Thickness: 1/4 inch (0.6 cm) thick.
   3. Length: 50 foot long (15.24 m) rolls.
   4. Colors: Black, Gray and Tan.

B. Bird-Zap Track Chargers: Bird-Zap Shock Track Chargers output high voltage, low amperage, low impedance DC power.
   1. Plug-In 120 Volt AC powered Track Chargers: AC chargers positioned outside or exposed to the weather, shall be installed inside a NEMA 3R rated utility box (purchased separately). Plug all AC powered chargers into a weatherproof outlet

installed by a licensed electrician. All Plug-In chargers from Nixalite are UL approved for use in USA.

a. Model #ST AC500: Powers up to 500 feet of Bird-Zap Shock Track.
   Size/Weight: 7 inches high by 4 inches wide by 2-3/4 inches deep; 1.2 lbs.
   Output: 0.05 joule, low impedance DC power.
b. Model #ST AC1500: Powers up to 1,500 feet of Bird-Zap Shock Track.
   Size/Weight: 11 inches high by 4-3/4 inches wide by 4 inches deep; 3 lbs.
   Output: 0.30 joule, low impedance DC power.

2. Solar Powered Track Chargers: Position chargers so they receive at least 2 hours of direct sunlight every day.

a. Model #ST SC500: Powers up to 500 feet of Bird-Zap Shock Track.
   Size/Weight: 10 inches high by 6-1/2 inches wide by 9 inches deep; 5 lbs.
   Output: 0.06 joule, low impedance DC power.
b. Model #ST SC1000: Powers up to 1,000 feet* of Bird-Zap Shock Track.
   Size/Weight: 14 inches high by 8 inches wide by 4-1/2 inches deep; 9 lbs.
   Output: 0.15 joule, Ultra low impedance DC power.
c. Model #ST SC1500: Powers up to 1,500 feet of Bird-Zap Shock Track.
   Size/Weight: 14 inches high by 8 inches wide by 6-1/2 inches deep; 10 lbs.
   Output: 0.25 joule, Ultra low impedance DC power.

C. Shock Track Jumper Wire: Used to connect the Bird Zap chargers to the Bird Zap track and to join separate runs of track together. Easy to cut, strip and crimp. J

1. Wire: 14 gage, double twisted strand copper core wire with heavy insulating jacket
2. Thickness: 1/4 inch (0.6 cm) thick.
3. Length: 50 foot long (15.24 m) rolls.
4. Colors: Black, Gray and Tan.

D. Snap-Tight Quick Connectors: Designed just for Bird-Zap Shock Track applications.

1. CORNER Snap-Tight Quick Connector: 2-piece "L" shaped connector joins two ends of the Bird-Zap Track together at any outside or inside 90 degree corners. Bottom half of the connector has 3 mounting holes that will accept 1/8 inch diameter nails or screws. Connectors can also be glued to the surface. Snap halves together over trimmed track.
2. STRAIGHT Snap-Tight Quick Connector: 2-piece connector quickly joins two ends of the Bird-Zap Track together in a row, passing power from one track to the next. Bottom half has 2 mounting holes that will accept 1/8 inch diameter nails or screws. Top half provides 2 electrical connection points that can be used to pass power to adjacent runs of track or connect the track to the charger.
3. LOCK DOWN Snap-Tight Quick Connector: 2-piece connector uses either nails or screws to hold the Bird-Zap Track to the installation surface. Each bottom half has 2 mounting holes that will accept 1/8 inch diameter nails or screws. The Bird-Zap Track runs over the installed bottom half of the connector and the top

half is snapped into place. Install every 1 to 2 feet along the run of the Bird-Zap Track.

E. Crimp Style Connectors: Weather resistant crush-style connectors for track-to-track and track-to-charger electrical connections.

F. Mounting Systems: Track can be fastened to the all types of installation surface materials with an adhesive or with any of the Snap-Tight Quick Connectors that provide mounting holes for mechanical hardware.

1. Adhesive Fastening: Follow the surface preparation steps provided on the adhesive container. Make sure the leave gaps in the beads of adhesive to allow for water drainage under the track.
2. Mechanical Fastening: Use any of the Snap-Tight Quick Connectors. The bottom half of these connectors provide 2 or 3 holes for mounting hardware. Use the hardware that best suits the installation surface.

PART 3 – EXECUTION

3.4 INSTALLATION BIRD SPIKES

A. Install in accordance with manufacturer's instructions.

B. Install specified bird control equipment in strict accordance with manufacturer's strip spacing and installation guidelines. Protect all surfaces.

C. Protect the entire surface, not just the outside edges. Install bird barrier strip with no gaps in coverage. Cut strips where necessary to fit the surface properly.

D. Wires of All Stainless Steel Premium Bird Spike Models to extend over outside edge or edges of a surface by at least 1/4 inch (0.6 cm). The Base Strip of the Premium Bird Spike must extend over any open ends of the surface by at least 1/2 inch (12 mm).

E. Fasten bird control strips to the surface with the mounting hardware recommended by the manufacturer. Follow hardware spacing guidelines and installation procedures supplied by manufacturer.

3.5 INSTALLATION POST AND WIRE BIRD DETERRENT

A. Install the FliteLine Post & Wire Bird Deterrent System as recommended by the manufacturer, strictly following the FliteLine row spacing and installation guidelines provided by the manufacturer.

B. Space and install guide posts per manufacturers spacing guidelines. Use the recommended combinations of guide post heights and multiple cable runs as recommended by manufacturer.

C. Row Spacing:

1. Maximum space between FliteLine rows: 3 inches (76 mm).
2. Maximum space from all edges and walls: 1 inches (25 mm).

D. Post Spacing:

1. FliteLine is installed in 10 feet (3 m) maximum length sections. Each section consists of 2 anchor posts (at each end) and 1 guide post (in the middle). If running continuous sections (end-to-end), the last anchor post in a section will serve as the first anchor post of the following section.
2. Maximum space between Anchor Posts: 10 feet (3 m).
3. Maximum space between Anchor Posts and Guide Posts: 5 feet (1.5 m).
4. Guide Posts are not required for sections less than 5 feet (1.5 m) long.

E. Multiple Row Installations: Alternate post heights for each row. The first row will always consist of all short posts; the next row will be all tall posts (and so on).
1. Single row installations will always be tall posts with both cables installed.
2. Install both cables at all outside edges of a FliteLine installation. This includes the "gate inch cables (closing the gate) at the ends of an installation.

F. Cable Connections: Connect Flite Cable to the anchor posts at each end of a section. One end is a simple loop connection that uses a Flite Ferrule for fastening. The cable is passed through the guide posts (if required) and then fastened the closed end of a Flite Spring using another loop connection. The open end of the Flite Spring is then hooked through the appropriate hole in the Flite Post.

3.6 INSTALLATION BIRD NETTING

A. Install the bird netting hardware as recommended by manufacturer.
B. Install perimeter and support hardware; attach bird netting to installed hardware; install access or additional support hardware as specified.
C. If necessary cut the netting to fit the area. If multiple pieces are needed, join the pieces together with the recommended seam fastening hardware.
D. Avoid contact with machinery, vehicles, extreme heat, tree branches, etc. Make necessary adjustments to keep netting a sufficient distance from these objects or conditions.
E. Finished installation to be taught, free of wrinkles, gaps and openings.

3.7 INSTALLATION OF ELECTRIC BIRD DETERRENT SYSTEM

A. Install Bird-Zap Shock Track on the surfaces specified or shown on the plans in accordance with the manufacturer's requirements..
B. Position the chosen Zap-Track Charger(s) as close to the Bird-Zap Shock Track installation as possible.
1. Plug-In chargers need to be either installed in a location protected from the weather or installed inside a NEMA 3R rated utility box for protection. If the 120 Volt AC outlets are installed in the weather, it must be a weatherproof outlet installed by a licensed electrician.

C. Follow the track spacing and quantity recommendations provided by the manufactuer. Quantity and spacing of track shall be determined by the size of the birds, the depth of surface and the number of birds in the area.

D. For small birds and/or heavy infestations of any bird species, install more rows of track, spaced closely together. For large birds, fewer rows of track will be needed. Refer to the manufacturer's Spacing Guidelines on the Bird-Zap Shock Track brochure.

E. Install the Shock Track in straight rows or make sure that the track follows the contour or shape of the surface perfectly. Verify that there are no excessive gaps or wrinkles in the Shock Track. Dry fit the track at least once before installing on the surface.

F. Fasten the Shock Track to the surface using adhesive or the appropriate Snap-Tight Quick Connectors. Follow the Installation Guidelines provided by the manufacturer.

G. Connect the Bird-Zap charger to the closest section of Shock Track with the Jumper Wire and Crimp Connectors or Snap-Tight Straight Quick Connectors. Connect each section of track together in a series circuit using the same crimps or Quick Connectors.

H. If the Bird-Zap Shock Track installation is in a location where the people might come into direct contact with the installation, install the available Warning Signs. These caution people that there is an active, high voltage bird control system in operation.

END OF SECTION

SECTION 11 12 00

PARKING CONTROL EQUIPMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Parking revenue components.
   1. Ticket dispenser.
   2. Payment terminals.
   3. Parking pay stations.

B. Parking access controls.
   1. Gate arm access control.
   2. Barrier gate access control.

C. Maintenance.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

F. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2017.

G. ITS (DIR) - Directory of Listed Products; current edition.

H. NEMA MG 1 - Motors and Generators; 2014.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

K. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. Product Data: Provide data on operating equipment, characteristics, limitations, and temperature range of operation.

B. Shop Drawings: Indicate plan layout of equipment access lanes, curbing, mounting bolt dimensions, conduit and outlet locations, power requirements, and wiring diagrams.

C. Samples: Submit two samples of access cards with illustrating size and coding method.

D. Samples: Submit two samples 6 inches (150 mm) long of preformed steel curb frame.

E. Manufacturer's Qualification Statement.

F. Installer's Qualification Statement.

G. Maintenance Contract.
H. Operation Data: Submit data for operating equipment, clock timer, changing security access code.
I. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.
J. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
K. Record Documentation: Record and submit actual locations of concealed conduit.
L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. Spare Parts: Two extra gate arm assemblies.

1.04 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.
B. Provide five year manufacturer warranty for operating equipment.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:
B. Other Acceptable Manufacturers - Parking Control Equipment:
    1. Access Control Systems, LLC (ACS); _____: www.acs-llc.com/#sle .
    2. Canadian Parking Equipment Inc; _____: www.cpeape.com/#sle .
    3. Falcon Eye Global Security, LLC; _____: www.falconeyeglobal.com/#sle .
    4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESCRIPTION

A. Parking Control System: Automatic operation at entrance and automatic operation at exit.
B. Provide protection against interference or damage by lightning or other electrical influences; include fuse, over-voltage protection, flash-over protection, and line filter.
C. Entry: Automatic parking access control system is activated upon insertion of coded card.
D. Exit: Automatic parking access control system is activated upon insertion of paid or validated ticket.

2.03 REGULATORY REQUIREMENTS

A. Comply with applicable code and requirements of authorities having jurisdiction for emergency vehicle access.

B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

2.04 PARKING REVENUE MANAGEMENT SYSTEM

A. Parking Revenue Management System: Provide complete operating system and necessary hardware in compliance with parking control system and equipment requirements.
   1. Parking Entry - Ticket Dispensers: Provide entry terminal ticket dispensers that consist of printing and issuing mechanisms, with controls mounted within protective dispenser cabinet enclosures.
   2. Parking Exit - Payment Terminals: Provide exit terminal payment dispensers that consist of ticket collectors and readers, with controls mounted within protective dispenser cabinet enclosures.
   3. Parking Pay Stations: Provide self-contained, pay stations designed for self-service operations, and consisting of ticket readers/validators, with controls mounted within protective dispenser cabinet enclosures.
      a. Location: As indicated on Drawings.

B. Basis of Payment: Coins, Dollar bills, Credit card, Debit card, or Token acceptance.

2.05 PARKING REVENUE COMPONENTS

A. Ticket Dispenser: Activated by manual push button, and ticket presented to user without opening car door or touching metal part of ticket dispenser.
   1. Cabinets: Steel cladding, at least 14 gage, 0.075 inch (1.9 mm) thick, with weather-tight seams and gaskets; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.
      a. Finish: Baked enamel on steel, color as selected by Architect.
   2. Capacity: Minimum of 5,000 tickets, with low ticket indicator light and automatic shut down when empty.
   3. Time Recorder: 24 hour readout.
   4. Provide self-contained, plug-in, and easily replaceable controller units.
   5. Imprint and punch ticket with dispenser number, indicating "In" time and date, and provide printed "Please Take Ticket" sign at visible location.
   6. Provide audible signal bell when ticket is dispensed and stops when ticket is removed from slot in dispenser unit.
   7. Provide ticket dispenser with thermal circuit breaker, on/off switch, grounded convenience outlet, battery back-up, and thermostatically controlled electric heater rated at a minimum of 250 watts.

B. Payment Terminals: Activated by manual push button.

1. Cabinets: Steel cladding, at least 14 gage, 0.075 inch (1.9 mm) thick, with weather-tight seams and gaskets; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.
    a. Finish: Baked enamel on steel, color as selected by Architect.
2. Provide self-contained, plug-in, and easily replaceable controller units.
3. Magnetically decode ticket for time, date and calculated cost, and provide electronic display of parking fee at visible location.

C. Parking Pay Stations: Activated by manual push button.

1. Cabinets: Steel cladding, at least 14 gage, 0.075 inch (1.9 mm) thick, with weather-tight seams and gaskets; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.
    a. Finish: Baked enamel on steel, color as selected by Architect.
2. Provide self-contained, plug-in, and easily replaceable controller units.
3. Magnetically decode ticket for time, date and calculated cost, and provide electronic display of parking fee at visible location.

2.06 PARKING ACCESS COMPONENTS

A. Gate Arm - Access Control: Provide equipment listed and labeled in compliance with UL 325 safety standards of gate operators.

1. Classification: Class I - Residential, vehicular gate operator with gate arm access control complying with UL 325.
2. Controls: Mechanism in compliance with UL 325 safety standards of gate operators, with cadmium coated steel components to raise and lower arm by instant reversing electric motor, enclosed speed reducer operated by self-contained, plug-in replaceable controller with slip clutch to prevent breakage if arm is forced, and to permit manual operation and arm movement to stop and start at reduced speed if required.
    a. Activate automatic arm reversing switch if an obstacle is sensed when in downward motion.
    b. Maintain gate arm in raised position until vehicle clears control area.
3. Control Cabinet: Steel, at least 14 gage, 0.075 inch (1.9 mm) thick, with weather-tight seams and gaskets; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.

4. Gate Arm: Wood, 3/4 by 3-1/2 inch (19 by 89 mm), one piece, with internal counterbalance, rubber bottom safety edge, automatic arm reversing switch, and _____; with _____ ft (_____ mm) extension and break line in arm.
5. Gate Arm, Articulating: Wood, articulating arm with internal counterbalance, rubber bottom safety edge, automatic arm reversing switch, and _____.
6. Gate Arm Length: 10 feet (3 m).
7. Gate Arm Height: Locate top of gate arm in down position at not more than 35 inches (889 mm) above pavement.
8. Gate Arm Finish: Two coats of reflective enamel based paint with black and yellow diagonal stripes on both sides of arm.
9. Gate Arm Finish: Comply with applicable code for paint finish and markings on gate arm.
10. Gate Arm Clamp: Cast metal, quick change clamp and hub bracket, to permit rapid replacement of gate arm without fitting or drilling.
11. Pivot, Limit Stops, and Counterbalancing: Galvanized steel construction, enclosed in arm clamp, with oil impregnated bronze bearing.
12. Gate Arm Support Post: Steel section; 37 inches (940 mm) high, 6 inches (150 mm) square, with 10 gage, 0.135 inch (3.4 mm) minimum wall thickness; with welded and sealed steel post cap and base plate.
    a. Finish: Baked enamel on steel, color as selected by Architect.
13. Gate Arm End Post: Steel section; 37 inches (940 mm) high, 2 inch (50 mm) square, with 10 gage, 0.135 inch (3.4 mm) minimum wall thickness; with alignment bracket, closed cap and base plate.
    a. Finish: Baked enamel on steel, color as selected by Architect.
14. Base Plate: Steel, welded to post, _____ inches (_____ mm) larger than post, with anchor bolts into concrete slab.
15. Padlocking Feature: To lock gate arm in either open or closed position.

B. Barrier Gate - Access Control: Provide equipment listed and labeled in compliance with UL 325 safety standards of gate operators and ASTM F2200 construction standards.
1. Classification: Class II - Commercial/General Access, for vehicular gate operator with barrier gate access controls complying with UL 325.
2. Type of Gate: Vehicular horizontal slide gate.
3. Controls: Mechanism in compliance with UL 325 safety standards of gate operators, with cadmium coated steel components to move gate by instant reversing electric motor, enclosed speed reducer operated by self-contained, plug-in replaceable controller with slip clutch, and to permit manual operation and gate movement to stop and start at reduced speed if required.
    a. Activate automatic gate reversing switch if an obstacle is sensed while gate is in motion.
    b. Maintain gate in open position until vehicle clears control area.
4. Control Cabinet: Steel, at least 14 gage, 0.075 inch (1.9 mm) thick, with weather-tight seams and gaskets; thermally insulated to permit heater to

maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.

5. Configuration: As indicated on drawings.
6. Operation Speed: 10 inches per second (254 mm per second), nominal.
7. Barrier Gate Material: Vertical steel bars with smooth bottom edge free of protrusions and openings of 2-1/4 inch (57 mm) or less in size.
8. Barrier Gate Length: 10 feet (3 m).
9. Barrier Gate Height: 6 feet (1.8 m) above pavement.
10. Barrier Gate Support Posts: Steel section; 6 feet (1.8 m) high, 2-1/2 inch (63.5 mm) round; with welded and sealed post cap and base plate.
    a. Finish: Baked enamel on steel, color as selected by Architect.
11. Base Plate: Steel, welded to post, _____ inches (_____ mm) larger than post, with anchor bolts into concrete slab.
12. Fail-Safe Operation: Upon loss of primary electrical power, system automatically transfers to fail-safe mode allowing barrier gate to be manually pushed open without special knowledge, keys or releasing mechanisms.

2.07 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics:
   1. _____ hp (_____ W).
   2. _____ rated load amperes.
   3. _____ volts, single phase, 60 Hz.
   4. _____ amperes maximum fuse size.
   5. _____ minimum circuit capacity.
   6. _____ percent minimum power factor at rated load.
   7. Refer to Section 26 0583 - Wiring Connections: Electrical connections.

B. Electrical Components: Self-contained, plug-in, and replaceable components that comply with NFPA 70 and are listed and labeled by UL (DIR) or ITS (DIR).
   1. Provide wiring for control units, zinc plated connection box, grounded convenience outlet, switch for automatic or manual operation, switch to disconnect power unit, thermostatically controlled with at least 250 watt heater strip, and thermally protected disconnect for motor.

C. Motor: NEMA MG 1 compliant.

D. Backup Power Inverter: Provides electrical power to allow system to remain in operation upon loss of primary electrical power.

E. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized in compliance with NFPA 70.

F. Disconnect Switch: Factory mount disconnect switch in control panel.

2.08 VEHICLE DETECTION

A. Vehicle Detection: For use in temperature range of minus 40 to 160 degrees F (minus 40 to 71 degrees C); consisting of detection unit in conjunction with sensing loop to activate parking revenue control device or access control device when vehicle enters or exits.

B. Sensing Loop: 14 gage, 0.064 inch (1.63 mm) insulated wire; loop size of 48 by 72 inches (1219 by 1829 mm), with loop extension cable and detector.

1. Loop Groove Fill: Cold poured rubberized asphalt emulsion.

A. Treadle Switch Plate: Galvanized steel, 12 by 72 inches (305 by 1829 mm) overall size; consisting of weatherproof sensor detector.

B. Infrared Scanner: Active infrared detectors mounted adjacent to vehicle entry and exit locations.

2.09 MATERIALS

A. Wood Species: Pine.

B. Aluminum: Extruded aluminum in compliance with ASTM B221 or ASTM B221M.

C. Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

D. Iron and Steel Hardware: Hot-dip zinc coating, ASTM A153/A153M.

E. Structural Steel Tubing: ASTM A500/A500M

2.10 ACCESSORIES

A. Curb Frames: Formed steel type, _____ inch (_____ mm) high above pavement, _____ inch (_____ mm) thick, galvanized finish.

B. Tire Spikes: Cast steel frame and fingers, counter-balanced with fingers hinged and protruding in one direction, perimeter frame with anchors for casting into concrete.

1. Concrete anchors, refer to Section 03 3000 for additional requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that anchor bolts are ready to receive this work and dimensions are as required by manufacturer.

B. Verify that electric connections are properly located and have necessary characteristics.

3.02 INSTALLATION

A. Install parking control system and components in accordance with manufacturer's instructions and in compliance with requirements.

B. Install curb frame as indicated and complying to requirements.

C. Install tire spikes as indicated and complying with requirements.

D. Cut grooves in pavement surface, install vehicle detection loops and lead-in wires, and fill grooves with loop filler.

E. Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components as required.

3.03 ADJUSTING

A. Adjust system components for smooth operation.

3.04 MAINTENANCE

A. Provide a separate maintenance contract for specified maintenance service.
B. Provide service and maintenance of operating equipment for a period of two years from Date of Substantial Completion.

END OF SECTION

SECTION 12 21 24

MANUAL AND ELECTRONIC INTELLIGENT ROLLER SHADE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Provide [manually] [power] operated, sunscreen and blackout roller shades as applicable.

B. All wall switches shall be situated accessible pathways, and mounted within accessible reach. The chain shall be long enough to extend a sufficient distance into the accessible reach range below 48" above the floor, and must be operable with no more than 5 lbs. of force.

C. Provide electrically operated, sunscreen and blackout roller shades as applicable. Work includes local, group and master control systems for shade operation with addressable, encoded, electronic drive units (EDU).

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
3. Storage and handling requirements and recommendations.
4. Mounting details and installation methods.
5. Typical wiring diagrams including integration of EDU controllers with building management system, audiovisual and lighting control systems as applicable.

B. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, power and control wiring diagrams, and relationship to adjacent work.

1. Prepare shop drawings on AutoCAD or Microstation format using base sheets provided electronically by the Architect.
2. Prepare control, wiring diagrams based on, switching and operational requirements provided by the Architect in electronic format.
3. Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section. This includes but is not limited to all required extrusions, accessories, controls and fabricated roller shades or else all stated and published warranties may be void.

B. Installer Qualifications: Engage an installer, which shall assume responsibility for installation of all system components with a minimum of ten years' experience.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components shall be FCC compliant.

E. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

F. PVC-Free Shadecloth: Comply with the following.

1. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified below. Initial submittals, which do not include the Environmental Certification, below will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.

G. Requirements for Electronic Hardware, Controls, and Switches:

1. Roller shade hardware, shade fabric, EDU, and all related controls shall be furnished and installed as a complete two-way communicating system and assembly.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Manufacturer for Window Shade System: Products by Mecho-Systems.

B. Substitution on an equivalent basis.

2.2 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

A. Electronic Drive Unit (EDU):

1. Intelligent Encoded EDU, and Control System: Tubular, asynchronous (non-synchronous) EDU's, with built-in reversible capacitor operating at 120VAC/60Hz, (230VAC/50Hz) single phase, temperature Class B, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each EDU.
2. Quiet [42 – 46 db] (within 3 feet open air).
3. Conceal EDU's inside shade roller tube.
4. Maximum current draw for each shade EDU of 0.9Amps at 120VAC.
5. Use EDU's rated at the same nominal speed for all shades in the same room.
6. Use EDU's with minimum of 34RPM, that shall not vary due to load / lift capacity.
7. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade EDU and tube assembly.

B. EDU System: (software, two-way communication): Specifications and design are based on the Intelligent EDU Control System, WhisperShade®IQ® System) as manufactured by MechoSystems. Other systems may be acceptable providing all of the following performance capabilities are provided. EDU and control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.

1. EDU shall support two methods of control.
    a. Local Dry Contact Control Inputs:
        1) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to the upper and lower limits.
        2) EDU shall be equipped with dry contact inputs to support moving the EDU/shade to local switch preset positions.
        3) Shall support configuring the EDU under protected sequences so that a typical user would not change the EDU's setup. At a minimum the configuration should include setting limits, setting custom presets and configuring key modes of operation.
    b. Network Control:
        1) EDU shall be equipped with a bi-directional network communication capability in order to support commanding the operation of large groups of shades over a common backbone. The network communication card shall be embedded into the tubular EDU assembly.
2. Local Switch Presets: A minimum of 3 customizable preset positions shall be accessible over the local dry contact control inputs and over the network connection.
    a. Upon setting the limits for the shade EDU these preset positions shall automatically default to 25%, 50% and 67% of the shade travel.
    b. These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator or local switch shall be capable of customizing the position of these presets.
3. Network Presets: A minimum of 29 customizable preset positions (including the 3 local switch presets) shall be accessible via network commands.
    a. Upon setting the limits for the shade EDU these preset positions shall automatically default to the lower limit unless customized elsewhere.
    b. These positions shall be capable of being customized to any position between and including the upper and lower limits of the shade. A removable program module / configurator shall be capable of customizing the position of these presets.
4. Operating Modes:
    a. Uniform or Normal Modes of Operation:

1) Uniform mode shall allow for shades to only move to defined intermediate stop positions to maintain maximum uniformity and organization.
2) Normal Mode shall allow for shades to move to both intermediate stop positions, plus any position desired between the upper and lower limits as set by the installer.

5. Wall Switches:
   a. Shades shall be operated by, 5, 7, or 10-button low voltage standard switches, or programmable intelligent switches [IS]. Standard switch shall be wired to a bus interface and the bus interface will be programmed to transmit an address for the local switch.
   b. Intelligent switches may be installed anywhere on the bus line. Each IS shall be capable of storing one control level address to be broadcast along the bus line.
   c. An address that is transmitted by either a switch or central controller shall be responded to by those EDU's with the same address in their control table.
   d. IS shall provide for interface with other low voltage input devices via a set of dry contact terminals located on the switch.
   e. Standard switch or IS may control an individual, sub-group or group of EDU's in accordance with the address in each EDU.

2.3 SHADE BANDS

A. Shade Bands: Construction of shade band includes the fabric, the enclosed hem weight, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

2.4 ROLLER SHADE FABRICATION

A. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shade cloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design.

B. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shade bands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shade cloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

C. For railroaded shade bands, provide seams in railroaded multi-width shade bands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shade bands

D. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shade bands.

E. Blackout shade bands, when used in side channels, shall have horizontally mounted, roll- formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in an integrally colored fabric to match the inside and outside colors of the shade band, in accordance with manufacturer's published standards for spacing and requirements.

1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

2.5 ROLLER SHADE COMPONENTS

A. Access and Material Requirements:

1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
3. Use only Delran engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester shall not be accepted.

PART 3 - EXECUTION

3.1 PREPARATION

A. Turn-Key Single-Source Responsibility for Interior Roller Shades: To control the responsibility for performance of the electric roller shade system; assign the design, engineering, and installation of electronic drive roller shade control system, shades, addressable controls, communication interfaces, and any required sensors, switches and low voltage control wiring specified in this Section to the manufacturer of the shade and control system. The Architect will not produce a set of electrical drawings for the installation of control wiring for the electric roller shade control system.

B. Integration with Third Party Systems:

1. Main Contractor shall coordinate and provide for others to furnish, install or program any interfaces or wiring to integrate 3rd party systems to the roller shade control system as specified herein. Integration to shade control network can be accomplished locally through dry contact closures, or RS-232.

3.2 INSTALLATION OF ROLLER SHADES

A. Contractor Furnish and Install Responsibilities:

1. Supervise the roller shade installation, and setting of intermediate stops of all shades to assure the alignment of the shade bands within a single EDU group, which shall not exceed +/- 0.125 inches (3.175mm), and to assure the alignment between EDU groups, which shall not exceed +/- 0.25 inches (6.35mm).
2. Provide accurate to 0.0625 inch (1.5875mm); field measurements for custom shade fabrication on the Roller Shades manufacturers input forms.
3. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and as specified here in. Blocking for roller shades installed under the contract of the interior General Contractor shall be installed plumb, level, and fitted to window mullion as per interior architect's design documents and in accordance with industry standard tolerances. The horizontal surface of the shade pocket shall not be out-of-level more than 0.625 inch (15.875mm) over 20 linear feet (6.096 meters)
4. Shades shall be located so the shade band is not closer than 2 inches (50 mm) to the interior face of the glass. Allow proper clearances for window operation hardware.
5. Adjust, align and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
6. Set Upper, Lower and up to 3 intermediate stop positions of all motorized shade bands, and assure alignment in accordance with the above requirements.
7. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
8. Train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

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

END OF SECTION

SECTION 12 36 00

COUNTERTOPS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.
B. Countertops for manufactured casework.
C. Wall-hung counters and vanity tops.
D. Sinks molded into countertops.
E. Epoxy resin sinks.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2009.
B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018a.
F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
G. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
H. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.
I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
J. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
L. PS 1 - Structural Plywood; 2009.
M. SEFA 2 - Installations; 2010.
N. SEFA 3 - Laboratory Work Surfaces; 2010.

PART 2 – PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Quality Standard: SEFA 3 for laboratory worksurfaces.

C. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
   1. Manufacturers:
      a. Durcon, Inc, _____: www.durcon.com/#sle.
      b. Prime Industries, Inc, _____: www.piilab.com/#sle.
   2. Flat Surface Thickness: 1 inch (25 mm), nominal.
   3. Chemical-Resistance: Provide products that resist the following chemicals with not more than Moderate Effect when tested in accordance with NEMA LD 3:
   4. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
   5. NSF approved for food contact.
   6. Surface Finish: Smooth, non-glare.
   7. Color: Black.
   8. Exposed Edge Shape: 3/16 inch (5 mm) radius corner.
   9. Exposed Edge Shape in Sink Areas: Built-up marine edge 1/4 inch (6 mm) higher than counter by 1 inch (25 mm) wide.
   10. Drip Edge: Drip groove 1/8 inch (3 mm) wide and deep, located 1/2 inch (12 mm) back from edge on underside of all exposed edges.
   11. Back and End Splashes: Same material, same thickness; separate for field attachment.
   12. Sinks: Same material, same color; integrally molded with counter; bottom sloped to outlet; molded outlets; drain outlet located in back corner.
      a. Sides and Ends: 1/2 inch (12 mm) minimum thickness.
      b. Bottoms: 5/8 inch (16 mm) minimum thickness.
      c. Interior Corners: 1 inch (25 mm) minimum radius.
      d. Clamping collars for 1-1/2 or 2 inch (38 or 50 mm) diameter waste pipe, for sealed but not permanent connection.
      e. Steel channel supports front to back on each side, fastened to underside of top to support twice full sink weight.
   13. Troughs: Same material; bottom sloped to outlet.
   14. Associated Reagent Shelves and Ledges: Same material.
      a. Thickness: 3/4 inch (19 mm).
   15. Associated Window Sills: Same material.
      a. Thickness: 3/4 inch (19 mm).
   16. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
   17. Fabricate in accordance with manufacturer's standard requirements.

D. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous,

non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.

a. Manufacturers:
   1) Avonite Surfaces; _____: www.avonitesurfaces.com/#sle.
   2) Dupont; _____: www.corian.com/#sle.
b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
c. NSF approved for food contact.
d. Sinks and Bowls: Integral castings; minimum 3/4 inch (19 mm) wall thickness; comply with IAPMO Z124.
e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
f. Color and Pattern: As selected by Architect from manufacturer's full line.

3. Other Components Thickness: 1/2 inch (12 mm), minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
6. Skirts: As indicated on drawings.
7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
8. Fabricate in accordance with manufacturer's standard requirements.

E. Solid Surfacing Wall Panels: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Flat Sheet Thickness: 1/4 inch (6 mm), minimum.
2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   a. Manufacturers:
      1) Meganite, Inc; _____: www.meganite.com/#sle.
   b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
3. Fabricate in accordance with manufacturer's standard requirements.

F. Stainless Steel Countertops: ASTM A666, Type 304, stainless steel sheet; 16 gage, 0.0625 inch (1.59 mm) nominal sheet thickness.

1. Finish: 4B satin brushed finish.
2. Edge and Backsplash Sink Details: As indicated on drawings.

3. Exposed Edge Shape: Straight turndown with return; 1-1/2 inch (38 mm) high face, 1/2 inch (12 mm) return to face of case; reinforced with hardwood or steel.
4. Exposed Edge Shape: Bullnose with return; 5/8 inch (16 mm) radius, return to face of case; reinforced with hardwood or steel.
5. Exposed Edge Shape: Marine edge with return; edge raised 3/16 inch (5 mm) above counter with 45 degree transition, minimum 1 inch (25 mm) flat rim; 1-1/2 inch (38 mm) high turndown, 1/2 inch (12 mm) return to face of case; reinforced with hardwood or steel.
6. Back and End Splashes: Same material; welded 1/4 inch (6 mm) radius coved joint to countertop; square top edge with 1 inch (25 mm) wide top surface and minimum 1/2 inch (12 mm) turndown.
7. Splash Dimensions: 4 inch (100 mm) high by 1 inch (25 mm) thick, unless otherwise indicated.
8. Splash Depth Where Faucets are Mounted in Splash: 2 inches (50 mm).
9. Splash Height at _____: 6 inch (150 mm).
10. Sinks: Same material, same thickness; flush welded to counter; bottom sloped to outlet; radiused interior corners; drain outlet located in back corner.
11. Troughs: Same material; bottom sloped to outlet.
12. Associated Reagent Shelves: Same material, with formed raised edges.
13. Associated Window Sills: Same material, same thickness.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
E. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
F. Joint Sealant: Mildew-resistant silicone sealant, [white] or [ ].

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.

a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.

3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
   1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.

D. Stainless Steel: Fabricate tops up to 144 inches (3657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
   1. Weld joints; grind smooth and polish to match.
   2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
   3. Provide wall clips for support of back/end splash turndowns.
   4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.
   5. Integral sinks: Fabricate with corners rounded and coved, double-walls for sink compartment partitions, and drainboards. Factory-punch holes for fittings, and weld sinks to countertops.

E. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install laboratory worksurface countertops in compliance with requirements of SEFA 2.

B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

C. Attach stainless steel countertops using stainless steel fasteners and clips.

D. Attach epoxy resin countertops using compatible adhesive.

E. Seal joint between back/end splashes and vertical surfaces.
   1. Where indicated use rubber cove molding.
   2. Where applied cove molding is not indicated use specified sealant.

3.02 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
B. Offset from Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.03 CLEANING

A. Clean countertops surfaces thoroughly.
B. Must be able to pass all Government inspections like Health Department.

3.04 PROTECTION

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

END OF SECTION

SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum entrance floor grilles.

B. Stainless steel entrance floor gratings.

C. Carpet mat.

D. Vinyl link mat with custom design inlay.

E. Rubber mat.

F. Cocoa mat.

G. Chenille mat.

H. Recessed mat frames.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Entrance Floor Grilles and Gratings:

1. Activar Construction Products Group - JL Industries; Entrance Grilles: www.activarcpg.com/#sle.

2. Babcock-Davis; _____: www.babcockdavis.com/#sle.

3. Nystrom, Inc; envIRONtread II Rigid Grille: www.nystrom.com/#sle.

4. Pawling Corporation; ____: www.pawling.com/#sle.

5. Reese Enterprises, Inc; ____: www.reeseusa.com/#sle.

B. Floor Mats:

1. Activar Construction Products Group - JL Industries; _____: www.activarcpg.com/#sle.

2. American Floor Products Company, Inc; _____: www.afco-usa.com/#sle.

3. Babcock-Davis; _____: www.babcockdavis.com/#sle.

4. Nystrom, Inc; MATrac: www.nystrom.com/#sle.

5. R.C. Musson Rubber Co; _____: www.mussonrubber.com/#sle.

6. Pawling Corporation; _____: www.pawling.com/#sle.

7. Reese Enterprises, Inc; _____: www.reeseusa.com/#sle.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Entrance Floor Grilles: Recessed extruded aluminum grille assembly with nominal 1 inch (25 mm) wide tread strips running perpendicular to traffic flow, slots between treads, and perimeter frame forming sides of recess; grille hinged for access to recess.

1. Recess Depth: 3/4 inches (19 mm).
2. Tread Surfaces: Alternating serrated anodized aluminum and nylon carpet.
3. Colors: As indicated on drawings.
4. Length in Direction of Traffic Flow: 72 inches (1830 mm).
5. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
6. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
7. Pan: Anodized aluminum bottom pan with drain, sealed to frame.

B. Entrance Floor Gratings: Recessed stainless steel bar grating with longitudinal bars running perpendicular to traffic flow and perimeter frame forming sides of recess; grating hinged for access to recess.

1. Grating: Longitudinal bars 0.09 inch (2.3 mm), nominal, in width, spaced at less than twice the bar width apart; cross bars set below for pronounced linear appearance.
2. Carpet Strips: Nylon carpet tread strips, nominal 1 inch (25 mm) wide, set into grating at 4 inches (100 mm), nominal, on center in direction of traffic flow.
3. Grating Depth: 3/8 inches (9 mm), nominal.
4. Recess Depth below Bottom of Grating: 1 inch (25 mm).
5. Length in Direction of Traffic Flow: 72 inches (1830 mm).
6. Width Perpendicular to Traffic Flow: Full width of entrance door opening.
7. Frame: Anodized aluminum for embedding in concrete; minimal exposed trim; stud or hook concrete anchors.
8. Pan: Anodized aluminum bottom pan with drain, sealed to frame.

C. Mounting: Top of non-resilient members level with adjacent floor.

D. Structural Capacity: Capable of supporting a rolling load of 500 pounds (226.8 kg) without permanent deformation or noticeable deflection.

E. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 MATS

A. Carpet Mat: Cut nylon pile permanently bonded to vinyl backing; ____ inch (____ mm) wide by ____ inch (____ mm) long with one inch (25 mm) black matching vinyl border on all edges.

B. Link Mat: Extruded vinyl links fastened with 11 gage, 0.0907 inch (2.30 mm) diameter galvanized spring steel wire; overall size ____ inch (____ mm) wide by ____ inch (____ mm) long, 1/2 inch (13 mm) thick; square nosing; black color.

C. Rubber Mat: 1/4 inch (6 mm) thick; ____ inch (____ mm) wide by ____ inch (____ mm) long; corrugated surface texture; square edges; _____.

D. Cocoa Mat: Woven jute backing with vegetable hair strand pile, interlocking woven edging, ___ by ___ inch (___ by ___ mm) size by ____ inch (____ mm) thick.

E. Chenille Mat: Recycled rubber mat with _____ surface fiber.

F. Recessed Frame: ____ inch (____ mm) thick zinc exposed top strip, zinc coated steel concealed bottom strip, ____ inch (____ mm) deep, with anchoring features.

2.04 FABRICATION

A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 – EXECUTION

3.02 INSTALLATION

A. Install frames to achieve flush plane with finished floor surface.

B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION

SECTION 14 20 00

ELEVATORS

PART 1 - GENERAL

1.1 General

A. Electric hydraulic elevators, holed; and traction elevators.

B. Reference Standards:

1. Applicable Codes (Latest Edition):
2. American National Standard, Safety Code for Elevators and Escalators (ASME A17.1)
3. California Coded of Regulations (CCR)
4. Title 8
5. Title 24
6. National Electric Code (NEC)
7. California Building Code (CBC)
8. Americans with Disabilities Act Standards (ADAS)

1.2 Contractor Qualifications

A. F or elevator renovations, the demolition, renovation and installation shall be handled by the same contractor.

1.3 Warranty

A. The warranty period shall be 3 years, with maintenance included for the first year.

B. The warranty shall begin at Occupancy or Final Completion.

C. Response time for repairs shall be within 24 hours.

D. Emergencies response time shall be less than 3 hours at no additional cost to the College.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Elevator Type: Installations with 4 stops or less shall by hydraulic elevator with PVC sleeve.

B. Existing elevators in buildings to be modernized shall be modernized without changing the type of conveyance. The amount of change to an existing system shall be determined by the college (Director of College Facilities), the design professional, and the selected elevator consultant (i.e. lift and control cables, cylinders, inside and outside control panels, doors, etc.).

C. All installations shall meet or exceed ADA requirements and comply with the state elevator code.

D. Where traction elevators are approved, variable frequency drives shall be used.

E. Door operators shall be approved by the college (Director of College Facilities).

F. Elevators shall have an elevator machine control room for equipment. The rooms shall be temperature controlled to limit heat to conform to the manufacturers operating instructions.

G. Elevators and installations shall be of a make and design that they are maintainable by a third party.

H. Elevator shall be designed so that during a power outage, the elevator will automatically return to the ground floor and the doors will open.

I. Outdoor elevators that have glass shall have tinted glass, dual glaze glass and/or low-E glass to limit the heat gain inside the cab during hot weather.

J. All finishes inside the cab and elevator doors shall be stainless steel or vandal resistant material. Final approval of cab and door finishes shall be approved in writing (signed off) by the college.

K. Elevator cabs and electrical lighting fixtures installed with the elevator shall be LED lighting.

L. Elevator controls shall be of a generic type that can be maintained and replaced by a third party.

M. Failure to comply with the design standards will result in the changes needed to be made (to be in compliance) at the contractor/architect's expense.

N. Push buttons must comply with ADAS requirements and be metal with an illuminated center.

O. The rate of travel shall be 125 feet per minute (FPM) or greater for hydraulic elevators and 350 FPM or greater for traction elevators.

P. Passenger elevators must be rated to carry a minimum load of 3,500 pounds.

2.2 ACCEPTABLE MANUFACTURES

Manufacturers and Products: Otis, Schindler and Mitsubishi Electric. Any substitution must be on an equivalent basis and must have written approval of the college.

2.3 MATERIALS

A. Steel:

1. Sheet Steel (furniture steel for Expose work): Stretcher-leveled, cold-rolled commercial-quality carbon steel, complying with ASTM A366, matte finish.

2. Sheet Steel (for Unexposed Work): Cold-rolled, commercial quality carbon steel.

3. Stainless Steel: Type 302 304 or 430 (when SmokeGuards are used) to comply with ASTM A167, with standard tempers and harness required for fabrication, strength and durability. No. 4: stainless steel directional polish (satin finish)

Graining direction is longest dimension. Patterned: Rigidized Metal's No. 5 WL or accepted equal.

4. Aluminum: Extrusions per ASTM B221; sheet plate per ASTM B209

5. Paint: Clean exposed metal of oil, grease, scale and other foreign matter and factory paint one shop coat of Manufacturer's standard rust-resistant primer. After erection, provide one finish coat of industrial enamel paint. Galvanized metal need not be painted.

6. Baked Enamel: Primer per "E" above. Apply and bake 2 additional coats of enamel in the selected solid color.

2.4 EXECUTION

A. When replacing or eliminating hydraulic cylinders, the disposal of all related fluids shall comply with all federal, state and local regulations and guidelines. When removing in-ground cylinders, the remaining cavity shall be properly backfilled with concrete or other material approved by the college (Director of College Facilities).

B. Upon completion of work and prior to acceptance by the college, the fire alarm and communication systems must be tested and proven to be operational.

C. During construction, elevator shafts shall be protected form damage. If damage is detected in the elevator shaft at the end of construction, the contractor shall install a pump and filter in order to clear the shaft.

END OF SECTION

SECTION 14 43 00

VERTICAL PLATFORM LIFT

PART 1 - GENERAL

1.1 GENERAL

A. All labor, materials, plant appliances, equipment incidental to fabrication, furnishing, delivery and installation of vertical platform lift shall be provided.

B. Full maintenance service shall be provided for 12 months following acceptance by College.
   1. During the full maintenance portion of contract the elevator contractor is to submit a quarterly report to the Facilities Manager.

C. Requirements of the General Conditions, Supplementary Conditions and Division1 apply to work of this section.

D. Architect and project manager note: Platform lifts can provide a cost effective option for path of travel access compliance problems, but Stanford Facility Operations will permit their use only in cases where it can be demonstrated a commercial elevator cannot be installed.

E. Platform lifts with a rise of five feet or less may be installed without a runway enclosure; for travel of more than 5 feet, an enclosed runway is required. Travel of a platform lift is limited to a max of 12 feet. When fully enclosed runways are installed, they shall be illuminated.

1.2 RELATED WORK- SPECIFIED ELSEWHERE

A. Supports: A reinforced concrete pad adequate for platform lift insulation will be provided

B. Patching: Patching of floors, walls, and surfaces constituting final finishes.

C. Block-outs: Providing block-outs pockets and chases in walls and floors as required.

D. Guard railings: will be provided where required.

E. Elec. work/Power feeders: installation and connection to terminals of control, including fused lockable safety mainline switches or circuit breakers in control area. 110 VAC, single phase or 220 VAC single phase; coordinate with lift installer.

F. Painting: Field painting if prime finish items constituting final finishes

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Codes: Materials and workmanship shall be in accordance with the latest applicable edition requirements of the following and as specified:
   1. ASME: A17.1; Safety code for elevators and escalators. A17.1; Making buildings and facilities accessible to and usable by physically disabled persons.
   2. CCR: Title 8 and 24; California code of regulations
   3. NEC: National Electric Code
   4. CBC: California Building Code
   5. All local codes which govern

B. Permits: Upon completion of the vertical platform lift, the Contractor shall arrange and pay for inspections by governing authorities and obtain operating permits required.

C. Where runways and runway doors of transparent construction are installed, detailed drawings of the materials and their fastenings shall be submitted to DOSH, State Elevator unit fir review and approval prior to installation.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Scaled and Fully Dimensioned layouts: Plan indicating equipment arrangement, section of hoistway, details of enclosures and entrances, etc.
   2. Space requirements, general arrangements of the equipment, and material being supplied shall be clearly indicated. Connections, attachments, reinforcing, anchorage and location of exposed fastenings, and location s and amounts of loads and reaction to be carried on the building structure shall be shown
   3. Power confirmation sheets; include motor horse power, code letter, starting current, full load running current, and demand factor for applicable motors.
   4. Finish material: submit samples
   5. Fixtures: Submit elevations and detail drawings.
   6. All drawings showing structural attachments (rails, clips, brackets, machine tie downs, etc…) shall be stamped by a certified engineer and accompanied by a calculation booklet showing how methods of attachment have been achieved

B. Contract Closeout Submittal
   1. Operations and maintenance: after completion of work, 4 copies of final control wiring diagrams, parts list, type list, typewritten description of operating data and other information helpful for proper operation of equipment installed shall be submitted. Submit 3 copies of all applicable keys for normal operation.

C. Respond to drawing mark-up within 21 days of return; promptly incorporate required changes due to inaccurate data or incomplete definition so that

delivery and installation schedules are not affected. Revision response is not justification for delivery or installation delay

1.5 QUALITY ASSURANCE

A. Qualified Bidders:
   1. General: Platform lift shall be manufactured by one of the following:
      a. Access industries, inc.
      b. The National Wheel-o-Vator Company, inc.
      c. Garaventa.

B. Installer & Maintenance Qualifications: Installer must be a properly licensed contractor and shall provide maintenance services on the platform lift and must:
   1. Be able to show evidence of successful experience in complete maintenance of platform lifts.
   2. Directly employ sufficient competent personnel within 50 miles of the new project to handle service.
   3. Command local store of parts adequate for replacement on permanent or emergency basis.
   4. Be able to respond to trouble calls within 4 hours
   5. Be able to offer the District agreement for continuing maintenance after expiration of maintenance period under this contract.

C. Design Criteria
   1. Performance:
      a. Contract speed: Speed variation under any loading condition in either direction shall be no more than 5%
      b. Leveling: Within 3/8 inch under any loading condition. Lift shall level into floor at all times, not overrun floor and level back.
   2. Operating Qualities: Architect and LACCD's Representative shall judge riding quality of lift and enforce the following requirements. The Contractor shall make all necessary adjustments.
      a. Transition: Starting and stopping shall be smooth and comfortable. Stopping shall be without objectionable jars or bumps.
      b. Full Speed: Riding shall be free from vibration and sway.
   3. Sound Control:
      a. Vibration: Provide effective sound isolation materials to isolate the machine from building structure to prevent objectionable noise transmission to occupied building spaces.
      b. Airborne noise: Maximum acoustical output level shall not exceed 86 decibels within a frequency range of 20 to 10,000 cycles, measured in machine area.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect equipment during transportation, erection and construction. Store under cover to prevent damage due to weather conditions. Replace damaged materials.

1.7 WARRANTY

A. Provide a special project warranty, signed by contractor, installer, and manufacturer, agreeing to replace/repair/restore defective materials and workmanship of platform lift which may develop within 1 year from final date of completion and acceptance of the entire installation. A defective is hereby to include, but not by way of limitation, operation and control, system failures, performance below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration and similar unusual, unexpected and unsatisfactory conditions.

1.8 MAINTENANCE SERVICE

A. Provide 12 months of monthly maintenance service during the warranty period, by trained mechanics. Maintenance shall commence upon completion and acceptance of all elevator work and shall include examination, adjustment, greasing, oiling, parts replacement due to normal use. Provide 24 hour call back complete maintenance for all installed equipment.

B. Provide a monthly report to Facilities Director showing date and time of monthly service, services done and parts replaced.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF SYSTEMS

A. Vertical Platform Lift:

1. Type: Access Industries Inc. & National Wheel-o-Vator
2. Capacity: 750 pounds
3. Speed: Manufacturer's standard - not to exceed 20 fpm
4. Stops/Openings: Refer to drawings
5. Travel: Refer to drawings not more than 12 feet
6. Drive: Recirculating ball screw
7. Platform Size: 12 sq. ft net area; with non skid surface
8. Control: Constant pressure type

B. There shall be a level and clear floor area or landing at each floor or level served by the lift to allow safe access to and exiting from the platform. The minimum size of all landings shall be 60" by 60".

2.2 MATERIAL

A. Aluminum: alloy and temper best suited for anodizing finish specified.

B. Sheet Steel: ASTM A366, uncoated, pickled, free from defects.

C. Stainless Steel: ASTM A167, type 302 or 304.

2.3 FINISHES

A. Exposed-to-View Surfaces:
   1. Aluminum: Submit manufacturer's standard sample for approval.
   2. Sheet Steel: Clean of foreign substances. Apply one coat of primer and two coats finish paint; color as selected from manufacturer's standards
   3. Stainless steel: Satin directional polish, no. 4 finish unless otherwise specified
   4. Touch-up; Painted Surfaces: Use same paint as factory for field touch up.

B. Non-Exposed-to-View Surfaces: Degrease and shop paint manufacturer's standard rust inhibiting primer.

2.4 OPERATION:

A. General: Provide control system to perform the functions of motion, platform operation and protection.

B. Provide continuous pressure operation. Operation shall be by means of pressure type paddle switches in the lift and at the landings, any one of which may be used to control the movement of the lift as long as the switch is manually maintained in the activating position.

2.5 RAMP AND GATE OPERATION:

A. For installations without a pit, provide a non-slip ramp/guard plate which operates automatically permitting access to the platform.
   1. When the platform is at the lower landing, the ramp automatically folds down for entry and exit.
   2. The ramp automatically folds up to form a vertical barrier when the upper lift or landing button is activated. Provide a safety device that disconnects the power supply if the ramp is not fully engaged in the "up" position.

B. Provide 42" high self closing and locking gates at the top landing level and lower landing side of the platform.
   1. Equip each gate with a tamper proof interlock which shall prevent operation of the platform until the gates are locked in the "closed" position and shall prevent opening of the gate at a landing unless the platform is at rest at that landing.

C. Ramps are not required when a pit is provided. Pit depth shall be no more than 4" and a contrasting stripe shall outline the pit area.

D. At Architect's option, 6'-8" self-closing doors may be substituted when an enclosed runway is provided.

2.6 EQUIPMENT

A. General: Provide equipment which fits space and structural conditions as specified
   1. Drive: Recirculating ball screw type with rotating screw or hydraulic drive may be provided at contractor's option. For ball screw type drive, provide the following:
      a. Ball safety: Ball nut provided with integral safety to prevent uncontrolled descent in the event of ball nut failure.
      b. Motor: Manufacturer's standard acceptable. As a minimum, provide 1/4 HP, 1725 RPM, 110 VAC, instant reverse, single-phase motor.
      c. Brake: Spring actuated, electrically released type; mounted directly on ball screw shaft. Brake sets automatically upon release of control switches or loss of main power.
   2. Platform: Provide a sheet steel platform that is 12 sq. ft. net (usable area inside the barriers). Platform to have a non-skid surface and grab rail.
   3. Platform sensors: Provide with safety sensors to stop download movement, should obstruction be encountered.
   4. Limit Switches: Provide with final limit to deactivate lift in the event of control limit failure.
   5. Platform and Landing Controls: Constant pressure paddle type; activation of switch operates lift in direction desired. Security key-locks on controls meeting access limitation requirements of ASME A17.1, part 2000 shall be provided.
   6. Gate Lock: Provide, at upper landings, electric or mechanical locks to prevent movement of platform should gate be in open position.
   7. Platform enclosure: Provide 42" high side guard enclosure constructed of durable aluminum or steel. Provide an access door, hinge and lock on the outside face (opposite side from platform) of the motor and control housing to provide easy access to that area. Housing may be made of 12-gauge sheet steel.
   8. Manual lowering device: provide a device that will manually lower the platform in the event of a power failure.
   9. Wiring: provide electrical wiring and components in the vertical platform lift that will comply with the National Electric Code.
   10. Signs: Durable signs with lettering on a contrasting background shall be permanently posted at each landing indicating:
      a. The international symbol accessibility
      b. The lift cannot be used for material or equipment transport.
      c. The lifts capacity
      d. Telephone number to call in case of emergency
   11. Security: The platform lift may be locked for security reasons, but must remain unlocked during normal building hours.

PART 3 - EXECUTION

3.1 INSPECTION

A. Bidders shall examine architectural, structural, electrical, and mechanical plans and specifications. Any discrepancies that affect the vertical platform lift work or conditions adverse to the bidders equipment shall be brought to LACCD Representative's attention prior to the bid date. If no discrepancies are presented, changes required to plans or specifications become the responsibility of and cost to the contractor

3.2 PREPARATION

A. Field measurements: Field verify dimensions before proceeding with the work. Coordinate related work by other trades.

3.3 INSTALLATION

A. Install by approved manufacturer's representative per requirements of regulatory agencies and as specified. Lift shall be installed on a level, reinforced concrete anchor pad.

3.4 FIELD QUALITY CONTROL

A. Tests: Upon completion of the vertical platform lift, contractor shall provide instruments, weights and personnel to conduct the State and the following tests that shall be witnessed by a representative of the architect. The contractor shall submit a complete report describing the results of the tests.
1. Performance and leveling tests, empty and fully loaded lift.
2. Check and verify operation of all safety features.

B. Inspection: Assist LACCD in making a walk through inspection of entire installation to assure workmanship and equipment complies with contract documents.

C. Correction: Make corrections to defects or discrepancies at no cost to LACCD.

3.5 INSTRUCTIONS

A. Instruct Facilities personnel in proper use of system.

3.6 MAINTENANCE

A. General: Provide continuing maintenance on vertical platform lift equipment during regular working hours on regular working days for a period of 12 months after filing Notice of Completion.

B. Examination: Include systematic examination once a month, adjustment and lubrication of vertical platform lift equipment whenever required and replacement of defective parts with parts of same manufacturer as required for proper operation. Contractor is not responsible for repairs to lift resulting from

misuse, accidents, and negligence unless caused by contractors' acts or omissions.

C. Performance Standards:
   1. Maintain the performance standard set forth in the specification.
   2. Starting and stopping shall be smooth and comfortable.

D. Call-Backs: In event of failures, provide 24-hour call back service at no additional cost to LACCD

E. Shutdowns:
   1. Should the platform lift become inoperative, repair within 24 hours of notification of such failure. Breakdown of major components shall be completed and service restored within 72 hours.
   2. Failure to comply with above, LACCCD may order the work done by other contractors at the contractor's expense.
   3. If devices are repaired or replaced by other than the installing contractor, contractor shall, nevertheless, provide maintenance and become completely responsible for correct operation of such devices for lifetime of this contract.

F. Maintenance materials: Maintain an adequate supply of spare parts.

G. Final Service and inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standards designated. A complete inspection will be made by a representative of the LACCD.

H. Quotation: Base bid shall include cost of maintenance as described above.

END OF SECTION

SECTION 21 13 00

FIRE PROTECTION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.

C. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

D. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

E. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.

F. ANSI/ASTM A135 - Electric-Resistance-Welded Steel Pipe.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.

H. FM - FM Global Approval Guide.

I. NFPA -National Fire Protection Association.

J. UL - Underwriter's Laboratory Fire Protection Equipment Directory.

K. NFPA 13 – Standard for the Installation of Sprinkler Systems.

L. NFPA 14 – Standard for the Installation of Standpipe and Hose Systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Materials and equipment provided under this Section to make a complete installation shall be UL Listed and/or FM Approved and in compliance with NFPA Standards.

2.2 PIPE AND FITTINGS - WET PIPE SPRINKLER SYSTEMS

A. General

1. Piping shall meet applicable ANSI or ASTM standards requirements and shall have the manufacturer's name and standard marked on each length. Joints shall meet applicable ANSI and ASTM standards requirements.

B. Piping – Above Ground 2" and Under:

1. Design Pressure: 175 psig

2. Pipe: Schedule 40, black steel, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating. Exposed pipe to weather shall be galvanized.

3. Joints: Threaded.

4. Fittings:

a. Threaded:

1) Cast iron, Class 125, black, UL/FM, ANSI/ASME B16.4.

2) Malleable iron, Class 150, black, UL/FM, ANSI/ASME B16.3.

3) Steel, Class 150, black, UL/FM, ASME B16.11.

C. Piping – Above Ground 2-1/2" and Above:

1. Design Pressure: 175 psig

2. Pipe: Schedule 10, black steel, ASTM A135, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating. Exposed pipe to weather shall be galvanized.

a. Joints: Roll grooved or flanged.

b. Fittings:

1) Grooved:

a) Ductile iron housing ASTM A-536, Grade 65-45-12, UL/FM, enamel coating, Grade E (Type A) EPDM molded pressure-responsive gaskets suited for 40°F to 150°F. Carbon steel bolts and nuts. Acceptable Manufacturers: Victaulic, Gruvlok or Central.

2) Flanged:

a) Cast iron, Class 125, black, UL/FM, ANSI/ASME B16.1.

D. Standpipe System

1. Piping 2 ½" and larger may be Schedule 10 black steel conforming to ASTM 135. Exposed pipe to weather shall be galvanized.

2. Piping 2" and smaller shall be Schedule 40 black steel conforming to ASTM A53. Exposed pipe to weather shall be galvanized.

2.3 VALVES

A. General Requirements:

1. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Valves 1-1/2” and Smaller: Bronze body with threaded ends.

2. Valves 2” and 2-1/2”: Bronze body with threaded ends or ductile-iron body with grooved ends.

3. Valves 3”: Ductile-iron body with grooved ends.

C. Check Valves:

1. 2 inches and smaller, 200 psi WOG, swing type, Bronze body, bronze disc, conforming to MSS-SP-80-97, threaded ends. Acceptable Manufacturers: Crane, Nibco, or Stockham.

2. 2-1/2” inches or larger, 250 psig, Swing check Cast iron body, grooved or flanged ends. Acceptable Manufacturers: Stockham, Kennedy, or Tyco.

D. Bronze OS&Y Gate Valves:

1. 2 inches and smaller, class 175, bronze body, solid bronze wedge disc, OS&Y, copper silicon alloy stem, UL/FM listed, threaded ends. Acceptable Manufacturers: Stockham, Crane, or Nibco.

E. Iron OS&Y Gate Valves:

1. 2 ½-inch and larger, class 175, Cast or ductile iron body, solid wedge disc, OS&Y, Teflon-impregnated packing, UL/FM listed, flanged or grooved ends. Acceptable Manufacturers: Stockham, Crane, Kennedy, Mueller.

F. Indicating-Type Butterfly Valves:

1. 300 psi, UL/FM listed, with weatherproof gearbox and double pole/double throw monitor switch, double seal design for bubble tight shut off at 175 psi, grooved or flanged ends. Acceptable Manufacturers: Kennedy, Nibco, Victaulic or Tyco.

2. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

2.4 TRIM AND DRAIN VALVES

A. General Requirements:

1. Pressure Rating: 175 psig minimum.

B. Provide Angle Valves, Ball Valves, Globe Valves, Plug Valves

2.5 SPECIALTY VALVES

A. General Requirements:

1. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

b. High-Pressure Piping Specialty Valves: 250 psig minimum.

2. Body Material: Cast or ductile iron, Size: Same as connected piping, End Connections: Flanged or grooved.

B. Alarm Valves:

1. Design: For horizontal or vertical installation, include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer, Drip Cup Assembly: Pipe drain with check valve to main drain piping. Acceptable Manufacturers: Victaulic, Viking or Reliable.

C. Post Indicator Valves:

1. 4” and larger, ductile iron, fusion bonded epoxy coated resilient wedge, class 175 lb, non-rising stem, mounting plate for indicator post, UL/FM listed, flanged or mechanical ends (in accordance with NSF 61). Acceptable Manufacturers: Stockham, Kennedy, Clow, Mueller or Victaulic.

2.6 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

1. Type: Exposed, projecting, for wall mounting.

2. Pressure Rating: 175 psig minimum.

3. Body Material: Corrosion-resistant metal.

4. Inlets: Brass with threads according to local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

5. Caps: Brass, lugged type, with gasket and chain.

6. Escutcheon Plate: Round, brass, wall type.

7. Escutcheon Plate Marking: Similar to “[AUTO SPKR & STANDPIPE] [AUTO SPKR].”

8. Outlet: Back, with pipe threads.

9. Number of Inlets: [Two] [Three][Four] [Six].

10. UL/FM listed.

11. Finish: [Polished chrome plated] [Rough brass or bronze] [Rough chrome plated].

12. Outlet Size: [4”] [5”] [6”].

13. Acceptable Manufacturers: Potter Roemer, Tyco or Powhaten.

B. Flush-Type, Fire-Department Connection:

1. Type: Flush, for wall mounting.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Corrosion-resistant metal.
4. Inlets: Brass with threads according to local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
5. Caps: Brass, lugged type, with gasket and chain.
6. Escutcheon Plate: Rectangular, brass, wall type.
7. Escutcheon Plate Marking: Similar to “[AUTO SPKR & STANDPIPE] [AUTO SPKR].”
8. Outlet: Back with pipe threads.
9. Body Style: [Horizontal] [Square] [Vertical].
10. Number of Inlets: [Two] [Three] [Four] [Six].
11. Outlet Location: [Back] [Bottom] [Left side] [Right side] [Top].
12. Finish: [Polished chrome plated] [Rough brass or bronze] [Rough chrome plated].
13. Outlet Size: [4”] [5”] [6”] [8”].
14. Acceptable Manufacturers: Potter Roemer, Tyco or Powhaten.

C. Yard-Type, Fire-Department Connection:

1. Type: Exposed, freestanding.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Corrosion-resistant metal.
4. Inlets: Brass with threads according to local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
5. Caps: Brass, lugged type, with gasket and chain.
6. Escutcheon Plate: Round, brass, floor type.
7. Escutcheon Plate Marking: Similar to “[AUTO SPKR & STANDPIPE] [AUTO SPKR].”
8. Outlet: Bottom, with pipe threads.
9. Number of Inlets: [Two] [Three] [Four][Six]..
10. Sleeve: [Brass] [Not required].

11. Sleeve Height: 18 inches.

12. Finish [Including Sleeve]: [Polished chrome plated] [Rough brass or bronze] [Rough chrome plated].

13. Outlet Size: [4”] [5”] [6”].

14. Acceptable Manufacturers: Potter Roemer, Tyco or Powhaten.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Pressure Rating: 175 psig minimum, Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve, Size: Same as connected piping.

2. Inlet and Outlet: Threaded.

3. Acceptable Manufacturers: AGF Manufacturing.

B. Seismic Swing Joints:

1. UL/FM Approved flexible seismic connector or fittings with grooved, or threaded ends for seismic separation requirements. Acceptable Manufacturers: Metraflex, Vistaulic.

2.8 SPRINKLERS

A. General Requirements:

1. Pressure Rating for Automatic Sprinklers: 175 psig minimum, Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum, Sprinklers with O-rings are not permitted. Acceptable Manufacturers: Victaulic, Tyco, Viking or Reliable.

B. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: Characteristics: Nominal ½-inch orifice with Discharge Coefficient K of 5.6, and 8.0 for “Ordinary” temperature classification rating unless otherwise indicated by this specification or required by application, Provide ½ inch thread for K5.6 and ¾ inch thread for K8.0. Acceptable Manufacturers: Victaulic, Tyco, Viking or Reliable.

C. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.

3. Painted.

D. Special Coatings:

1. Corrosion resistant coating in corrosive environments only.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: [Chrome-plated steel, one piece, flat] [Chrome-plated steel, two piece, with 1-inch vertical adjustment].

2. Sidewall Mounting: [Chrome-plated steel] , one piece, flat.

3. Acceptable Manufacturers: FPPI, Tyco or Reliable.

F. Sprinkler Guards:

1. Guards shall be UL/FM listed, supplied and approved for use with the sprinkler by the sprinkler manufacturer. Sprinkler head guards shall securely fasten with bolt-on feature to the base of the sprinkler or be a factory installed guard. Approved Manufacturers: Reliable, Viking, Tyco or Victaulic.

G. Flexible piping systems shall be UL Listed and FM Approved and suitable for their intended use. All flexible piping connections shall include a fully welded, braided, leak-tested sprinkler drop with a minimum internal corrugated hose diameter of 1”; and a one-piece multi-port ceiling bracket with removable attachments hub and self-securing integrated snap-on clip ends for attachment to the ceiling grid without the need for a screw fastener. Acceptable Manufacturers: Flexhead Industries, Victaulic VicFlex, or Sprinkflex.

2.9 ALARM DEVICES

A. Water-Flow Indicators:

1. UL/FM Listed, electrically supervised, Components: Two double-throw circuit switches for isolated alarm and auxiliary contacts, complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed, Type: Paddle operated with screw terminals, Pressure Rating: 250 psig, Design Installation: Horizontal or vertical, Time Delay Feature: from 0 to [30][45] seconds. Acceptable Manufacturers: Potter Roemer or Notifier.

B. Valve Supervisory Switches:

1. UL/FM Listed, electrically supervised with screw terminals, Components: Double-pole, double-throw switch with normally closed contacts, Design: Signals that control valve is in other than fully open position. Acceptable Manufacturers: Potter Roemer or Notifier.

C. Indicator-Post Supervisory Switches:

1. UL/FM Listed, electrically supervised with screw terminals, Components: Double-throw switch with normally closed contacts, Design: Signals that controlled indicator-post valve is in other than fully open position. Acceptable Manufacturers: Potter Roemer or Notifier.

2.10 PRESSURE GAGES

A. Liquid filled, Dial Size: 4-1/2-inch diameter, Pressure Gage Range: 0 to 250 psig minimum, Water System Piping Gage: Include “WATER” or “AIR/WATER” label on dial face.

2.11 PIPE ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast-Brass Escutcheons: [Polished chrome-plated] [or] [rough-brass] finish with set-screws.

C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.

D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with [set-screw] [or] [spring clips].

E. Split-Casting, Cast-Brass Escutcheons: [Polished chrome-plated] [or] [rough-brass] finish with concealed hinge and set-screw.

F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with [concealed] [exposed-rivet] hinge, [set-screw] [or] [spring clips].

G. One-Piece Floor Plates: Cast-iron flange [with holes for fasteners].

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

A. Steel-Pipe Sleeves: ASTM A53/A53M, Type E, standard weight, plain ends.

2.13 HANGERS

A. Materials available by product type. Provide materials to comply with location and application requirements unless noted otherwise on drawings and schedules.

1. Pipe rings - Malleable iron, carbon steel.

2. Clevis - Carbon steel.

3. Steel pipe clamps - Carbon steel, alloy, stainless steel.

4. Socket clamps - Carbon steel.

5. Beam clamps - Malleable/ductile iron, hardened steel, carbon steel, forged steel.

6. Structural attachments - Carbon steel, malleable iron.

7. Ceiling plates/ceiling flanges - Plastic, cast iron, malleable iron.

8. Concrete inserts and attachments – Malleable iron, carbon steel; stainless steel body, fiberglass bars, polypropylene disc (iron cross design).

9. Rod attachments - Carbon steel, malleable iron, forged steel.

10. Pipe supports - Carbon steel, cast iron.

11. Pipe shields and saddles - Carbon steel, alloy steel, stainless steel.

12. Pipe rolls - Cast iron, carbon steel.

13. Guides - Carbon steel; slides, carbon steel with PTFE slide plates.

14. Engineered hangers - Carbon steel, stainless steel, chrome molybdenum steel.

15. Powder driven studs – Not permitted

B. Finishes: Provide finishes to comply with location and application requirements unless noted otherwise on drawings and schedules.

1. Electro-plating galvanizing process per ASTM B633.

2. Hot Dipped galvanizing process per ASTM A153.

3. Epoxy paint.

4. Zinc-rich paint.

5. Copper

6. Standard primer shall meet Fed Spec TT-P-636.

2.14 SIGNAGE

A. Provide [plastic], [steel] or [aluminum] signs for each valve and to identify hydraulic design. Signs shall have white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

2.15 SPRINKLER CABINET

A. Provide metal cabinet(s) as required containing a stock of spare sprinkler heads of all types and ratings installed as well as any special tools required for removal or replacement of the heads. The number of spare sprinklers shall conform to NFPA 13. The cabinet shall be located, in an area where the temperature will not exceed 100 degrees F (38 degrees C) and approved by the GSA Regional Fire Protection Engineer. Acceptable Manufacturer: Potter Roemer or Guardian.

END OF SECTION

SECTION 21 3000
FIRE PUMPS

PART 1 - GENERAL

1.1 REFERENCES

A. FM Global System (FM) - Approval Guide.

B. NEMA MG-1 - Motors and Generators.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volt Maximum).

D. NFPA 20 - Installation of Centrifugal Fire Pumps.

E. UL - Fire Protection Equipment Directory.

F. UL 448 - Pumps for Fire Protection Service.

G. UL 778 - Motor Operated Water Pumps.

H. UL 1247 - Diesel Engines for Driving Centrifugal Fire Pumps.

I. CCR California Code of Regulation

J. CBC California Building Code

K. CEC California Electric Code

L. CMC California Mechanical Code

M. CPC California Plumbing Code

N. CFC California Fire Code

PART 2 - PRODUCTS

2.1 VERTICAL IN-LINE PUMPS

A. Type: UL 448 and UL 778, vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 250 psi. Fire pump shall be capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head. Factory assembled and tested to comply with NFPA 20.

B. Casing: Cast or ductile iron, with suction and discharge gauge ports, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, statically and dynamically balanced, keyed directly to motor shaft.

D. Shaft: Solid alloy steel with bronze sleeve.

E. Seal: Packing gland with minimum four rings graphite impregnated packing and lantern rings, 230ºFmaximum continuous operating temperature.

F. Wear Rings: Replaceable, bronze.

G. Finish: Manufacturer's standard red paint.

H. Provide nameplate complete with rated capacities and pump characteristics.

I. Performance: Refer to Schedule on drawings. Acceptable Manufacturers: Aurora Pumps, Fairbanks Morse, Peerless Pump, A-C Pump; ITT Industries, Patterson Pump.

J. Controllers: Acceptable Manufacturers: Aquarius, Firetrol, Masters, Cutler-Hammer

2.2 HORIZONTAL BASE MOUNTED PUMPS

A. Type: UL 448 and UL 778, horizontal shaft, single stage, double suction, direct connected, horizontally split casing, for 250 psi maximum working pressure. Fire pump shall be capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head. Factory assembled and tested to comply with NFPA 20.

B. Casing: Cast iron, with suction and discharge gauge ports, renewable bronze casing wear rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, double suction, fully enclosed, balanced and keyed to shaft.

D. Bearings: Grease lubricated ball bearings in cast iron housing.

E. Shaft and Sleeve: Alloy steel with replaceable bronze shaft sleeve.

F. Seal: Packing gland with minimum four rings graphite impregnated packing and lantern rings, 230ºFmaximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

I. Finish: Manufacturer's standard red paint.

J. Provide nameplate complete with rated capacities and pump characteristics.

K. Performance: Refer to Schedule on drawings. Acceptable Manufacturers: Aurora Pumps, Fairbanks Morse, Peerless Pump, A-C Pump; ITT Industries, Patterson Pump.

L. Controllers: Acceptable Manufacturers: Aquarius, Firetrol, Masters, Cutler-Hammer

2.3 ELECTRIC MOTOR DRIVE

A. Motor: UL listed, squirrel cage induction type; in open drip-proof NEMA MG1 enclosure, 1750 3550 RPM complying with NFPA 20 and NFPA 70.

B. Controller: UL 218 and NFPA 20, full service type with solid state reduced voltage starter across the line starter VFD and electrical characteristics as scheduled on the drawings, in NEMA 3R enclosure, combined automatic and manual operation, factory assembled and wired, and factory tested for capacities and electrical characteristics, including the following:

1. Disconnect Means: Externally operable, quick-break type.

2. Circuit Breaker: Continuous current rating not less than 115% of the rated full load current of the motor. Overcurrent sensing elements of the non-thermal type. Instantaneous short circuit current rating for 100,000 _____ amperes interrupting capacity and service entrance rated.

3. Locked Rotor Protection: Calibrated and set at a minimum of 300% of full load current.

4. Motor Starter: Energized automatically by pressure switch or manually by externally operable handle.

5. Pressure Switch: Water pressure actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire suppression piping. This Contractor is responsible for determining and setting start and stop pressures based on hydraulic calculations, available water pressure, required system pressure, controller manufacturer's recommendations, and NFPA requirements. If the fire pump is serving a sprinkler system, the activation of one sprinkler shall be sufficient to bring on the fire pump.

6. Running Timer: Keeps motor operating when started automatically, for at least ten minutes.

7. Pilot Lamp: Indicates circuit breaker closed and power available.

8. Ammeter and voltmeter built into enclosure.

9. Built-in Alarm: Energizes alarm to indicate circuit breaker open or power failure.

10. Remote start switch relay.

11. Contacts for monitoring PHASE LOSS, PHASE REVERSAL, PUMP RUNNING, and ALTERNATE SOURCE.

12. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32 inch orifice in clapper or ground face union with non-corrosive diaphragm having 3/32 inch orifice.

13. Automatic Transfer Switch connected to primary and alternate power source: UL 218 and UL 1008 and requirements for and attached to fire pump controllers. Include enclosure complying with UL 50, Type 2, with automatic transfer switch with rating at least equal to fire pump driver motor horsepower. Include ampere rating not less than 115 percent of motor full load current and suitable for switching motor locked rotor current. Instantaneous short circuit current rating for 100,000 _____ amperes interrupting capacity and service entrance rated.

14. Surge Protection: Provide a factory-installed listed surge protection device with the fire pump controller.

15. System Pressure Recorder: Digital type with memory.

16. Finish: Manufacturer's standard red paint.

2.4 DIESEL ENGINE DRIVE

A. Diesel Engine: Conform to NFPA 1247, arranged for automatic operation, include overspeed/overcrank switch and drive, two contactor switches, low oil pressure and high-water temperature warning switches, and fuel shutoff solenoid with wiring terminating in junction box.

B. Include the following engine accessories:

1. Stub shaft.

2. Oil bath air cleaner.

3. Water cooled exhaust manifold.

4. Heat exchanger.

5. Mechanical speed governor.

6. Fuel filter.

7. Lube oil filter and bypass valve.

8. Lube oil cooler and relief valve.

9. Fuel pump.

10. Instrument panel with tachometer, hour meter, oil pressure gauge, water temperature gauge, ammeter, hand speed control and start switch.

11. Starting system including generator/alternator, starting motor and voltage regulator.

C. Cooling Water System: Closed system with cooling water supply to heat exchanger from fire pump discharge. Include four shutoff valves (including bypass line), two strainers, pressure regulating valve, automatic solenoid valve and pressure gauge.

D. Storage Batteries: Dual lead acid batteries with 100 percent standby reserve capacity. Provide all necessary cables and battery racks.

E. Fuel System: 250 gallon_____, but not less than required by NFPA 20, above ground storage tank, fill pipe and cap, manual shutoff valve, flame arrestor, oil level gauge, braided bronze flexible connectors, seamless Type L copper tubing with flared joints. Provide secondary containment tank with capacity equal to fuel storage tank.

F. Automatic Diesel Engine Controller: Enclosed in floor mounted 14 gauge steel housing, UL and NFPA 20 listed and labeled.

1. Controller automatically starts fire pump from water pressure control switch or test switch.

2. Stopping push button shall manually stop engine.

3. Under automatic conditions, controller alternates batteries automatically on each 15 second cranking cycle. Alarm sounds if engine is not started after six attempts.

4. Dual built-in battery charger, UL 1236 listed, recharges both batteries within 24 hours. Chargers shall have automatic overload protection (current limiting). Provide individual voltmeters and ammeters for each battery.

5. Include individual pilot lights and common alarm bell for:

    a. Low engine oil pressure.

    b. High engine jacket water temperature.

    c. Failure to start automatically.

    d. Charger failure.

    e. Battery 1 failure.

    f. Battery 2 failure.

    g. Overspeed shutdown.

6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32 inch orifice in clapper or ground face union with non-corrosive diaphragm having 3/32 inch orifice.

G. Remote Alarm and Signal Panel: Provide wall mounted panel in NEMA 3R Type 1 enclosure with:

1. Engine running light.

2. Common engine failure light for:

    a. Low engine oil pressure.

    b. High engine jacket water temperature.

    c. Failure to start automatically.

    d. Charger failure.

    e. Battery 1 failure.

    f. Battery 2 failure.

    g. Overspeed shutdown.

3. Power on light.

4. Switch off light indicating position of main control switch (off or manual).

H. Exhaust System: ASTM A53/A53M, Type E or S, Schedule 40, black steel pipe; ASME B16.9, weld type pipe fittings; ASME B16.5, steel flanges; and ASME B16.21, nonmetallic gaskets. Fabricate double-wall, ventilated thimble from steel pipe. Provisions shall be made for manually draining condensate from the silencer and exhaust piping.

1. Exhaust Connector: Flexible type.

2. Exhaust Silencer: Residential type.

I. Finish: Manufacturer’s standard red paint.

2.5 PRESSURE MAINTENANCE (JOCKEY) PUMP

A. Pressure Maintenance Pumps: Factory assembled and tested pumps with electric motor driver, controller, and accessories and specialties. Include cast iron or stainless steel casing and bronze or stainless steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.

B. Electrically operated, horizontal turbine type with NEMA MG1, open drip-proof squirrel cage induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.

C. Provide suction and discharge pressure gauges.

D. Provide with pressure relief valve and pipe to outdoors sump.

E. Control by automatic jockey pump controller to start pump on pressure drop in system. Fire pump starts automatically on further pressure drop or on jockey pump failure.

F. Controllers: UL 508, factory assembled, wired, and tested across the line type for combined automatic and manual operation.

1. Enclosure: UL 508 and NEMA 250, Type 2, wall mounting type for field electrical wiring.

2. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32 inch orifice in clapper or ground face union with non-corrosive diaphragm having 3/32 inch orifice.

3. Rate controller for scheduled horsepower, and include the following:

   a. Fusible disconnect switch.

   b. Pressure switch.

   c. Hand-off-auto selector switch.

   d. Pilot light.

   e. Running period timer.

4. Finish: Manufacturer’s standard color paint applied to factory assembled and tested unit before shipping.

G. Performance: Refer to schedule on drawings.

END OF SECTION

SECTION 22 00 00

PLUMBING SYSTEM DESIGN CRITERIA

PART 1 - GENERAL

1.1 DESIGN CRITERIA

A. GENERAL

1. The interface points between the Civil Design and the Plumbing Design will be at 5 feet outside the building wall.

2. All utilities shall enter each building above ground.

3. Each building shall have an isolation valve in the firewater and domestic line servicing each building.

4. The mains for any building shall not run through the building to the room where the isolation valve is located.

5. All outside isolation valves shall be located in a valve box. The box shall be arranged such that dirt does not fill the box over time and water shall not collect in the box.

6. All exposed piping and equipment in harsh environments shall be adequately protected.

7. No plumbing system or piping shall be located below raised floors.

8. Connections to dissimilar metals be avoided if at all possible and if this can't be avoided the connection shall be through the use of a dielectric connection.

9. Line size ball or gate valve shall be used. No butterfly valves shall be used.

10. All ball valves shall be so located for easy access and periodic exercise.

11. All exterior hose bibbs shall be recessed and have lockable doors.

12. All domestic water booster pumps shall be provided with a full line size bypass.

13. All pumping systems shall be provided with a discharge check valve.

14. Mop sinks and Janitor sinks in Hopper Rooms shall be provided with a second faucet for the chemical dispensing system. There shall be backflow preventers on the hot and cold water lines servicing the chemical dispensing system.

15. Locating any piping system under the slab on grade shall be avoided. A suggested separation of building systems to avoid maintenance issues is three feet.

16. Heat exchangers having a heat source from the mechanical boilers shall not be used.

17. The use of hot water storage tanks shall be limited.

18. Whenever possible water heaters shall be located on the first floor of any building. When water heaters are on a floor above the first, a pan shall be provided. The pan shall be drained to a floor sink through an air gap.

19. When a sewage ejector or sump pump are required, they shall be located for easy access and maintenance. Locating these outside the building is strongly suggested. There shall be a remote notification of power failure and for alarms. The location of the remote notification panel shall be specified by the campus.

20. Under counter acid neutralizers shall easily maintainable. Neutralizers with side access for are strongly suggested.

21. Central acid neutralizers shall be located for easy maintenance. Locating those requiring stone replacement outside are strongly suggested.

22. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, and function. Do not label exposed equipment in public areas.

23. Provide engraved plastic tags at all hydronic or steam system makeup water meters.

24. Do not use one transformer to power multiple fixtures.

25. All equipment shall be located for easy maintenance.

26. Gas earthquake valves shall be provided on the exterior of each building.

27. Locate condensate pumps outside of sensitive areas.

28. The location of any piping or equipment shall not render access to another building system component inaccessible.

29. All penetrations through a roof shall be permanently sealed water tight.

30. Access panels shall be the lockable with a key. All access panels shall be keyed the same.

31. All wall access panels shall be 12” by 12”.

32. All ceiling access panels shall be 24” by 24”.

33. Wall access panels shall not be more than 4 feet high as measured to the top of the panel.

34. Access panel doors must be closable when the valve is in the closed position.

35. All reasonable efforts shall be to locate the access panels for restrooms in the men’s restroom.

B. STORM DRAINAGE DESIGN

1. Storm drainage piping system will be sized in accordance with two (2) inches per hour of rainfall intensity.

2. The overflow drains will also extend from the roof however each of these will terminate at the exterior wall approximately 12 inches above the outside finished surface.

3. Overflow discharges shall not be onto a public walkway but rather through a fitting that takes the line under a walkway and discharges through a curb.

4. Both the piping for the storm drains and the piping for the overflow drains will be sloped at 2%.

5. There shall be a cleanout at the base of each storm drain riser prior to the final horizontal turn to connect to the site piping and cleanouts throughout the piping system as required by the Los Angeles City Plumbing Code.

6. Any groundwater drainage that will be collected below the elevation of city gravity storm drainage lines will be collected by means of a building foundation drain. The foundation drainage system will be provided at footings of the structural foundation in accordance with the Geologist report.

7. The foundation drainage system will discharge into a sump pit from which it will be pumped up such that the discharge can flow by gravity to the city storm drain system. The sump pit will be provided with two 100% redundant automatic sump pumps. System operation will be monitored by alarm panel provided with auxiliary contacts for remote annunciation in a continuously supervised location. Access to pumps and control panel will be maintained at 3'-0" minimum for servicing.

8. All metallic underground piping shall be encased in a Polyethylene tube or wrapped in a Polyethylene sheet. The Polyethylene shall conform to ASTM A674 or AWWA C105, high density, cross laminated, having a thickness of 0.004 inch or LLDPE having a thickness of 0.008 inches.

C. SANITARY DESIGN

1. The vents shall extend 6 inches above any roof not normally used. Vents terminating above roofs which are used for other than weather protection shall extend to a point 7 feet above the roof surface.

2. Building's over 10,000 square feet may have a sub-meter for sewage discharge. The sub-meter shall be configured to interface and exchange data with the District's existing software. Sub-meters shall include an Ethernet communications port or wireless communication capability or other networking capability. Sub-meters shall retain data for a period of no less than 12 months.

3. All the sanitary system including the above and underground horizontal piping will be sloped at 2% for sizes up to 3" and 1% for sizes 4" and larger.

4. There shall be cleanouts throughout the piping system as required by the Los Angeles City Plumbing Code.

5. All metallic underground piping shall be encased in a Polyethylene tube or wrapped in a Polyethylene sheet. The Polyethylene shall conform to ASTM A674 or AWWA C105, high density, cross laminated, having a thickness of 0.004 inch or LLDPE having a thickness of 0.008 inches.

6. Waste generated below the elevation of city sewer mains will be drained by gravity to a sewage ejector pit.

7. The sewage ejector pumps will pump the waste up such that the discharge can flow by gravity to the city sewer main. The sewage ejector pit will be provided with two 100% redundant automatic pumps. The sewage ejector pit will be lined with air tight and will need to be properly vented. System operation will be monitored by alarm panel provided with auxiliary contacts for remote annunciation in a continuously supervised location. Access to pumps and control panel will be maintained at 3'-0" minimum for servicing.

8. Restrooms having two or more water closets or a combination of one water closet and one urinal shall be provided with floor drains.

9. Mechanical Rooms shall be provided with floor sinks and floor drains.

10. All equipment or condensate drains shall be discharged into a floor sink or another approved receptor.

11. There shall be a floor drain below all emergency showers. These floor drains shall have a trap primer.

12. Storage Closets, Hopper Rooms and Main Custodial Supply Areas shall have a floor drain and automatic trap primer.

D. DOMESTIC COLD WATER DESIGN

1. A water meter and backflow preventer will typically be provided under Civil Engineer.

2. Building's over 10,000 square feet may have a sub-meter for domestic water. The sub-meter shall be configured to interface and exchange data with the District's existing software. Sub-meters shall include an Ethernet communications port or wireless communication capability or other networking capability. Sub-meters shall retain data for a period of no less than 12 months.

3. If required, the available water pressure in the building will be reduced to the below the maximum code requirement of 80 PSI. The reduction in pressure will be by means of a pressure reducing station consisting of a line size pressure reducing valve and a parallel bypass. Both pressure reducing valves will be provided with strainers. The Pressure reducing station will be located outside the building in an easily accessible location.

4. As a minimum, each building shall be provided with one backflow preventer. The domestic water system shall be provided with reduced pressure backflow preventers. These backflow preventers shall be on a concrete pad with a lockable cage. The cage shall have a rounded top to reduce the likelihood of a student sitting on the top of the cage. The cage shall be of suitable construction to prevent damage due to students sitting on it.

5. The cold water system shall be thoroughly thought out to limit the quantity of backflow preventers feeding the building(s) as well as to limit the backflow preventers used inside the building. The intent is to keep to a minimum the quantity of backflow preventers used.

6. Hydraulic calculations shall be performed for each building. The hydraulic calculations shall include the pressure losses for the change in site elevation changes, site piping, meter losses, backflow pressure losses, building static, mixing valve losses, pressure reducing valve fall offs, and any other losses that may be applicable.

7. The domestic water piping shall be designed to a pressure loss of 3 psi per 100 feet and a maximum velocity of 6 feet per second unless the hydraulic calculation indicated a different pressure loss for the piping.

8. Domestic water piping shall not be oversized.

9. A common cold water line shall supply back-to-back fixtures.

10. The domestic water system shall be designed such that there will be 30 psi at the most remote flush valve fixture and 20 psi at the most remote fixture.

11. Hose bibbs shall be provided in Mechanical Rooms, in all public restrooms, by Mechanical Units on the roof, and as required by the Architect along the exterior of the building.

12. Combination emergency eyewash/shower stations shall be provided in accordance with ANSI Z358.1 in locations where there may be the possibility of having fluids discharged on to the skin or into the eyes.

13. All floor drain and those floor sinks which will not have their traps maintained shall be provided with a trap primer.

14. Pressure differential trap primers or flush valve primers shall be utilized to maintain p-traps where there is a water header serving a flushvalve. The pressure differential trap primers shall activate at 3 psi differential.

15. Electronic trap primers shall be utilized to maintain p-traps where there are no flushvalve headers to connect.

16. All electronic and pressure differential type trap primers shall be provided with an isolation valve.

17. All trap primers shall be behind a lockable 12” by 12” access panel.

18. All water hammer arrestors shall be behind a lockable 12” by 12” access panel.

19. The only plumbing that shall be in or run over a Telecommunication Room, UPS , Battery Rooms, Electrical Room and Elevator/Escalator Machine Room will those which serve these rooms.

20. There shall be shut-off valves for each restroom, at the bottom of each riser, for each floor, prior to each piece of equipment and strategically placed throughout the domestic water system. All shut-off valve will be line size ball valves.

21. All metallic underground piping shall be encased in a Polyethylene tube or wrapped in a Polyethylene sheet. The Polyethylene shall conform to ASTM A674 or AWWA C105, high density, cross laminated, having a thickness of 0.004 inch or LLDPE having a thickness of 0.008 inches.

E. DOMESTIC HOT WATER DESIGN

1. Water temperature to plumbing fixtures will not exceed 120 degrees F. Only heaters with a minimum output of 84% thermal efficiency will be selected. Circulation pumps will be utilized to circulate the hot water throughout the building and back to the heaters if the fixtures are more than 20 feet from the water heater. The hot water equipment will be located in its own room or a Mechanical Room.

2. An aquastat and 7 day time clock located in NEMA rated control panel will be provided for a complete automatic operation of the system.

3. The domestic water piping shall be designed to a pressure loss of 3 psi per 100 feet and a maximum velocity of 4 feet per second unless the hydraulic calculation indicated a different pressure loss for the piping.

4. Master mixing valves shall not be used. Individual mixing valves will be provided at each fixture.

5. Domestic water piping shall not be oversized.

6. A common hot water line shall supply back-to-back fixtures.

7. The domestic water system shall be design such that there will be 20 psi at the most remote fixture.

8. All hot water piping shall be insulated over the entire length.

9. There shall be shut-off valves for each restroom, at the bottom of each riser, prior to each piece of equipment and strategically placed throughout the domestic water system. All shut-off valve will be line size ball valves.

10. There shall be shut-off valves for each restroom, prior to each restroom, at the bottom of each riser, prior to each piece of equipment and strategically placed throughout the domestic water system. All shut-off valve will be line size ball valves.

11. All hot water and return piping will be insulated with pre-formed jacketed fiberglass insulation to maintain set temperature and minimize temperature drop in uncirculated dead-end hot water lines.

F. PIPING

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

2. Remove scale and dirt, on inside and outside, before assembly.

3. Connect to equipment with flanges or unions.

4. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.

5. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

6. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

7. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.

8. Provide flanges or unions at all final connections to equipment and valves.

9. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

10. Unless otherwise indicated, install all piping, including shutoff valves and strainers, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.

11. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45º or 90º angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

12. Provide dielectric connections between dissimilar metals.

13. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.

14. Slope water piping and arrange to drain at low points.

15. Seal pipes passing through exterior walls. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

16. Underground Piping:

    a. Install buried water piping outside the building with at least 3 feet of cover.

b. Underground fire protection service piping shall have at least 3 feet of cover, or as recommended by NFPA 24, whichever is greater.

17. Sanitary and Storm Piping:

    a. All sanitary and storm piping shall have at least 36” of cover when leaving the building.

18. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.

19. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

20. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

21. Main Custodial Supply Areas shall have 2 compressed air connections from a compressor with a minimum of 25 cfm at 90 psi, 10 Hp, electric driven motor and a 90 gallon receiver.

22. There shall be water faucets on the outside of the Main Custodial Room.

23. The Main Custodial Supply Room shall have a commercial washer and dryer. The washer and dryer shall be front loading with a 60 lbs. capacity.

24. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.

25. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

26. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.

27. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.

28. Vent pipes through the roof shall be located a minimum of 10 feet from any air intake or exhaust opening on the roof.

29. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

30. Provide necessary connections at the start of individual sections of mains for adding chlorine.

G. VALVES:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

3. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement.

4. Provide clearance for installation of insulation and access to valves and fittings.

5. Provide 12” by 12” access panels for concealed valves.

6. Install valve stems upright or horizontal, not inverted.

H. DEIONIZED (DI) WATER

1. The DI system shall consist of three basic components; a Reverse Osmosis Skid, RO/DI Water Post Treatment/Pump Skid and storage tank.

2. The Reverse Osmosis Skid shall consist of 5 micron prefilters, Sodium Bisulfate Chemical Feed System, Antiscalant Feed System, Booster Pump, RO Membrane vessels, adjustable flow controls, FRP Pressure Vessels with TFC membranes, required gauges and controls mounted on a powder coated frame.

3. The low pressure piping on the skid shall be Schedule 80 PVC and ½” poly tubing. The high pressure piping shall be Schedule 80 PVC and ½” poly tubing

4. The pump shall have a stainless steel body with a 200 psig pressure rating.

5. The RO/DI Water Post Treatment/Pump Skid shall consist of UV light(s), DI bottles, Mixed Bed Exchange Tank, Recirculation Loop Resistivity Monitoring, 1 Micron DI Filter(s), 0.2 Micron Sub-Filter(s), backpressure valve, Multistage DI Pump(s), required gauges and controls mounted on a powder coated frame.

6. The suction and discharge piping shall be Schedule 80 Polypropylene.

7. The tank shall be 100 gallons, constructed of Isophthalic Resin, dished bottom and annular head configuration

8. The tank shall be in a containment basin having a capacity equivalent to the tank volume.

I. AIR COMPRESSORS

1. Install compressor units on concrete foundation with sole plates and vibration isolators as scheduled on the drawings. Level, grout, and bolt in place.

2. Install line size shutoff valve and check valve on compressor discharge.

3. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.

4. Place shutoff valve on water inlet to aftercooler. Pipe drain to floor drain.

5. Connect condensate drains to nearest floor sink.

6. Install valved bypass around air dryers. Factory insulate inlet and outlet connections.

7. Install drain valves at all low points of piping system.

8. Install take-offs from top of mains, with shutoff valves after take-offs. Install line size filter regulators at each take-off.

9. Install compressed air couplings, 3/8" female speed couplers, and pressure gauges where outlets are indicated.

J. NATURAL GAS DESIGN

1. The system pressure will be selected by the Engineer based on the length of run and the quantity of gas required.

2. Building's over 10,000 square feet shall have a sub-meter for natural gas. The sub-meter shall be configured to interface and exchange data with the District's existing software. Sub-meters shall include an Ethernet communications port or wireless communication capability or other networking capability. Sub-meters shall retain data for a period of no less than 12 months.

3. If at all possible no gas piping shall be run below a building. If it is necessary to run the piping below the slab, a CPC code compliant double containment system shall be installed.

4. The gas line will include a service shut-off valve and seismic type gas valve to interrupt gas flow to equipment during seismic events. A separate manual shut-off valve will be provided upstream of the seismic valve for service when necessary.

5. Install No. 12 Insulated Type UF copper tracer wire, terminate above grade at each end of non-metallic gas pipe.

6. No metallic piping shall be used underground. Only Polyethylene piping shall be used underground.

K. PIPE MARKERS:

1. All pipe markers shall be compliant with ASME A13.1.

2. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
CONDENSATE DRAIN	Black	Yellow

Pipe Service	Lettering Color	Background Color
COMPRESSED AIR	Black	Yellow
DOMESTIC COLD WATER	White	Green
DOMESTIC HOT WATER - 115°F	Black	Yellow
DOMESTIC HOT WATER - 140°F	Black	Yellow
DOMESTIC HOT WATER CIRCULATING - 115°F	Black	Yellow
DOMESTIC HOT WATER CIRCULATING - 140°F	Black	Yellow
SANITARY SEWER	Black	Yellow
VENT	Black	Yellow
STORM SEWER (PRIMARY AND SECONDARY)	White	Green
NATURAL GAS	Black	Yellow
TEMPERED WATER	Black	Yellow
TEMPERED WATER RETURN	Black	Yellow
NON-POTABLE WATER	Black	Yellow
DEIONIZED WATER	White	Green
DISTILLED WATER	White	Green
RO WATER	White	Green
FUEL OIL SUPPLY	Black	Yellow
FUEL OIL RETURN	Black	Yellow
Tracer Wire - Water Pipe Lines	---	Blue
Tracer Wire - Natural Gas Pipe Lines	---	Yellow
Tracer Wire - All other buried types	---	Green

3. Secure all adhesive markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.

   b. On both sides of walls that pipes penetrate.

   c. At least every 20 feet along all pipes.

   d. On each riser and each leg of each "T" joint.

   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

L. TRACER WIRE

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tracer wire shall be continuous between boxes and shall be tested for continuity.
6. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**
7. The tracer wire shall daylight to grade through a 2” PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

M. FIXTURES

1. All restrooms shall be ADA compliant.
2. All fixtures shall be white.
3. Urinals shall be 17” minimum width with extended side.
4. All fixtures shall be easy to install and replace by using standard/none-proprietary tools.
5. All surfaces and finishes of the fixtures shall withstand commercial usage and harsh chemical treatment during cleaning and maintenance yet vandal resistant.
6. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
7. Seal fixtures to wall and floor surfaces with sealant.
8. Solidly attach water closets to the wall.
9. No waterless urinals shall be used.
10. For ADA accessible water closets, install flush valve with handle to wide side of stall.
11. Provide gray water to water closets and Urinals where it is available.
12. Fixtures shall not have filters or cartridges which require regular maintenance or replacement.
13. Provide access panels to all plumbing devices in the wall.

14. Hopper rooms shall have a corner floor type mop sink with hot and cold water, mop hanger, 36” hose with wall hanger, vacuum breaker on the faucet.

15. Main Custodial Supply Area shall have a 41-imch high stainless steel utility sink, wall mounted faucet with built in backflow preventer and level handles.

N. WATER HAMMER ARRESTERS:

1. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.

2. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

O. CLEANOUTS:

1. Provide cleanouts at bases of all sanitary and storm risers.

2. Extend cleanouts to the floor above with long sweep elbows.

3. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

4. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12” above the finished floor.

5. Cleanouts shall be so located that they are in open spaces or have easy access.

P. FLOOR DRAINS AND SINKS:

1. Drains in upper floors shall have a flashing of EPDM or similar membrane sheet. The sheet shall be at least 36" X 36" square with the drain in the center. Clamp membrane in auxiliary clamping ring of floor drain. Membrane is not required if upper floor construction is single pour, cast-in-place concrete.

2. Top of floor drain and sinks grate/strainer shall not extend above the finished floor elevation.

Q. BACKFLOW PREVENTER:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Install unit between 12" and 60" above finish floor.

R. BALANCING VALVES:

1. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer’s installation instructions.

END OF SECTION

SECTION 22 0001
DESIGN REQUIREMENTS FOR ACCESS

PART 1 - GENERAL (NOT APPLICABLE)

PART 2 - PRODUCTS

2.1 FIXTURE REQUIREMENTS

A. Accessible plumbing fixtures shall comply with all of the requirements in CBC Section 11B.

B. Heights and location of all fixtures shall be according to CBC Sections 11B-602 through 11B-612.

C. Fixture controls shall comply with CBC Sections 11B-608.5 for showers, 11B-606.4 for lavatories and sinks, 11B-604.6 for water closets, and 11B-607.5 for urinals.

D. Each accessible sink shall be a maximum of 6-1/2” deep. Sinks shall be mounted with the counter or rim no higher than 34” above the finish floor. CBC Section 11B-606.3 and 11B.

END OF SECTION

SECTION 22 05 23
GENERAL DUTY VALVES / DOMESTIC WATER VALVES / DOMESTIC WATER

PART 1 - GENERAL (NOT APPLICABLE)

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE
HOT WATER - POTABLE AND NON-POTABLE
TEMPERED WATER - POTABLE AND NON-POTABLE

A. Shutoff Valves:

1. For pipe systems where, mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Butterfly Valves:

a. 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line, Keystone, Watts, Stockham, Nibco, Milwaukee, Hammond.

b. 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line, Keystone, Watts, Stockham, Nibco, Milwaukee, Hammond.

c. Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic, Nibco.

3. Ball Valves:

a. 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo, Stockham, Milwaukee, Watts, Nibco, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

B. Throttling/Shutoff Valves:

1. For pipe systems where, mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Globe Valves:

a. 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane, Stockham, Walworth, Milwaukee, Hammond, Watts, Nibco.

b. 2-1/2" thru 10", 125# steam @ 353ºF, 200# CWP @ 150ºF, flanged, iron body, bronze mounted. Crane, Hammond, Stockham, Walworth, Milwaukee, Watts, Nibco.

C. Check Valves:

1. For pipe systems where, mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane, Hammond, Stockham, Walworth, Milwaukee, Watts, Nibco.

3. 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek (with Inconel springs), Mueller Steam Specialty Co., Stockham, Nibco.

D. Strainers:

1. For pipe systems where, mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong, Metraflex, Mueller Steam Specialty Co., Sarco, Watts.

3. 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co.

2.2 UNIONS

A. Copper pipe - wrought copper fitting - ground joint.

B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.

C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

2.3 WATER PRESSURE REDUCING VALVES

A. PRV-1: Self-contained type up to 2-1/2" size, diaphragm actuated, with cast iron body, stainless steel springs, diaphragm, trim and seats for maximum operating pressure of 150 psig and maximum pressure drop of 100 psi. Acceptable Manufacturers: Fisher Type 95H, Cash Acme, Masoneilan, Trerice, Watts.

B. PRV-2: 2-1/2" through 6” size, single seated plug valve, with cast iron body, stainless steel seat, maximum 125 psig inlet, 20-100 psi differential. Acceptable Manufacturers: Fisher, Masoneilan, Trerice, Watts.

2.4 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Furnish one meter kit equivalent to Bell & Gossett meeting the following requirements:

1. Carrying case with handle.

2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.

3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.

4. Coordinate with the Mechanical Contractor if a meter kit is also required in specification section 23 21 00. It is not our intent to require two identical kits, rather it will be acceptable to provide only one kit to the owner which can be used with both plumbing and hydronic piping systems.

D. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design, Preso, Armstrong, Bell & Gossett, Griswold, Gerand or Nibco Globe Style balancing valve.

E. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett, Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.

F. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.5 WATER HAMMER ARRESTERS

A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100ºF and 300ºF and maximum 250 psig working pressure.

C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12” long at fixtures and minimum 24” long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

2.6 DIELECTRIC FITTINGS (CONNECTIONS BETWEEN DISSIMILAR METALS)

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic, Grinnell, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.7 AIR VENTS

A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.

B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.8 DRAIN VALVES

A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

2.9 RELIEF VALVES

A. RV-1: (Compressed Air) Spring loaded disc type, cast iron or steel body, stainless steel disc, side outlet and lifting lever, 250# CWP. Acceptable Manufacturers: Consolidated Div. of Dresser Ind., Kunkle, Keckley.

B. RV-2: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210ºF temperature. Capacities ASME certified and labeled. Acceptable Manufacturers: Cash, Watts.

2.10 SANITARY – PUMPED (ABOVE GROUND)
STORM - PUMPED (ABOVE GROUND)

A. Shutoff Valves:

1. Ball Valves:

a. 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze or brass body, stainless steel ball and trim, Teflon seats and seals. Apollo, Stockham, Milwaukee, Watts, Nibco, National Utilities Co., RUB.

2. Gate Valves:

a. 2-1/2" thru 12", 200# CWP @ 150ºF, flanged, iron body, bronze trim, OS&Y. Crane, Hammond, Stockham, Walworth, Milwaukee, Nibco.

B. Check Valves:

1. 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane, Hammond, Stockham, Walworth, Milwaukee, Watts, Nibco.

2. 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co., Stockham, NIBCO, Crane.

END OF SECTION

SECTION 22 05 29
PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 REFERENCES

A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices

D. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

E. California Building Code (CBC)

F. California Division of State Architect (DSA)f

PART 2 - PRODUCTS

2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8”	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel, cast iron, and glass pipe.
Column #2: Copper and plastic pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

2.2 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).

2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing.

   a. Insulation Couplings:

      1) Insulation Coupling: Molded thermoplastic, -65ºF to 275ºF, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

      2) Horizontal Strut Mounted Insulated Pipe:

         a) Acceptable Manufacturers: Klo-Shure.

      3) Vertical:

         a) Acceptable Manufacturers: Klo-Shure Titan.

3. Copper piping located in an exposed area, including indirect waste piping in kitchens and janitor's closets, shall use band hangers for copper tubing. Support shall include plastic pipe insert. Use threaded rod. There are to be electro-galvanized or have a more corrosion resistant coating. Wall anchors are to have corrosion resistant threaded rod. Acceptable Manufacturers: Erico/M-Co, B-Line, Anvil or Nibco/Tolco.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in a multi-story structure, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations. Acceptable Manufacturer: Copper/B-Line, Erico or Nibco/Tolco.

2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts. Acceptable Manufacturers: Mason.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.

3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

4. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used. Acceptable Manufacturers: Copper/B-Line, Pipe Shields or Erico.

5. Unless otherwise indicated, hangers shall be as follows:

   a. Clevis Type:
      Service: Bare Metal Pipe
      Rigid Plastic Pipe
      Insulated Cold Pipe
      Insulated Hot Pipe - 3 inches & Smaller

      Acceptable Manufacturers: Anvil, Copper/B-Line, Erico or Nibco/Tolco.

   b. Adjustable Swivel Ring Type:
      Service: Bare Metal Pipe - 4 inches and Smaller

      Acceptable Manufacturers: Anvil, Copper/B-Line, Erico or Nibco/Tolco.

6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

   a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

   b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

   a. Clamp Type:
      Service: Bare Metal Pipe
      Rigid Plastic Pipe
      Insulated Cold Pipe
      Insulated Hot Pipe - 3 inches and smaller

      1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

      2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.

      3) Acceptable Manufacturers: Unistrut, Cooper/B-Line or Nibco/Tolco.

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps

1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists):

2) Acceptable Manufacturers: Anvil, Cooper/B-Line, Erico or Nibco/Tolco.

3) Scissor Type Beam Clamps (For use with bar-joists and wide flange):

4) Acceptable Manufacturers: Anvil, Cooper/B-Line, Erico or Nibco/Tolco.

b. Concrete

1) Concrete Inserts, Single Rod Galvanized:

2) Acceptable Manufacturers: Anvil, Cooper/B-Line, Erico or Nibco/Tolco.

3) Concrete Inserts, Continuous Strip Galvanized:

4) Acceptable Manufacturers: Unistrut, Cooper/B-Line or Erico.

5) Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

6) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports for plumbing equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Concrete bases shall be a minimum of 4 inches thick and shall extend a minimum of 3 inches on all sides of the equipment (6 inches larger than factory base).

2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6”x6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

C. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum, 302 stainless steel, 316 stainless steel, PVC coated, powder coated or zinc trivalent chromium finish.

7. Acceptable Manufacturers: Anvil , Cooper B-Line, Erico or Miro Industries.

D. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Support heavy equipment from concrete floors or hang from ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

E. Grout:

1. Grout shall be non-shrinking premixed, unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 MATERIALS FOR SEISMIC BRACING

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.

2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTSFOR SEISMIC BRACING

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade 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.

2.6 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 1011, GR 33.

2. Materials for Fittings and Accessories: ASTM A 635, 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.

2.7 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless-steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.8 SLEEVES AND LINTELS

A. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

B. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

C. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

D. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

E. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

F. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

G. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

H. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

I. Wall Seals ("Link-Seals"):

1. Pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120ºF, sleeves may be thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.

5. Sealing element shall be as follows:

Service	Element Material	Temperature Range
Standard (Stainless)	EPDM	-40ºF to 250ºF
High/Low Temperature	Silicone	-67ºF to 400ºF
Fire Seals (1 hour)	Silicone	-67ºF to 400ºF
Fire Seals (3 hours)	Silicone	-67ºF to 400ºF
Oil Resistant/Stainless	Nitrile	-40°F to 210°F

6. Acceptable Manufacturers: Thunderline "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex (cold service only).

2.9 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.10 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.11 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.12 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. UL83 - Thermoplastic-insulated Wires and Cables.

C. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Acceptable Manufacturers: 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries,

Seton, W.H. Brady, Marking Services.

K. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION: Tracer wire shall be installed on top of all non-metallic pipes.

END OF SECTION

SECTION 22 05 76

CLEANOUTS, STORM AND SANITARY

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.

B. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

C. Exterior Surfaced Areas: [Round] [Square] cast nickel bronze access frame and non-skid cover.

D. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.

E. Interior Finished Floor Areas: Lacquered] cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and [round] [square] depressed cover with gasket to accept floor finish in finished floor areas.

F. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.

G. Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

H. Acceptable Manufacturers: MIFAB, J.R. Smith or Zurn.

END OF SECTION

SECTION 22 07 00

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

B. ANSI/ASTM C534 - Elastomeric Foam Insulation.

C. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.

D. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.

E. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.

F. ASTM E84 - Surface Burning Characteristics of Building Materials.

G. NFPA 255 - Surface Burning Characteristics of Building Materials.

H. UL 723 - Surface Burning Characteristics of Building Materials.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white Kraft jacket for above grade installations.

D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300ºF; 1200ºF maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

E. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75ºF; moisture resistant; suitable for -297ºF to +300ºF.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

B. Stainless Steel Jackets: ASTM C1767. Type [304] [316] stainless steel; 0.010" thick (thicker where required by ASTM C1729); smooth finish with Z edge seams and stainless steel bands for outdoor use.

C. Plastic Jackets and Fitting Covers: High impact, glossy white, [0.020"] [0.030"] thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

B. ANSI/ASTM B32 - Solder Metal.

C. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.

D. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

E. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

F. ANSI/AWWA C153 – Compact Ductile Iron Fittings 3” through 48”, for Water and Other Liquids.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

H. ASTM B88 - Seamless Copper Water Tube.

I. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

J. NSF - National Sanitation Foundation

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE (ABOVE GROUND)
HOT WATER - POTABLE AND NON-POTABLE (ABOVE GROUND)
TEMPERED WATER - POTABLE AND NON-POTABLE (ABOVE GROUND)

A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.

B. Piping - All Sizes:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping - 4” and Under:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

2.2 COLD WATER - POTABLE AND NON-POTABLE (UNDERGROUND)
HOT WATER - POTABLE AND NON-POTABLE (UNDERGROUND)
TEMPERED WATER - POTABLE AND NON-POTABLE (UNDERGROUND)

A. Design Pressure: 150 psi.
Maximum Design Temperature: 200ºF.

B. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Brazed Alloy, BCuP-5, AWS A5.8.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping - 4” and Under:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

2.3 SERVICE WATER - POTABLE

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150ºF.

B. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

C. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts.

ANSI/AWWAC111/A21.11.

D. Piping - 2" and Under:

1. Tubing: Type K soft annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

E. Valve Box/Curb Box:

1. 2" and under, extension type curb box with arch pattern base and sufficient length to allow top to terminate flush with finished grade. Cast iron lid with integrally cast brass bushing and marked “water” in integrally cast raised letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Acceptable Manufacturers: Mueller, A.Y. McDonald, Tyler Pipe.

2. 3" through 12", extension type valve box with flat base, 5-1/4" shaft and sufficient length to allow top to terminate flush with finished grade. Cast iron lid marked “water” in integrally cast letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements.

3. Acceptable Manufacturers: Tyler Pipe.

2.4 COMBINATION WATER AND FIRE PROTECTION SERVICE
FIRE PROTECTION SERVICE

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150°F.

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

B. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

C. PVC Pressure Pipe (Outside Building-Underground):

1. Pipe: PVC pressure pipe, Class 150 Class 200 ANSI/AWWA C900 approved, bell

and spigot ends.

2. Joints: Push-On Type, elastomeric ring seal per ASTM F477, bevel spigot ends.

3. Fittings: Cast iron bell and spigot type, 150 psig 200 psig rating, corrosion protective coating outside, cement mortar lined inside, ANSI A21.10 or A21.11.

2.5 DEMINERALIZED WATER
DISTILLED WATER

A. Design Pressure: 50 psi.
Maximum Design Temperature: 120ºF

B. Piping:

1. Pipe: Schedule 40, rigid, unplasticized PVC, normal impact Type I, plain ends.

2. Joints: Solvent-weld socket type with solvent as recommended by manufacturer.

3. Fittings: Unplasticized PVC, normal impact Type I, solvent-weld socket type ends for Schedule 40 pipe. For connections to equipment, outlets and valves requiring screwed connections, use solvent socket to screwed joint PVC adapters or unions.

4. Special Requirements: Schedule 40 PVC pipe.

C. Shutoff/Throttling Valves:

1. 2" and under, 125 psi at 95°F, 35 psi at 140°F, socket weld, PVC, true union ball valve with PTFE ball seats, EPDM O-ring seals. Acceptable Manufacturers: Georg Fischer, Asahi Omni, Nibco.

2. 2-1/2” to 6”, 80 psi at 100°F, 25 psi at 140°F, socket weld, PVC, true union ball valve with PTFE ball seats, EPDM O-ring seals. Acceptable Manufacturers: Georg Fischer, Asahi Omni, Nibco.

3. 2" and under, 125# CWP @ 75ºF, socket weld, normal impact PVC, Teflon faced diaphragm. Acceptable Manufacturers: Cabot Corp, Nibco/Chemtrol.

D. Check Valves:

1. All sizes, 125# CWP @ 75ºF, socket weld, normal impact PVC, ball type. Cabot Corp, Nibco/Chemtrol.

2.6 DEIONIZED (DI) AND REVERSE OSMOSIS (RO) WATER

A. Design Pressure: 150 psi at 70ºF

B. Piping: Ducted Returns

1. Pipe: Schedule 80 polypropylene without plasticizers or pigments, ASTM D-1785.

2. Joints: Fused type.

3. Fittings: Polypropylene socket fused or flanged fittings, ASTM D-4101.

4. Products: All manufacturers must have approval to furnish this system. Purity test data and fitting samples are required for evaluation of equivalency.

C. Acceptable products are as follows: Acceptable Manufacturers: Georg Fischer - PPRO-Seal, Enfield, Nibco/Chemtrol, Orion pure water piping.

D. Piping: Non-Ducted Returns

1. Pipe: Schedule 80 CPVC without plasticizers or pigments, ASTM D-1785.

2. Joints: Solvent type.

3. Fittings: CPVC socket type, ASTM D-4101.

4. Products: All manufacturers must have approval to furnish this system. Purity test data and fitting samples are required for evaluation of equivalency.

E. Acceptable Manufacturers: Corzan.

F. Shutoff and Throttling Valves:

1. Ball Valves:

a. 2" and under, 150 psi at 70°F, true union type, polypropylene or PVDF body and ball, PTFE or Viton seats and "O" rings. Acceptable Manufacturers: Sloun, ASAHI, Georg Fischer Plastics, Chemtrol.

b. 3" and 4", 150 psi at 73°F, flanged, virgin polypropylene or PVDF body and ball, PTFE seats and "O" rings. Acceptable Manufacturers: ASAHI, Chemtrol.

G. Check Valves:

1. PVDF or natural polypropylene with PTFE or Viton seats, flanged or true union ends, 75 psi at 140ºF. Acceptable Manufacturers: ASAHI (swing check with PVDF or PTFE coated SS hinge) or Enfield (ball type mounted in vertical pipe with upward flow),:Nibco/Chemtrol.

END OF SECTION

SECTION 22 11 19

BACKFLOW PREVENTERS

PART 1 - GENERAL

1.1 REFERENCES

A. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 1.

B. ASSE 1015 – Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers: ¾” – 2”, comply with ASSE 1013, Lead free, Bronze body, with corrosion resistant internal parts, two independently operating positive seating spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; assembled with two ball valves, and four test cocks. Acceptable Manufacturers: Watts, Zurn, Wilkins.

B. Reduced Pressure Backflow Preventers: 2 1/2” – 10”, comply with ASSE 1013, Lead free, FDA/NSF epoxy coated cast iron body, two independently operating positive seating spring loaded check valves, diaphragm type differential pressure relief valve located between check valves, assembled with two OS&Y gate valves, and four test cocks. Acceptable Manufacturers: Watts, Zurn, Wilkins.

C. Double Check Valve Assemblies: ¾” – 2”, comply with ASSE 1015 or AWWA C510; Lead free, Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves, two ball valves, and four test cocks . Acceptable Manufacturers: Watts, Zurn, Wilkins.

D. Double Check Valve Assemblies: 2 1/2” – 10”, comply with ASSE 1015 or AWWA C510; Lead free, Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves, two OS&Y gate valves, and four test cocks . Acceptable Manufacturers: Watts, Zurn, Wilkins.

END OF SECTION

SECTION 22 13 00

FACILITY STORM AND SANITARY PIPE AND FITTINGS

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASME A112.3.1 – Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.

B. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

C. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

D. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

E. ANSI/ASTM B32 - Solder Metal.

F. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.

G. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

H. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

I. ANSI/AWWA C153 – Compact Ductile Iron Fittings 3” through 48”, for Water and Other Liquids.

J. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

K. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.

L. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.

M. ASTM B88 - Seamless Copper Water Tube.

N. ASTM B306 - Copper Drainage Tube (DWV).

O. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

P. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

Q. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

R. FM 1680 - Couplings Used in Hubless Cast Iron Systems.

S. NSF - National Sanitation Foundation

PART 2 - PRODUCTS

2.1 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
STORM DRAINAGE (ABOVE GROUND)

A. Piping:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

2. Joints: Compression gasket, ASTM C564.

3. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

4. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

5. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.2 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
SANITARY VENT (BELOW GROUND - INSIDE BUILDING)
STORM DRAINAGE (BELOW GROUND - INSIDE BUILDING)

A. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF certified, CISPI trademark.

2. Joints: Compression gasket, ASTM C564.

3. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

4. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

5. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.3 GREASE SANITARY DRAINAGE (BELOW GROUND)
GREASE SANITARY DRAINAGE (ABOVE GROUND)
GREASE SANITARY VENT (BELOW GROUND)
GREASE SANITARY VENT (ABOVE GROUND)

A. Piping – 2” through 8”:

1. Pipe: Stainless Steel Type 316L, ASME A112.3.1

2. Fittings: Stainless Steel Type 316L, ASME A112.3.1, push-on joints.

3. Joints: Push-on joint with integral rubber gaskets suitable for use with greasy waste typical for kitchen grease sanitary applications.

4. Adapters: Transition from stainless steel pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C564, 300 Series stainless steel shield, clamp and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

5. Acceptable Manufacturers: Blucher, Watts, Josam, or approved equivalent.

B. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, epoxy paint corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.4 SANITARY - PUMPED (BELOW GROUND - OUTSIDE OF BUILDING)
STORM - PUMPED (BELOW GROUND - OUTSIDE OF BUILDING)

A. Piping - All Sizes:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, long radius, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

B. Piping - All Sizes:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar line per ANSI/AWWA C104/A21.4, long radius, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts, ANSI/AWWA C111/A21.11.

2.5 SANITARY - PUMPED (BELOW GROUND - INSIDE BUILDING)
STORM - PUMPED (BELOW GROUND – INSIDE BUILDING)

A. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Brazed Alloy, BCuP-5, AWS A5.8.

3. Fittings: Long Radius Style, Wrought copper solder joint, ANSI B16.22.

2.6 SANITARY – PUMPED (ABOVE GROUND)
STORM - PUMPED (ABOVE GROUND)

A. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Long Radius Style, Wrought copper solder joint, ANSI B16.22.

B. Piping - 4" and Under:

1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Galvanized cast iron screwed drainage type, ANSI B16.12, long radius.

2.7 CONDENSATE DRAINAGE

A. Piping - 1-1/4" through 4":

1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.

1. Pipe: Type M hard temper seamless copper drainage tube, ASTM B306.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

END OF SECTION

SECTION 22 13 19

FLOOR DRAINS

PART 1 - GENERAL

1.1 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.21.1 - Floor Drains.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS AND SINKS

A. Interior Floor Drain: ASME A112.21.1; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

B. Interior Floor Drain: ASME A112.21.1; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable [round] [square] nickel-bronze strainer with removable perforated sediment bucket.

C. Interior Floor Drain: ASME A112.21.1; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer.

D. Interior Floor Drain: ASME A112.21.1; lacquered cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer with hinged grate and sediment bucket.

E. Exterior Surfaced Areas: [Round] [Square] cast nickel bronze access frame and non-skid cover.

F. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.

G. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

2.2 FLOOR SINKS

A. Lacquered cast iron body with dome strainer and seepage flange.

B. [Round] [Square] lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, clamp collar, sediment bucket, epoxy coated, nickel bronze frame and [full] [half] grate.

C. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

END OF SECTION

SECTION 22 14 26

ROOF DRAINS

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI A112.21.2 - Roof Drains.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

A. Roof Drain: Assembly: ASME A112.21.2M, Body: [Lacquered] [Galvanized] cast iron with sump, Strainer: Removable cast iron dome with vandal proof screws, Accessories: Coordinate with roofing type:

1. Membrane flange and membrane clamp with integral gravel stop.
2. Adjustable under deck clamp.
3. Roof sump receiver.
4. Waterproofing flange.
5. Controlled flow weir.
6. Leveling frame.
7. Adjustable extension sleeve for roof insulation.
8. Perforated or slotted ballast guard extension for inverted roof.
9. Perforated stainless steel ballast guard extension.

B. Overflow Drain: Assembly: ASME A112.21.2M, Body: [Lacquered] [Galvanized] cast iron with sump, Strainer: Removable cast iron dome with vandal proof screws, Accessories: Coordinate with roofing type:

1. Membrane flange and membrane clamp with integral gravel stop.
2. Adjustable under deck clamp.
3. Roof sump receiver.
4. Waterproofing flange.
5. Controlled flow weir.
6. Leveling frame.
7. Adjustable extension sleeve for roof insulation.
8. Perforated or slotted ballast guard extension for inverted roof.

9. Perforated stainless steel ballast guard extension.

10. 2” water dam.

C. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

2.2 CANOPY AND CORNICE DRAINS

A. [Lacquered] [Galvanized] cast iron body with aluminum flashing clamp collar and [epoxy coated] [nickel bronze] flat strainer.

B. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

2.3 DOWNSPOUT NOZZLES

A. Product Description: [Cast] [Nickel] [Polished] bronze body and wall flange round with [straight] [offset] bottom section.

B. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

END OF SECTION

SECTION 22 14 26.16

FACILITY AREA DRAINS

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI A112.21.2 - Roof Drains.

PART 2 - PRODUCTS

2.1 AREA DRAINS

A. Area Drain: ASME A112.21.1M; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

1. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

B. Area Drain:

1. Assembly: ASME A112.21.1M. Body: Lacquered cast iron with sump. Strainer: [Round] [Square] nickel-bronze.

2. Accessories: Membrane flange and membrane clamp with integral gravel stop, with [adjustable under deck clamp] [roof sump receiver] [waterproofing flange] [leveling frame] [adjustable extension sleeve (for insulation)] [perforated or slotted ballast guard extension for inverted roof] [perforated stainless steel ballast guard extension].

3. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

2.2 EXTERIOR PLANTER DRAINS

A. ASME A112.21.1M; lacquered cast iron body with sump, Strainer: Removable cast iron dome with [stainless steel] [bronze] screen, Accessories: Membrane flange and membrane clamp with integral gravel stops.

1. Acceptable Manufacturers: MIFAB, J. R. Smith or Zurn.

END OF SECTION

SECTION 22 15 00

COMPRESSED AIR EQUIPMENT

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

B. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

C. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

E. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

PART 2 - PRODUCTS

2.1 TYPE

A. Provide simplex compressor unit consisting of single-stage, air-cooled motor-compressor, air receiver, filter regulator, rubber isolators, and operating controls.

B. Acceptable Manufacturers: Ingersoll-Rand, Champion, Quincy, or Curtis.

2.2 COMPRESSOR CONSTRUCTION

A. Construct compressor with cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connecting rods, aluminum pistons with non-lubricated carbon rings, and high-strength alloy suction and discharge valves. Statically and dynamically balance rotating parts.

B. Provide oil pressure switch to shut down compressor.

C. Provide automatic capacity reduction equipment consisting of suction valve unloaders, and lifting mechanism operated by oil pressure gas discharge pressure solenoid valve centrifugal force. Provide for unloaded compressor start.

D. Mount motor and compressor on one-piece ribbed cast iron or welded steel base with provision for V-belt adjustment.

E. Provide thermostatically controlled water valve on compressor to maintain water temperature through compressor at 98ºF to 109ºF.

F. The compressor modules and motors shall be fully isolated from the main compressor base by means of a four-point; heavy-duty seismic-restrained California-approved isolation system for a minimum of 95% isolation efficiency. Engineering data shall be provided supporting isolation efficiency and equal weight distribution between supports. Pumps not having this feature shall have an inertia base sized for that system installed at this contractor’s expense.

2.3 AIR RECEIVER

A. Provide [_____] gallon [vertical] [horizontal] receiver, ASME stamped [125] [175] [250] [_____] psi working pressure. Receivers shall meet requirements of ASME Code for Unfired Pressure Vessels and bear ASME approval stamp. Flanged or screwed inlet and outlet connections.

B. Fittings: Adjustable pressure regulator, safety valve, pressure gauge, drain cock, and automatic drain trap.

C. Tank Finish: [Shop primed] [Hot-dipped galvanized] [Shop vinyl].

2.4 FILTER REGULATOR

A. Push-pull, non-rising knob allows one-hand adjustment.

B. Balanced valve-type diaphragm regulation ensures positive pressure adjustment.

C. Regulator offers in-line repairability. Valve and diaphragm can be replaced without removing unit from line.

D. Automatic drain.

E. 10 psig minimum operating pressure.

2.5 CONTROLS

A. Adjustable pressure switch set to cut out at 100 psi with minimum differential of 20 psi.

2.6 PIPING

A. Design Pressure: 125 psi.
Maximum Design Temperature: 350ºF

B. Piping - 2" and Under:

1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.

2. Joints: Screwed. (For below ground, all sizes to have welded joints, primed and painted.)

3. Fittings: 150# steam 300# CWP, galvanized malleable iron, banded, ASTM A197, ANSI B16.3.

4. Unions: 250# steam - 500# CWP, galvanized malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight galvanized steel, beveled ends, ASTM A53.

2. Joints: Butt welded and flanged. (All welded joints shall be ground, primed, and painted.)

3. Fittings: Standard weight seamless galvanized steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.

4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5.

D. Shutoff Valves:

1. Ball Valves:

a. 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Acceptable Manufacturers: Apollo, Stockham, Milwaukee, Watts, Nibco, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Acceptable Manufactures: Apollo, Stockham, Nibco, Milwaukee.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2. Plug Valves:

a. 2" and under, 125# steam @ 450ºF, 175# CWP @ 180ºF, cast iron body, screwed, full port. Acceptable Manufactures: Walworth, DeZurik.

b. 2-1/2" thru 4", 125# steam @ 450ºF, 175# CWP @ 180ºF, flanged, cast iron body, full port. Acceptable Manufactures: Walworth, DeZurik.

c. 6" and larger, 125# steam @ 450ºF, 175# CWP, cast iron body, flanged, resilient faced plug, gear and handwheel operator, full port. Acceptable Manufactures: Walworth, DeZurik.

E. Throttling Valves:

1. Globe Valves:

a. 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Acceptable Manufactures: Crane, Stockham, Walworth, Milwaukee, Hammond, Watts, Nibco.

b. 2-1/2" thru 10", 125# steam @ 450ºF, 200# CWP @ 150ºF, flanged, iron body, bronze mounted. Acceptable Manufactures: Crane, Hammond, Stockham, Walworth, Milwaukee, Watts, Nibco.

F. Check Valves:

1. 2" and under, 250# CWP, screwed, all iron, horizontal swing. Crane #346-1/2.

2. 2-1/2" thru 12", 125# steam @ 450ºF, 200# CWP @ 150ºF, flanged, all iron, horizontal swing. Acceptable Manufactures: Crane, Hammond, Stockham, Walworth, Milwaukee, Watts, Nibco.

3. 2" and larger, 125# CWP, flanged, iron body, cast iron or carbon steel body with stainless steel internals. Acceptable Manufactures: Hoerbiger Design "CT". NOTE: Use only for compressor discharge.

G. Strainers:

1. Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi CWP @ 150°F. Acceptable Manufactures: Armstrong, Metraflex, Mueller Steam Specialty Co, Sarco, Watts.

2. Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 300# CWP @ 150°F. Acceptable Manufactures: Armstrong, Metraflex, Mueller Steam Specialty Co., Sarco.

2.7 COMPRESSED AIR FILTERS

A. Filters shall have a stainless steel sleeve, micro-glass media with epoxy coating, elastomeric filter to housing seal and sealed end caps.

B. Filters shall be capable of removing the following:

1. All solids 3 microns and larger.

2. Liquids up to 25,000 ppm by weight.

3. 99% of water droplets.

4. 40% of oil aerosols.

C. Provide a differential pressure alarm for each filter. Range shall be adjustable from 10 to 35 psi differential at 100 psig.

D. Acceptable Manufacturer: Hankison.

2.8 COMPRESSED AIR CONDENSATE TRAPS

A. Furnish and install traps of the type and capacity shown on the drawings.

B. Traps shall be mechanically actuated with stainless steel construction, and 10-300 psig working pressure.

C. Acceptable Manufacturer: Hankison.

END OF SECTION

SECTION 22 34 36

WATER HEATERS

PART 1 - GENERAL

1.1 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. American Society of Mechanical Engineers:

1. ASME PTC 25 - Pressure Relief Devices.

2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/ASME Section 8D - Pressure Vessels.

E. ANSI Section 21.10.1 or Section ANSI 21.10.3 - Gas Water Heaters Ratings 75,000 BTU per Hour and Less.

F. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.

G. ANSI/NFPA 54 - National Fuel Gas Code.

H. ANSI/NFPA 70 - National Electrical Code.

I. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.

J. ASSE 1005 - Water Heater Drain Valves, 3/4" Iron Pipe Size.

K. UL 174 - Household Electric Storage Tank Water Heaters.

L. American National Standards Institute:

1. ANSI Z21.10.1 - Gas Water Heaters Vol. I Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.

2. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.

M. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

N. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

O. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

1.2 REGULATORY REQUIREMENTS

A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.

B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.

C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

A. Type: Factory-assembled and wired, electric, vertical storage.

B. Tank: [Glass lined] [Copper lined] welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches [glass fiber] [polyurethane] encased in corrosion-resistant steel jacket; baked-on enamel finish.

C. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.

D. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

E. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 Watts per square inch.

1. Acceptable Manufacturers: Lochinvar, A.O. Smith, Bradford White, or Rheem.

2.2 GAS FIRED WATER HEATERS

A. Type: Automatic, natural gas-fired, vertical storage.

B. Tank: Copper lined or Nickel (nickel/phosphorus) coating.

C. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

1. Approval: By AGA as automatic storage water heater.

2. Acceptable Manufacturers: Lochinvar, A.O. Smith, Bradford White, or Rheem.

2.3 DOMESTIC WATER EXPANSION TANK

A. Precharged welded steel tank with air charging valve and removable heavy duty butyl/ EPDM diaphragm or bladder separating water and air with a working pressure of 150 psig. All internal parts shall comply with FDA regulations and approvals. The tank shall have NPT stainless steel connection, gauge glass openings and drain and be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. For model number see schedule on the drawings. Acceptable Manufacturers: Amtrol.

2.4 AQUASTATS

A. Provide immersed type adjustable volatile liquid mercury tube switch similar to Mercoid Type DA-37-2 Range 5 (l pole single), similar to Mercoid Type DA-37-127 Range 5 (2 pole duplex). Set in oversized tee and nipple in hot water return line for automatically controlling hot water circulators and hot water circulating pumps. Acceptable Manufacturers: Honeywell.

2.5 TIME SWITCH

A. Provide an adjustable heavy duty self-starting synchronous motor clock (120 volt) in NEMA-1 enclosure for automatically controlling hot water circulators.

B. Clock shall have seven-day calendar dial. Acceptable Manufacturers: Tork.

2.6 IN-LINE CIRCULATION PUMPS

A. All bronze construction body, stainless steel face plate, 30% glass filled Noryl impeller, carbon steel shaft, stainless steel shaft sleeve, mechanical, carbon on silicon carbide seal, sealed precision steel ball bearing permanently lubricated motor bearings, maximum operating pressure of 150 psi; 1/12 HP, 115 volts, 2650 rpm, non-overloading type motor, drip-proof. Acceptable Manufacturers: Bell and Gossett, Grundfos, Taco.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 REFERENCES

A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall Hung Fixture Carriers:

1. Material: All Metal, ASME/ANSI A112.6.1M.

2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.

3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.

B. All china shall be from the same manufacturer where possible.

C. All lavatory and sink trim shall be from the same manufacturer where possible.

D. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

2.2 TRAPS

A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:

1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.

2. Insulated at accessible lavatories and sinks.

3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.

4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.

2.3 TRAP SEALS AND PRIMERS

A. Trap primers shall be pressure drop activated and be of all brass construction including a brass body with ½-inch male NPT inlet and ½-inch female NPT discharge. Internal components shall consist of a stainless steel debris screen, brass piston and brass discharge jet. Lubricated O-rings shall be EPDM and seal O-rings shall be nitrile. The trap primer shall be designed to operate upon a drop in line pressure of 10 psi. Working pressure shall be 35psi to 75 psi and a working temperature range of range of -40° to 450°F. Valves shall be listed with ASSE 1018. Acceptable Manufacturers: Precision Plumbing Products, Watts, Sioux Chief.

B. Trap primer enclosed in a NEMA-1 enclosure, flush mounted box, with a ½-inch NPT female inlet complying with ANSI/ASME BI.20.1, outlet shall be ½-inch compression fitting, with a 5/8-inch Type "L" copper tubing manifold complying with ASTM B88, provide with circuit breaker, switch, timer, manual override, solenoid valve marked as UL Listed, electronic assembly tested and certified per UL #73, and backflow device anti-siphon atmospheric vacuum breaker meets IAPMO, ASSE 1001 and CSA. Unit shall comply with ASSE Standard No. 1018. Working pressure shall be 35psi to 75 psi and a working temperature range of range of -40°F to 450°F. Acceptable Manufacturers: Precision Plumbing Products, Sioux Chief, Zurn.

2.4 WATER HAMMER ARRESTORS:

A. Water hammer constructed of type K hard drawn copper, cap attached by 95-5 solder joint, piston and threaded adapter of machined brass, “O”-ring constructed in compliance with EP-5778-80, silicon seal lubricant, operating pressures of 35 to 250 psi, spike pressures of 1,500 psi, temperature range -40°F to 212°F. Acceptable Manufacturers: Precision Plumbing Products, Watts, Sioux Chief.

END OF SECTION

SECTION 22 42 13

COMMERCIAL WATER CLOSETS AND URINALS

PART 1 - GENERAL

1.1 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.18.1 - Plumbing Fixture Fittings.

2. ASME A112.19.2M - Vitreous China Plumbing Fixtures.

PART 2 - PRODUCTS

2.1 WATER CLOSET, FLOOR MOUNTED

A. Bowl: ANSI A112.19.2M; 1.28 gallons per flush, commercial type, siphon jet, white vitreous china closet bowl with elongated rim, 1-1/2" spud and china bolt caps. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.18.1; 1.28 gallons per flush, exposed chrome plated, diaphragm type with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, escutcheon, vacuum breaker, integral screwdriver stops. Acceptable Manufacturers: Sloan Model No. 110.

C. Seat: Solid elongated white plastic, open front, stainless steel posts, and self-sustaining hinge. Acceptable Manufacturers: Church, Olsonite, Bemis.

2.2 WATER CLOSET, FLOOR MOUNTED, ACCESSIBLE

A. Bowl: ANSI A112.19.2M; 1.28 gallon per flush, commercial type, siphon jet, white vitreous china closet bowl with elongated rim, 17" to 19” to top of seat, 1-1/2" top spud and china bolt caps. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.18.1; 1.28 gallons per flush, exposed chrome plated, diaphragm with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, escutcheon, vacuum breaker, integral screwdriver stops. Acceptable Manufacturers: Sloan Model No. 110.

C. Seat: Solid elongated white plastic, open front, stainless steel posts, and self-sustaining hinge. Acceptable Manufacturers: Church, Olsonite, Bemis.

2.3 WATER CLOSET, WALL HUNG

A. Bowl: ANSI A112.19.2M; 1.28 gallons per flush, commercial type, siphon jet, white vitreous china closet bowl with elongated rim, 1-1/2" spud and china bolt caps. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.19.2; 1.28 gallons per flush, exposed chrome plated, diaphragm type with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, escutcheon, vacuum breaker, integral screwdriver stops. Acceptable Manufacturers: Sloan Model No. 110.

C. Seat: Solid elongated white plastic, open front, stainless steel posts, and self-sustaining hinge. Acceptable Manufacturers: Church, Olsonite, Bemis.

2.4 WATER CLOSET, WALL HUNG, ACCESSIBLE

A. Bowl: ANSI A112.19.2M; 1.28 gallons per flush, commercial type, siphon jet, white vitreous china closet bowl with elongated rim, 17" to 19” to top of seat, 1-1/2" spud and china bolt caps. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.19.2; 1.28 gallons per flush, exposed chrome plated, diaphragm with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, vacuum breaker, integral screwdriver stops. Acceptable Manufacturers: Sloan Model No. 110.

C. Seat: Solid elongated white plastic, open front, stainless steel posts, and self-sustaining hinge. Acceptable Manufacturers: Church, Olsonite, Bemis.

2.5 WATER CLOSET, FLOOR MOUNTED, FLUSH TANK

A. Bowl: ANSI A112.19.2M; 1.28 gallons per flush, pressure assisted, commercial type, siphon jet, white vitreous china closet with round front bowl, close-coupled tank and china bolt caps. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Seat: Solid white plastic, open front with stainless steel hinge posts. Acceptable Manufacturers: Church, Olsonite, Bemis.

2.6 URINAL, WALL HUNG

A. Urinal: ANSI A112.19.2M; white vitreous china, 1/8 gallon per flush, commercial type, siphon jet with flushing rim, integral trap, and 3/4 inch top spud. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, escutcheon, vacuum breaker. Acceptable Manufacturer: Sloan.

C. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.7 URINAL, WALL HUNG, ACCESSIBLE

A. Urinal: ANSI A112.19.2M; white vitreous china, 1/8 gallon per flush, commercial type, siphon jet with flushing rim, integral trap, 17” to top of rim, 14” to 17” from wall to front of rim edge, and 3/4 inch top spud. Acceptable Manufacturers: American Standard, Kohler, Eljer.

B. Flush Valve: ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating handle or hard wired infra-red sensor operated at the discretion of the campus, escutcheon, vacuum breaker. Acceptable Manufacturer: Sloan.

C. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

END OF SECTION

SECTION 22 42 16

COMMERCIAL LAVATORIES, SINKS, AND FAUCETS

PART 1 - GENERAL

1.1 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.18.1 - Plumbing Fixture Fittings.

2. ASME A112.18.2 – Plumbing Waste Fittings

3. ASME A112.19.2M - Vitreous China Plumbing Fixtures.

4. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

PART 2 - PRODUCTS

2.1 LAVATORY, WALL HUNG

A. Basin: ANSI A112.19.2M; vitreous china lavatory, approximately 20” x 18” rectangular basin, self-draining deck area, contoured splash shields, 4-inch high back, faucet ledge, 4-inch center drilling, front overflow, and concealed arm supports. Acceptable Manufacturers: American Standard and Kohler.

B. Trim:

1. Faucet: ANSI A112.18.1; chrome plated combination supply fitting with a cast brass body, adjustable time cycle, vandal resistant, with 0.35 gpm or 0.5 gpm aerator, manual metered faucet. Adjust between 2 and 15 seconds. Acceptable Manufacturers: Chicago Model No. 333-665E39PSHABCP or Chicago Model No. 3400-ABCP.

2. P-trap: 1 ¼” by 1 ½” chrome plated 17 gage cast brass, L.A. pattern, with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: ANSI/ASME A112.18.2, chrome plated, brass construction, open grid strainer, 1 ¼” tailpiece. Acceptable Manufacturers: Chicago Faucet, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8”, loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.2 LAVATORY, ACCESSIBLE WALL HUNG

A. Basin: ANSI A112.19.2M; vitreous china lavatory, approximately 20” x 18” rectangular basin, self-draining deck area, contoured splash shields, 4-inch high back, faucet ledge, 4-inch center drilling, front overflow, and concealed arm supports. Acceptable Manufacturers: American Standard and Kohler.

B. Trim:

1. Faucet: ANSI A112.18.1; chrome plated combination supply fitting with a cast brass body, adjustable time cycle, vandal resistant, with 0.35 gpm or 0.5 gpm aerator, manual metered faucet. Adjust between 2 and 15 seconds. Acceptable Manufacturers: Chicago Model No. 333-665E39PSHABCP or Chicago Model No. 3400-ABCP.

2. P-trap: 1 ¼" by 1 ½" chrome plated 17 gage cast brass, L.A. pattern, with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: ANSI/ASME A112.18.2, chrome plated, brass construction, open grid strainer, 1 ¼" tailpiece. Acceptable Manufacturers: Chicago Faucet, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.3 LAVATORY, COUNTER TOP

A. Basin: ANSI A112.19.2M; vitreous china, approximately 20" x 17" oval basin, self-rimming, faucet ledge, 4-inch center drilling with front overflow. Acceptable Manufacturers: American Standard, Kohler.

B. Trim:

1. Faucet: ANSI A112.18.1; chrome plated combination supply fitting with a cast brass body, adjustable time cycle, vandal resistant, with 0.35 gpm or 0.5 gpm aerator, manual metered faucet. Adjust between 2 and 15 seconds. Acceptable Manufacturers: Chicago Model No. 333-665E39PSHABCP or Chicago Model No. 3400-ABCP.

2. P-trap: 1 ¼" by 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: chrome plated, brass construction, open grid strainer, 1 ¼" tailpiece. Acceptable Manufacturers: Chicago Faucet, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.4 LAVATORY, ACCESSIBLE COUNTER TOP

A. Basin: ANSI A112.19.2M; vitreous china, approximately 20" x 17" oval basin, self-rimming, faucet ledge, 4-inch center drilling with front overflow. Acceptable Manufacturers: American Standard, Kohler.

B. Trim:

1. Faucet: ANSI A112.18.1; chrome plated combination supply fitting with a cast brass body, adjustable time cycle, vandal resistant, with 0.35 gpm or 0.5 gpm aerator, manual metered faucet. Adjust between 2 and 15 seconds. Acceptable Manufacturers: Chicago Model No. 333-665E39PSHABCP or Chicago Model No. 3400-ABCP.

2. P-trap: 1 ¼" by 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: chrome plated, brass construction, open grid strainer, 1 ¼" tailpiece. Acceptable Manufacturers: Chicago Faucet, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.5 SINK, SINGLE COMPARTMENT

A. Bowl: ANSI A112.19.3; outside dimension approximately 20" x 19", 7-1/2-inch deep, 18 gage thick, Type 304 stainless steel, self-rimming with undercoating, three hole punching, 3-1/2 inch strainer, ledgeback drilled for trim. Acceptable Manufacturers: Elkay, Just.

B. Trim:

1. Faucet: ANSI A112.18.1; deck mounted, gooseneck spout, chrome plated with a cast brass body, vandal resistant, with 1.5 gpm aerator, manually operated sensor. Acceptable Manufacturers: Chicago Faucet.

2. P-trap: 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: 3-1/2", Type 304 stainless steel, basket strainer, 1 1/2" tailpiece. Acceptable Manufacturers: Chicago Faucet, Just, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.6 SINK, ACCESSIBLE SINGLE COMPARTMENT

A. Bowl: ANSI A112.19.3; outside dimension approximately 20" x 19", 5-inch deep outside dimensions, 18 gage thick, Type 304 stainless steel, self-rimming with undercoating, single hole punching, 3-1/2 inch strainer, ledgeback drilled for trim. Acceptable Manufacturers: Elkay, Just.

B. Trim:

1. Faucet: ANSI A112.18.1; deck mounted, gooseneck spout, chrome plated with a cast brass body, vandal resistant, with 1.5 gpm aerator, manually operated sensor. Acceptable Manufacturers: Chicago Faucet.

2. P-trap: 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: 3-1/2", Type 304 stainless steel, basket strainer, 1 1/2" tailpiece. Acceptable Manufacturers: Chicago Faucet, Just, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.7 SINK, DOUBLE COMPARTMENT

A. Bowl: ANSI A112.19.3; outside dimension approximately 19" x 33" x 7 ½ inch deep, 18 gage thick, Type 304 stainless steel, self-rimming with undercoating, three hole punching, 3-1/2 inch strainer on right and strainer on left bowl, ledgeback drilled for trim, disposer under right bowl. Acceptable Manufacturers: Elkay, Just.

B. Trim:

1. Faucet: ANSI A112.18.1; deck mounted, gooseneck spout, chrome plated with a cast brass body, vandal resistant, with 1.5 gpm aerator, manually operated sensor. Acceptable Manufacturers: Chicago Faucet.

2. P-trap: 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: 3-1/2", Type 304 stainless steel, basket strainer, 1 1/2" tailpiece. Acceptable Manufacturers: Chicago Faucet, Just, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.8 SINK, ACCESSIBLE DOUBLE COMPARTMENT

A. Bowl: ANSI A112.19.3; 19" x 33" x 5-inch deep, 18 gage thick, Type 304 stainless steel, self-rimming with undercoating, three hole punching, 3-1/2 inch strainer on left bowl, ledgeback drilled for trim, disposer under right bowl. Acceptable Manufacturers: Elkay, Just.

B. Trim:

1. Faucet: ANSI A112.18.1; deck mounted, gooseneck spout, chrome plated with a cast brass body, vandal resistant, with 1.5 gpm aerator, manually operated sensor. Acceptable Manufacturers; Chicago Faucet.

2. P-trap: 1 ½" chrome plated 17 gage cast brass, L.A. pattern with secured escutcheon. Acceptable Manufacturers: McGuire.

3. Drain: 3-1/2", Type 304 stainless steel, basket strainer, 1 1/2" tailpiece. Acceptable Manufacturers: Chicago Faucet, Just, Elkay.

4. Stops and Supplies: angle stops, lock shield type, 3/8", loose key, and flexible supplies. Acceptable Manufacturers: Chicago Faucet, Brasscraft.

2.9 INSULATION KIT

A. Where lavatories or sinks are noted to be insulated for ADA compliance, furnish the following: Safety covers conforming to ANSI A177.1, ASTM E84-07 and consisting of insulation kit of molded closet cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves and supply piping. Acceptable Manufacturers: Truebro.

2.10 MOP SINK, FLOOR MOUNTED

A. Bowl: Enameled cast iron, corner type, with 3" IPS drain and flat chrome grid strainer and vinyl rim guard. Acceptable Manufacturers; American Standard, Kohler, CECO

B. Trim: ANSI A112.18.1; wall mounted, lever handles, chrome plated, integral check valves, integral stop valves with vacuum breaker, pail hook and 3/4"-inch hose thread outlet. Acceptable Manufacturers; Chicago Faucet.

END OF SECTION

SECTION 22 45 16
EMERGENCY EYE WASH

PART 1 - GENERAL

1.1 AMERICAN NATIONAL STANDARDS INSTITUTE:

A. ANSI Z358.1, "Emergency Eyewash and Shower Equipment.

PART 2 - PRODUCTS

A. COMBINATION EMERGENCY SHOWER AND EYE/FACE WASH Barrier-free design with coated galvanized steel piping; ANSI Z358.1 compliant, impact-resistant plastic shower head, Chrome-plated brass 1 1/4 inch IPS stay-open ball-type shower valve operated by a 304 stainless steel pull rod having triangular handle, 304 stainless steel eye wash bowl, [chrome-plated brass] [ABS plastic] spray head assembly eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve hand operated by a large, [PVC] [304 stainless steel] [push handle] [foot pedal], and 1-1/4 inch water supply connection.

B. Acceptable Manufacturers: Haws, Bradley, Guardian.

2.2 EYE/FACE WASH - WALL MOUNTED:

A. Barrier-free design ANSI Z358.1 compliant, with stainless steel bowl; stainless steel wrap-around skirt; chrome-plated brass spray head assembly with twin, soft flow, eye wash heads and protective spray head covers; integral flow control capable of maintaining uniform flow under varying water supply conditions from 30-90 psig; Chrome-plated 1/2 inch IPS stay-open ball-type eye wash valve hand operated by a large, stainless steel push handle; chrome-plated circular face spray ring; chrome plated brass pipe and fittings; dome type strainer; 1-1/4 inch drain fitting, wall tube and trap; universal identification sign; inspection tag, and 1/2 inch water supply connection.

B. Acceptable Manufacturers: Haws, Bradley, Guardian.

2.3 EMERGENCY THERMOSTATIC MIXING VALVE:

A. ASNI Z358.1 compliant, ASSE 1071 Certified, Lead Free, Liquid-filled thermostat or bimetallic thermostat, Strainer checkstops on inlets, adjustable temperature set point, built-in cold water bypass, positive shutoff of hot supply when cold supply is lost, dial thermometer, brass construction. Acceptable Manufacturers: Bradley, Leonard.

END OF SECTION

SECTION 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 REFERENCES

A. American National Standards Institute:

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

B. American Society of Mechanical Engineers:

1. ASME A112.19.3 - Stainless Steel Plumbing Fixtures.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAIN

A. Fountain: ASME A112.19.3; Wall mounted, 2 station, stainless steel, stain finish, push-button operation, laminar flow, lead free, polished chrome plated brass bubbler head, vandal-resistant bottom plate, integral 1 1/2" trap, less filter.

B. Bottle Filling Station (Strongly encouraged): At the discretion of the Campus Facility Director, the bottle filler station may be supplied with the drinking fountain [with filter] or [without filter]. Acceptable Manufacturers: Elkay Model No. LVRCTLDDWSK

C. Trim:

1. Stops and Supplies: angle stops, lock shield type, 1/2", loose key, and flexible supplies. Acceptable Manufacturers for Stops: Chicago Faucet or Sloan. Acceptable Manufacturers for Supplies: Chicago Faucet, Brasscraft.

2.2 ELECTRIC WATER COOLER, ACCESSIBLE

A. ASME A112.19.3; Wall mounted, dual "Hi-Lo" station, electric water cooler, 18 gauge, Type 304 stainless steel, , satin finish, push-button operated, polished chrome plated bubbler with stream guard, vandal resistant bubblers, vandal resistant strainers, vandal resistant bottom plates, louver intrusion resistant grill, mounting bracket, R-134 refrigerated with integral air cooled condenser; capacity of 8 gal/hr of 50 degree F water with inlet at 80 degree F, and room temperature of 90 degree F. Acceptable Manufacturers: Halsey Taylor, Haws, Elkay.

B. Trim:

1. P-trap: 1 ¼” by 1 ½” chrome plated 17 gage cast brass, L.A. pattern, with secured escutcheon. Acceptable Manufacturers: McGuire.

2. Stops and Supplies: angle stops, lock shield type, 1/2”, loose key, and flexible supplies. Acceptable Manufacturers for Stops: Chicago Faucet or Sloan. Acceptable Manufacturers for Supplies: Chicago Faucet, Brasscraft.

END OF SECTION

SECTION 22 66 00

CHEMICAL WASTE ACID PIPING

PART 1 - GENERAL

1.1 REFERENCES

A. ASTM E-84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

B. UL 723 - Standard for Test of Surface Burning Characteristics or Building Materials.

PART 2 - PRODUCTS

2.1 ACID WASTE AND VENT

A. Piping - All Sizes:

1. Pipe: Fire retardant polypropylene Schedule 40 drainage pipe.

2. Joints:

a. Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

b. Above Floor Only: Mechanical joint with gasket, stainless steel outer sleeve and corrosion resistant nuts and bolts or threaded fittings with gasket and compression nuts.

3. Fittings: Fire retardant polypropylene DWV pattern with socket ends for electrically fused joints.

4. Limitations: For use in non-return air plenums.

5. Acceptable Manufacturers: Orion, Fuseal, Enfield.

B. Piping – All Sizes:

1. Pipe and Fittings: Polyvinylidene fluoride (PVDF) Schedule 40 drainage pipe, ASTM E-84, UL 723.

2. Joints:

a. Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

b. Above Floor Only: Mechanical joint with gasket, stainless steel outer sleeve and corrosion resistant nuts and bolts or threaded fittings with gasket and compression nuts.

3. Fittings: Polyvinylidene fluoride (PVDF) DWV pattern with socket ends for electrically fused joints.

4. Limitations: For use in return air plenums.

5. Acceptable Manufacturers: Orion, Fuseal, Enfield.

2.2 ACID WASTE AND VENT (BELOW GROUND - INSIDE/OUTSIDE BUILDING)

A. Piping - All Sizes

1. Pipe: Non-fire retardant polypropylene Schedule 40 drainage pipe.

2. Joints: Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

3. Fittings: Non-fire retardant polypropylene DWV pattern with socket ends for electrically fused joints.

4. Acceptable Manufacturers: Orion, Fuseal, Enfield.

END OF SECTION

SECTION 23 0000

MECHANICAL SYSTEM DESIGN CRITERIA

PART 1 - GENERAL

1.1 COMPLIANCE LETTER

A. Design team or design build team should provide a compliance letter with statement of fully compliant with District Design Guidelines as part of final submission documentation to the district.

1.2 DESIGN CRITERIA

A. HVAC design weather conditions:

1. Summer Design: 0.5% ASHRAE Annual Cooling

2. Winter Design: 1% ASHRAE Annual Heating

3. Humidification Design: 99% ASHRAE Annual Humidification

B. Sustainable design criteria – Building energy efficiency

1. LEED Certified as required, LEED Platinum is not desired. Meet Title - 24 Energy Efficiency Standard is required as minimum.

C. System sizing: Capacity size should be based on TRACE 700 load calculation, HAP or EnergyPro load calculation with minimum 10% safety factor. Calculations should be provided for review upon the request of the reviewers.

D. Cooling/Heating Sources and System Types

1. Cooling/Heating sources – when a central plant is available on campus: central chilled water and heating hot water system are sources of cooling and heating, variable speed drive primary/secondary or primary only pumping system, 2-way control valves (except 2 valves at the end of loop on each floor using 3-way control valves), each building should be equipped at the building utilities entrance with flow meter, supply/return water temperature, pressure sensor (in addition to DP sensor), auto control valve, and circuit setter for flow limit control.

2. Cooling/Heating sources – when there is a central plant, chilled water and heating hot water are the sources of cooling and heating.

3. Cooling/Heating sources – when there is no central plant on campus:

a. 5,000 SF and under standalone building – single AC unit electric/gas system.

b. 5,000 SF to 10.000 SF building, VRF or Rooftop AC unit with VAV with heating hot water reheat. Heat source is from gas fired water heaters.

c. > 10,000 SF building, Rooftop AC with VAV reheat with heating hot water

reheat. Heat source is from gas fired water heaters.

d. > 15,000 SF building, maximum size for one AC unit.

e. System types (Rooftop AC unit or Air Handlers):

1) 5,000 SF and under standalone building – single unit electric/gas system with VVT control if more than 2,000 SF area.

2) 5,000 SF to 10,000 SF building – VRF or Air handler with cooling only AC unit with VAV control and heating hot water reheat. VRF for main building AC is only at the campus where there is no central plant.

3) > 10,000 SF buildings, Rooftop VAV or air handler VAV with heating hot water reheat.

4) Split cooling only units for electrical rooms with transformers

5) Split cooling only units for IT equipment room with hot/cold aisle design.

6) Dedicated exhaust fan for hazardous materials storage room.

7) Other type of systems should be submitted for District approval.

f. System size limitation

1) VAV air handler maximum 15,000 CFM per unit, with fan array.

2) VAV box maximum zone 2,000 CFM.

3) VAV box reheat coils should be minimum 2-row unless proven with calculations.

g. Space temperature control

1) Dedicated zone for conference room.

2) Dedicated zone for corner office.

3) Dedicated zone for classroom.

4) One zone/sensor for same orientation offices (4 max per zone)

5) VAV interior zone with reheat coil in all classrooms, admin areas and top floor administration spaces.

6) VAV interior zone without reheat coil in all floors administration offices except top floor.

7) Dedicated zone for electrical rooms with transformer.

8) Dedicated zone for IT equipment rooms.

h. Main ducts leakage test

1) With building floor area more than 8,000 SF with main ducts VAV systems, main ducts (supply, return) should be leakage tested with maximum allowed 1% prior to connecting VAV boxes.

2) Any high static pressure exhaust main ducts (>2.5" of water column) should be leakage tested with maximum allowed 1%.

i. Main duct design

1) VAV main duct should be looped with 2/3 capacity split at split point with 1/3 of total duct run, ½ capacity at mid third run, 1/3 at the final third duct run.

2) Static pressure sensor location: it should be located 2/3 of the longest duct run from air handler.

E. Central system design criteria:

1. Campus chiller plant should be multiple chillers with adequate pipe headers for future expansion (review long term plan, 50 years look ahead), indoor type. Initial chiller capacity should be designed at 65% each, total 2 chillers.

2. Campus chilled water system should have delta T at least 16F, variable flow primary system, constant temperature with seasonal resettable capability.

3. Chillers should be water cooled with cooling towers.

4. Water cooled chillers should be centrifugal type with full load minimum IPLV =<0.5 kW/Ton.

5. All chillers should be equipped with sound attenuation option, variable speed drive, compressor sound blankets.

6. Cooling towers should stay away from any building outdoor air intakes at least 60 ft.

7. Air cooled chillers should be only allowed under 300 Tons.

8. Evaporative condensers are not allowed.

9. Campus heating hot water heaters should be multiple, at 65% each if total of 2, condensing type, resettable, indoor type. Decentralized building heating hot water heaters should not consider condensing type unless it is indoor type.

10. Treat condensate from boilers using neutralizers prior to discharge condensate to sewer system.

11. Both chillers and boilers shall be located indoor.

12. Boiler size shall be limited to under 2 MMBtu/Hr.

F. Electrical rooms with transformer(s), IDF/MDF rooms cooling should be standalone electric

cooling with split or VRF systems with low ambient (32ºF) option cooling unit. If budget allows, chilled water source in building is nearby, design double source cooling system – chilled water and electric cooling split as dual source of cooling for redundancy. All rooms should be equipped with an independent temperature sensor that is connected to BMS for high temperature monitoring. Room AC control should be BACnet compatible and connected to BMS. BMS should be able to start/stop AC units in these rooms.

G. All fume hood shall be connected to BMS for monitoring.

H. CO2 sensors should be provided for ventilation control in high-level occupancies like classrooms, auditorium, cafeteria, conference rooms.

I. All piping, duct systems including supply, return, exhaust should be calculated for static pressure loss. The calculation should be available for review upon request.

J. Duct/Pipe sizing criteria.

1. Ductwork: Main duct (non-grease duct) velocity 1,800 FPM maximum; Branch duct 0.08”/100 Ft duct run.

2. Pipe: Velocity: indoor pipe 8 FPS max; outdoor main pipe 12 FPS max.
Pressure drop: 4 Ft WC/100 Ft pipe run.

K. Piping system isolation requirements

1. Each building, each type of piping system (chilled water, heating hot water) should be able shut off.

2. Each floor, each type of piping system should be able to shut off.

3. Each zone maximum 6,000 SF, piping zone should have isolation valves.

4. Each VAV box reheat coil should have isolation valves for unit replacement purpose.

5. Each equipment piping connection should have isolation valves for unit replacement purpose.

6. For pipes equal or larger than 1-1/2” should be equipped with gate valve for isolation on both floor level and main branches.

L. Water systems should be added with dye, blue for chilled water, red for heating hot water.

M. All pumps should be started with proof of water flow signal, a flow sensor is required for every pump.

N. Roof equipment leak protection and prevention:

1. All equipment curb flash sheet metal should be stainless steel.

2. Rooftop AC units should be side supply and side return to minimize the noise transferring to floor below.

3. Roof ducts penetrating roof should be thru an enclosure with side penetration

only (doghouse). Horizontal roof penetrations are not allowed.

4. Roof piping bundle (more than 4 pipes) penetrating roof should be thru an enclosure with side penetration only (doghouse).

O. For culinary department kitchen, gas stoves should be equipped with electric ignitor if possible to prevent relite the gas pilots after gas outage.

P. Fire damper, smoke damper and fire/smoke damper with electric actuators should be equipped with ceiling test station with red, green indicators. The dampers should also be equipped with double end switches that are connected to BMS or Fire Alarm system for remote monitoring.

Q. All valves, controller, VAV boxes, damper actuators should have access for maintenance. The ceiling access should be minimum 24”x24”. Electronic devices should be 30” clearance min. Valves should be 24” min clearance space for service. At the end of project construction, an access compliance letter should be signed by the college maintenance director as part of closing documents.

R. Roof walking pads should be provided for all necessary walking paths for maintenance personnel with the shortest routes to and from access location.

S. Campuses at Valley College, Mission College, Piers College, all exterior pipes, ducts, fans, air handlers, AC units need to be protected with coatings that can sustain strong wind, sever weather conditions. Air handlers exterior panels shall be not-through-metal, withstand 6 in. of static pressure (positive or negative) relative to exterior of air handling unit casing with less than 1% leakage rate, minimum 20 gauge G90 galvanized steel. Exterior finish shall be two-part epoxy painting system.

END OF SECTION

SECTION 23 0500
BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. CCR California Code of Regulation

B. CBC California Building Code

C. CFC California Fire Code

D. CEC California Electric Code

E. CMC California Mechanical Code

F. CPC California Plumbing Code

G. California Title 24 - Building Energy Efficiency Standards

H. SCAQMD Southern California Air Quality Management Division

1.3 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

B. Schedule overtime for the following work:

C. Itemize all work and list associated hours and pay scale for each item.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1) General plans: 1/4 Inch = 1 '-0" (minimum).

2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

END OF SECTION

SECTION 23 0513
MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/NFPA 70 - National Electrical Code.

G. Energy Independence and Security Act of 2007.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.

B. Submit shop drawings for all three phase motors.

C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.

D. Submit shaft grounding device for all motors as required.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. Design motors for continuous operation in 40ºC environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Explosion-Proof Motors: UL listed and labeled for the hazard classification shown on the drawing, with over-temperature protection.

D. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.

E. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

F. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.

G. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.

H. Each contractor shall set all motors furnished by him.

I. All motors shall have a minimum service factor of 1.15.

J. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.

K. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.

L. Aluminum end housings are not permitted on motors 15 HP or larger.

M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

N. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

A. All motors, unless exempted by EPAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
HP	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

B. Motor nameplate shall be noted with the above ratings.

2.3 MOTORS ON VARIABLE FREQUENCY DRIVES

A. All motors driven by VFDs shall be premium efficiency type.

B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, “Performance Standards Applying to All Machines,” Part 31 “Definite-Purpose Inverter-Fed Polyphase Motors.

D. All 480-volt motors controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive end of the motor shaft. Motor shafts 2” and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.

2.4 MOTORS FOR WET OR CORROSIVE DUTY

A. Where noted for wet and/or corrosive duty, motors shall be designed for severe duty with cast-iron frame, epoxy finish, stainless steel nameplate, polymer shaft seal, corrosion resistant fasteners and fan, moisture resistant windings, and non-wicking leads.

2.5 MOTORS FOR HAZARDOUS DUTY

A. Where noted for hazardous duty, motors shall be designed for the class, group, and T code listed for the application. Frame sizes 143T and larger shall have normally closed winding thermostats to keep surface temperatures below the nameplate T code under all conditions.

2.6 MOTOR DRIVEN EQUIPMENT

A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.

B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

2.7 SHEAVES

A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

B. When replacing sheaves, use sheaves of at least the originally supplied sizes.

C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

END OF SECTION

SECTION 23 0516
HVAC EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Expansion Joints and Compensators.

B. Pipe Loops, Offsets, and Swing Joints.

1.2 REFERENCES

A. Conform to Standards of Expansion Joint Manufacturer's Association.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Expansion joint shop drawings shall include maximum motion.

1.4 DESIGN CRITERIA

A. Unless noted otherwise, base expansion calculations on 50ºF installation temperature to 210ºF for heating water and steam condensate, plus 30% safety factor. Contact Architect/Engineer for steam temperatures.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Type EJ-1:

1. Multiple plies of 300 series stainless steel bellows.

2. Rated for 150 psi working pressure at 250ºF and 100psi at 400ºF.

3. Cycle life shall be at least 1,000 full range (compression and extension) cycles at rated stroke and 6,000 cycles at 1/2 rated stroke.

4. Axial motion shall be as scheduled on the drawings, but not less than 2" (compression plus extension).

5. Provide stainless steel inner liner for all steam expansion joints.

6. Provide removable metal insulation shroud around the bellows.

7. Joints 2" or smaller in copper piping systems shall have all copper, brass or bronze construction with stainless steel bellows and union ends or sweat ends with unions added. Acceptable Manufacturers: American BOA Type KH, Hyspan Type 8509, Flexonics Model HB, Metraflex Model HPMF, or Keflex Series 7QT.

8. Joints 2" or smaller in ferrous piping systems shall have steel bodies with union ends or male threaded ends with unions added. Acceptable Manufacturers: American BOA Type B, Hyspan Type 8503, Flexonics Model H, Metraflex Model HP, or Keflex Series 7Q-MPT.

9. Joints 2-1/2" or larger shall have 150 lb. forged steel flanges. Acceptable Manufacturers: American BOA Model 3150FS or 3150FL, Hyspan Model 1501, RM Model X-Flex-150 Multiply, Keflex Series 311-1215, or Metraflex Model MNLC.

B. Type EJ-2:

1. Multiple plies of 300 series stainless steel bellows.

2. Rated for 300 psi working pressure at 800ºF.

3. Cycle life shall be at least 1,000 full range (compression and extension) cycles at rated stroke and 6,000 cycles at 1/2 rated stroke.

4. Axial motion shall be as scheduled on the drawings, but not less than 2" (compression and extension).

5. Joints shall have 300 lb. flanges on each end.

6. Provide stainless steel inner liner.

7. Provide removable metal insulation shroud around the bellows.

8. Acceptable Manufacturers: American BOA Type FS3300, Flexonics, RM Model X-Flex-300 Multiply, or Hyspan Model 1501.

C. Type EJ-3:

1. Offset hinged or gimbal mounted, self-equalizing expansion joints with stainless steel carriers.

2. Suitable for vacuum to 300 psig.

3. Acceptable Manufacturers: Barco Manufacturing or Metraflex Model MC.

D. Type EJ-4:

1. Assembly consisting of two flexible connectors, two stainless steel flexible connectors, two 90º elbows, and a 180º return pipe. Unit shall be in the form of a pipe loop.

2. Connectors shall have corrugated stainless hose bodies with stainless steel braided casings.

3. Connectors shall be rated for 150 psi working pressure at 70ºF and 100 psi at 800ºF.

4. Sizes 2" and smaller shall have steel threaded connections.

5. Sizes 2-1/2" and larger shall have 150 lb. steel flanges.

6. Connectors shall be suitable for 1/2" permanent misalignment.

7. Acceptable Manufacturer: Metraflex Type ML.

E. Alignment Guides:

1. Bolted semi-steel spider.

2. Bolted guiding cylinder with supporting legs welded to pipe support.

3. Sized to allow insulation to pass through the outer cylinder.

4. Acceptable Manufacturers: American BOA, Hyspan, Flexonics, Keflex, or Metraflex.

F. Concrete Thrust Blocks - Rods and Clamps:

1. Bends, offsets, tees, crosses, and dead ends, including flange and spigot pieces, shall be suitably rodded or clamped and blocked with concrete thrust blocks.

2. Rods shall be all thread type, galvanized steel conforming to ANSI B1.1, Class 2A FIT, USS National Coarse Thread, tensile strength 55/77 ksi, yield strength 36 ksi minimum.

3. Rods and clamps shall receive one field coat of asphaltum after installation.

END OF SECTION

SECTION 23 0529
HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.

B. Equipment Bases and Supports.

C. Sleeves and Seals.

D. Flashing and Sealing of Equipment and Pipe Stacks.

E. Cutting of Openings.

F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.

B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

E. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 23 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel pipe.
Column #2: Copper, plastic and fiberglass reinforced pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

1.

2.3 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).

2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

a. Insulation Couplings:

1) Insulation Coupling: Molded thermoplastic, -65ºF to 275ºF, sizes up to 4-1/8” OD, and receive insulation thickness up to 1”. Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

2) Horizontal Strut Mounted Insulated Pipe:

a) Acceptable Manufacturers: Klo-Shure or equal.

3) Vertical:

a) Acceptable Manufacturers: Klo-Shure Titan or equal.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

Acceptable Products:

Cooper/B-Line -	Fig B3373 Series
Erico -	510 Series
Nibco/Tolco -	Fig. 82

2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

3. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.

4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.

3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

Acceptable Products:

Anvil -	Fig. 160, 161, 162, 163, 164, 165
Cooper/B-Line -	Fig. 3160, 3161, 3162, 3163, 3164, 3165
Erico -	Model 630, 631, 632, 633, 634, 635
Nibco/Tolco -	Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3,

Acceptable Products:

265-4

5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used.

Acceptable Products:

Cooper/B-Line - Fig. B3380 through B3384
Pipe Shields - A1000, A2000
Erico - Model 124, 127

6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:
Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

b. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

c. Continuous Channel with Clevis Type:
Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:

Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

d. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

   a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

   b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

   a. Clamp Type:
   Service: Bare Metal Pipe
   Rigid Plastic Pipe
   Insulated Cold Pipe
   Insulated Hot Pipe - 3 inches and smaller

      1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

      2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

   b. Roller Type:
   Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

   a. Steel Structure Clamps

      1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists):

Acceptable Products:	
Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300

Acceptable Products:	
Nibco/Tolco	68

2) Scissor Type Beam Clamps (For use with bar-joists and wide flange):

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

b. Concrete

1) Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

2) Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

3) Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

4) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 23 05 50 for additional requirements for concrete bases in seismic applications.

2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6”x6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

5. Equipment requiring bases is as follows:

a. Air Compressor

b. Air Handling Unit

c. Boiler

d. Boiler Feed Pump/Tank

e. Chemical Feed Equipment

f. Chiller

g. Expansion Tank

h. Condensate Return Station

i. Day Tank

j. Fans

k. Furnace

l. Steam Generator (Humidifier)

m. Heat Exchanger

n. Pump

o. Tank

C. Equipment Roof Support (Curbs and Rails):

1. Rooftop equipment such as packaged air handling units, roof hoods and rooftop exhaust fans shall be provided with curbs by the unit manufacturer.

2. Where not furnished with rooftop equipment, provide prefabricated curbs or rails as follows:

   a. 12" high above the top surface of the roof (not the roof structure).

   b. 14 or 18 gauge galvanized sheet metal, as required for the equipment weight.

   c. Internal reinforcing.

   d. Pressure treated wood nailer.

   e. 18 gauge counter flashing completely covering nailer.

   f. Factory insulated with rigid fiberglass.

3. Match units to the building roof with either a raised cant to match roof insulation (for built-up roofs), or with no cant (for single-ply roofs).

4. Where legs of equipment rest on rails, provide 1/4" bent plates 18” long.

5. Acceptable Manufacturers: Thy, Pate, United, Roof Products Systems or Portals Plus.

6. Equipment requiring curbs or rails is as follows:

   a. Condensing Units

D. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum 302 finish.

7. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load), Miro Industries 1.5, 3-R, 4-R or 5-R (to match pipe).

E. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

F. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor’s work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120ºF, sleeves may be thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.

5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40ºF to 250ºF
T	High/Low Temperature	Silicone	-67ºF to 400ºF
T	Fire Seals (1 hour)	Silicone	-67ºF to 400ºF
FS	Fire Seals (3 hours)	Silicone	-67ºF to 400ºF
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.8 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer’s recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

a. The hanger is attached within 6” from a web/chord joint.

b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel and Fiberglass (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"

5. Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:

   a. Continuous channel with hangers maximum 8'-0" OC.

6. Rigid Plastic Pipe:

   a. Hangers shall be spaced based on the piping system manufacturers' instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

7. Installation of hangers shall conform to MSS SP-58, 69, and 89.

END OF SECTION

SECTION 23 0548
HVAC VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bases.

B. Vibration Isolation.

C. Flexible Connectors.

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.

B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.

C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.

D. Isolator submittals shall include:

1. Equipment served
2. Type of Isolator
3. Load in Pounds per Isolator
4. Recommended Maximum Load for Isolator
5. Spring Constants of Isolators (for Spring Isolators)
6. Load vs. Deflection Curves (for Neoprene Isolators)
7. Specified Deflection
8. Deflection to Solid (at least 150% of calculated deflection)
9. Loaded (Operating) Deflection
10. Free Height
11. Loaded Height
12. Kx/Ky (horizontal to vertical stiffness ratio – for spring isolators)
13. Materials and Coatings
14. Spring Diameters

E. Make separate calculations for each isolator on equipment where the load is not equally distributed.

F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

G. Submit certification that equipment, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

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.

H. Submit calculations by a licensed Structural Engineer substantiating that equipment mountings and foundations, and their seismic restraints, can meet the required external forces "G" load for all rigidly and resiliently supported equipment without failure and permanent displacement. Submit similar calculations for life safety equipment restraints for "G" loading. Restrain all resiliently mounted piping with cable seismic bracing per OSHPD series OPM pre-approval.

I. Contractor shall provide seismic bracing calculations stamped by a licensed California Structural Engineer for all suspended utilities.

1. Contractor to submit shop drawings showing the following:

a. All seismic bracing locations and type of restraint being used.

b. Maximum seismic loads shall be indicated on the shop drawings for each brace location.

c. Manufacturer’s seismic restraint layout on contractor shop drawings to be stamped by a licensed California Structural Engineer for all suspended utilities.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENT

A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection [e.g., 3" for 2" calculated deflection]. The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.

C. The lateral to vertical stiffness ratio (Kx/Ky) of spring isolators shall be between 0.8 and 2.0.

D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.

E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.

F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

G. Provide motor slide rails for belt-driven equipment per Section 23 05 13.

H. All isolators, except M1, shall have provision for leveling.

2.2 MOUNTINGS

A. Type M1:

1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35”.

2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.

3. Acceptable Manufacturers: Mason "Super W", Kinetics "NGS", Amber/Booth “SPNR”, Vibration Eliminator Co. “400N”.

B. Type M2:

1. Double deflection neoprene with minimum static deflection of 0.15" at calculated load and 0.35" at maximum rated load.

2. All metal shall be neoprene covered. Mounting shall have friction pads both top and bottom.

3. All units shall have bolt holes and be bolted down.

4. Use steel rails above the mountings to compensate for the overhang of equipment such as small vent sets and close coupled pumps.

5. Acceptable Manufacturers: Mason Industries "ND" or "DNR", Amber/Booth "RVD", Kinetics "RD", Vibration Mountings and Controls "RD", Vibration Eliminator Co. “T22” or “T44”.

C. Type M3:

1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.

2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.

3. All mountings shall have leveling bolts.

4. Acceptable Manufacturers: Mason "SLFH", Kinetics "FDS", Amber/Booth "SW-3, 4”, 5” or 6", Vibration Eliminator Co. “OST”.

D. Type M4:

1. Use restrained spring mountings for equipment with operating weight different from the installed weight such as chillers and boilers, and equipment exposed to the wind such as cooling towers.

2. Spring isolators shall be free-standing with 1/4" neoprene acoustical friction pads.

3. All units shall have bolt holes and be bolted down. Prevent short circuiting with neoprene bushings and washers between bolts and isolators.

4. All mountings shall have leveling bolts.

5. Housings with vertical resilient limit stops shall prevent spring extension when weight is removed. Housings shall serve as blocking during erection and the installed and operating heights shall be the same.

6. Maintain a minimum clearance of 1/2" around restraining bolts and between the housings and the springs so as not to interfere with the spring action.

7. Limit stops shall be out of contact during normal operation.

8. Select isolators for equipment subjected to wind loads in conformance with ASCE 7-02.

9. Acceptable Manufacturers: Mason "SLRS", Kinetics “FLS”, Aeroflex “AWRS”, Vibration Eliminator Co. “KW”.

2.3 THRUST RESTRAINTS

A. Type TR1:

1. Horizontal thrust restraints shall consist of spring elements in neoprene cups with grommets to prevent short circuiting hanger rods and nuts and washers for pre-compression.

2. Select springs for deflection of 0.75" to 1.50" at maximum calculated thrust. Springs shall be field adjusted for 1/2" movement. Spring constant may not exceed 50% of the vertical stiffness of the mounts (M3, etc.).

3. Centrifugal fans shall incline slightly forward when off and discharge directly in line with the ductwork at maximum static pressure.

4. Fabricate structural supports as needed to attach thrust restraints.

5. If connected to a housing, check maximum thrust the housing can restrain and connections required.

6. Acceptable Manufacturers: Mason "WB" or "PC30", Kinetics, Vibration Eliminator Co. “HTR-1”.

2.4 HANGERS

A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.

2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.

3. Provide hangers with end connections as required for hanging ductwork or piping.

4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration Eliminator Co. “ALH”.

B. Type H2:

1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex “RSH”, Vibration Eliminator Co. “SNC”.

C. Type H3:

1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.

6. Deflection shall be indicated by a pointer and scale.

7. Acceptable Manufacturer: Mason "PC30", Kinetics “SFH”, Amber/Booth “BSW”, Vibration Eliminator Co. “PCS”.

2.5 BASES

A. Type B1:

1. Rectangular structural steel bases.

2. All perimeter members shall be beams or channels with minimum depth of 10% of the longest base dimension or 14" maximum if rigidity is acceptable to the equipment manufacturer.

3. Use height saving brackets, unless noted otherwise.

4. Acceptable Manufacturers: Mason "WF", Kinetics “SBB”, Aeroflex, Vibration Eliminator Co. “AF”.

B. Type B2:

1. Steel members welded to height-saving brackets to cradle machines having legs or bases that do not require complete supplementary bases.

2. Members shall be sufficiently rigid to prevent strains in the equipment.

3. Acceptable Manufacturers: Mason "ICS", Kinetics “SFB”, Aeroflex.

C. Type B3:

1. Rectangular structural channel concrete forms for floating foundations.

2. Where applicable, bases shall be large enough to support suction elbows, discharge elbows, and suction diffusers.

3. Channel depth shall be at least 1/12 the longest dimension of the base but not less than 6". Depth need not exceed 12" if rigidity is acceptable to equipment manufacturer.

4. Forms shall include 1/2" rebars welded on 6" centers running both ways in a layer 1-1/2" above the bottom, and drilled steel members with sleeves welded below the holes to receive the equipment anchor bolts.

5. Contractor shall pour 3,300 PSI concrete inside entire base. Concrete to be same thickness as sides of base. Trowel concrete smooth on top of base.

6. Use height saving brackets, unless noted otherwise.

7. Acceptable Manufacturers: Mason "K", Kinetics “CIB-H”, Aeroflex “MPF”, Amber Booth “CPF”, Bulldog, Inc., Vibration Eliminator Co. “SN”.

2.6 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC1:

1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.

2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.

3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.

4. Connectors up to 2" size may have threaded ends.

5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.

6. All connectors shall be rated for a minimum working pressure of 150 psi at 200ºF.

7. Acceptable Manufacturer: Metraflex "Double Cable-Sphere", Minnesota Flex Corp., Mercer “200 Series”, Twin City Hose “MS2”.

B. Type FC2:

1. Stainless steel flexible connectors with corrugated stainless steel hose body and stainless steel braided casing.

2. Rated for minimum working pressures of 150 psi at 70ºF and 100 psi at 800ºF.

3. Sizes 2" and under shall have steel threaded connections.

4. Sizes 2-1/2" and over shall have 150 lb. steel flanges.

5. Suitable for 1/2" permanent misalignment.

6. Acceptable Manufacturers: Mason or Mercer "BSS-GU", Metraflex "ML", Twin City Hose “TCHS”, American "BOA B4-1", Flexible Metal Hose Company "FM-21", or Wheatley.

PART 3 - EXECUTION

3.1 PIPE ISOLATION

A. The first three hangers from vibration-isolated equipment shall be type H1.

B. For base mounted pumps without resilient mountings, the first five hangers shall be Type H1.

C. Where piping is floor-supported, use M2 instead of H1 and M3 instead of H2.

D. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.

E. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220ºF, and the fluid handled is compatible with neoprene and EPDM.

F. Use Type FC2 for all other services. FC2 shall be installed parallel with equipment shafts.

G. Provide sufficient piping flexibility for vibrating refrigerant equipment or furnish flexible connectors with appropriate temperature and pressure ratings.

H. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.

I. Support piping to prevent extension of flexible connectors.

3.2 VIBRATION ISOLATION OF DUCTWORK

A. The first three hangers on all fan systems shall be Type H1 with at least 0.20” minimum static deflection.

B. Provide flexible duct connections as described in Section 23 33 00 at all fan inlets and outlets and on the mechanical room side of all locations where ducts penetrate mechanical room walls.

END OF SECTION

SECTION 23 0550
SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.

2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.

3. These requirements are beyond those listed in Section 23 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.

2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

D. Installer: Company specializing in performing the work of this Section.

E. Suppliers: Following is a partial list of manufacturer/supplier contact information for seismic restraints:

1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.

2. Unistrut Corporation http://www.unistrut.us/

3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.

4. Mason Industries, Inc. www.mason-ind.com.

5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.

6. Tolco (909) 737-5599, www.tolco.com

7. ISAT 877.523.6060, www.isatsb.com

8. Vibro-Acoustics (416) 291-7371 , https://virs.vibro-acoustics.com/

1.3 REFERENCES

A. ASHRAE - A Practical Guide to Seismic Restraint.

B. ASCE 7-02, Chapter 9.

C. ASCE 7-05, Chapter 13.

D. ASCE 7-10, Chapter 13.

E. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.

F. NFPA 13 - Installation of Sprinkler Systems.

G. NFPA 14 - Standpipe and Hose Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Submittal to Code Official

1. Contractor shall submit copies of the seismic shop drawings to the governing code authority for approval.

C. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Professional Structural Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.

2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.

3. Manufacturer's Certifications: Professional Structural Engineer licensed in the state where the project is located shall review and approve manufacturer's certifications of compliance.

4. System Supports/Restraints - Submit for each condition requiring seismic bracing:

a. Calculations for each seismic brace and detail utilized on the project.

b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.

c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.

d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Equipment - Submit for each piece of equipment supplied:

   a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.

   b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.

   c. Engineering calculations and details for equipment anchorage and support structure.

D. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

PART 2 - PRODUCTS

2.1 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions

1. Stay in Place:

   a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2. Remain Operational:

   a. Requirements for “Stay in Place” listed above shall be met.

   b. The following systems and associated equipment are intended not to fail externally or internally and are intended to remain operational.

      1) Fire Protection

      2) Plumbing

      3) Medical Gas

      4) Heating

      5) Cooling

      6) Humidification

      7) Air Handling

      8) Exhaust

9) Dust Collection

2.2 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.

2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.

3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.

4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.

5. All seismic restraint devices shall be designed to accept without failure the forces

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.

D. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.3 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.

B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:

1. Air Compressors

2. Pumps

3. Tanks

4. Fire Protection Equipment

5. Fire Pumps

2.4 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.

2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade 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.

2.6 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 1011, GR 33.

2. Materials for Fittings and Accessories: ASTM A 635, 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. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.

2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

C. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

END OF SECTION

SECTION 23 0553
HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 23.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. ASTM B-1, B-3, and B-8 for copper conductors.

C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kV Cables.

D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.

E. NFPA-99 – Health Care Facilities.

F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4”
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
HIGH TEMP HOT WATER - OVER 240ºF	Black	Yellow
STEAM - 90 PSI	Black	Yellow
STEAM - 60 PSI	Black	Yellow
STEAM - 30 PSI	Black	Yellow
STEAM - 15 PSI	Black	Yellow
STEAM - 5 PSI	Black	Yellow
CLEAN STEAM - 0 PSI	Black	Yellow
HEATING WATER SUPPLY	Black	Yellow
HEATING WATER RETURN	Black	Yellow

Pipe Service	Lettering Color	Background Color
HIGH PRESSURE CONDENSATE	Black	Yellow
MEDIUM PRESSURE CONDENSATE	Black	Yellow
LOW PRESSURE CONDENSATE	Black	Yellow
PUMPED CONDENSATE	Black	Yellow
CHILLED WATER SUPPLY	White	Green
CHILLED WATER RETURN	White	Green
CONDENSER WATER SUPPLY	White	Green
CONDENSER WATER RETURN	White	Green
CONDENSATE DRAIN	Black	Yellow
COMPRESSED AIR	Black	Yellow
CONTROL COMPRESSED AIR	Black	Yellow
NATURAL GAS	Black	Yellow
MEDICAL VACUUM - 15-30 IN. HG	Black	White
WASTE ANESTHETIC GAS DISPOSAL - 15-30 IN. HG	White	Violet
CARBON DIOXIDE - 50-55 PSI	White	Gray
INSTRUMENT AIR - 160-185 PSI	White	Red
MEDICAL AIR - 50-55 PSI	Black	Yellow
NITROGEN - 160-185 PSI	White	Black
NITROUS OXIDE - 50-55 PSI	White	Blue
OXYGEN - 50-55 PSI	White	Green
HYPERBARIC OXYGEN - 70-75 PSI	White	Green
REFRIGERANT LIQUID	Black	Yellow
REFRIGERANT SUCTION	Black	Yellow
REFRIGERANT HOT GAS	Black	Yellow
FUEL OIL SUPPLY	Black	Yellow
FUEL OIL RETURN	Black	Yellow
Underground Piping	Varies	Varies
Tracer Wire - Natural Gas Pipe Lines	---	Yellow
Tracer Wire - All other buried types	---	Green

B. Steam pipe markers shall include operating steam pressure within pipes shown in table above.

C. Medical gas pipe markers shall include system operating pressure shown in table above.

D. Medical gas pipe markers for systems not listed shall meet the pipe labeling requirements of NFPA-99.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.

B. Testing, adjusting, and balancing of heating systems.

C. Testing, adjusting, and balancing of cooling systems.

D. Testing, adjusting, and balancing of plumbing systems.

E. Testing, adjusting, and balancing of energy recovery systems.

F. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance, 2002.

B. ADC – Test Code for Grilles, Registers, and Diffusers.

C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.

D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.

E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.

F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.

G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.

H. TABB – International Standards for Environmental Systems Balance.

END OF SECTION

SECTION 23 0713

DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.

B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

D. ASTM E84 - Surface Burning Characteristics of Building Materials.

E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.

F. ASTM E814 - Fire Tests of Through Penetrations Firestops.

G. ASTM E2336-04 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

H. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

I. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

J. NFPA 255 - Surface Burning Characteristics of Building Materials.

K. UL - XHEZ - Through Penetration Firestop Systems.

L. UL 263 - Full Scale External Fire Tests with Hose Stream.

M. UL 723 - Surface Burning Characteristics of Building Materials.

N. UL 1479 - Fire Tests of Through Penetrations Firestops.

O. California Title 24 - Building Energy Efficiency Standards

P. CMC California Mechanical Code

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75°F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both “Out of Package” and “Installed-Compressed 25%” K and R-values.

B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim Kraft facing, 3 lb./cu. ft. density.

C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 4000 fpm air velocity.

D. Type D: Rigid Fiberglass Liner; 0.23 maximum 'K' value at 75°F; smooth coated mat facing laminated to the insulation, suitable for 5000 fpm air side velocity.

E. Type E: Double wall ductwork insulation; fiberglass; 0.27 maximum ‘K’ value at 75°F mean temperature; 1.5 lb/cu ft density.

F. Type F: Flexible High Temperature Wrap; ASTM E2336 rating as 2-hour separation with zero clearance to combustible materials over the full length. Material to be totally scrim encapsulated. Material to be a minimum 1-1/2” thick with a minimum core density of 6 pcf. Wrap system should offer zero clearance to combustibles per ASTM E2336 at all locations, comply with all applicable codes, and be approved by AHJ. If system is not rated for zero clearance per ASTM E2336 at all locations with single layer, a two-layer system shall be provided with zero clearance per ASTM E2336 at all locations. Material must be tested and listed for installation on grease ducts and installed per listed design. Refer to Section 23 33 00 for prefabricated, pre-insulated access doors required for grease duct systems.

G. Type G: Preformed rigid fiberglass acoustical liner. ANSI/ASTM C1071; 0.23 maximum ‘K’ value at 75°F mean temperature; Noise Reduction Coefficient (NRC) per ASTM C423 Type “A” mounting of 0.70 afor 1” thickness, 0.90 for 1.5” thickness. Liner shall be factory coated with an anti-microbial agent to prevent fungus and bacteria growth per ASTM G-21 and G-22. Max flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

H. Type I: Flexible Elastomeric Liner; EPDM (NBR/PVC Blend is not permitted) Elastomeric cellular foam sheet; ANSI/ASTM C534; 0.25 maximum 'K' value at 75ºF; 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723); coated air side for 4000 fpm air velocity.

2.2 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM B209; 0.016" thick; smooth or embossed stucco finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

END OF SECTION

SECTION 23 0716
HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment Insulation.

B. Equipment Insulation Finishes.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

3. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM B209 – Aluminum and Aluminum Alloy Sheet and Plate

C. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

E. ANSI/ASTM C534 – Elastomeric Foam Insulation

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ANSI/ASTM C553 – Mineral Fiber Blanket Thermal Insulation.

H. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

I. ANSI/ASTM C921 – Properties of Jacketing Materials for Thermal Insulation

J. ANSI/ASTM D1668 – Glass Fabric for Waterproofing

K. ASTM E84 - Surface Burning Characteristics of Building Materials.

L. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

M. NFPA 255 - Surface Burning Characteristics of Building Materials.

N. UL 723 - Surface Burning Characteristics of Building Materials.

O. California Title 24 - Building Energy Efficiency Standards

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Rigid Mineral Fiber Blocks; ANSI/ASTM C612; 0.625 maximum 'K' value 800ºF. Suitable to 1900ºF, 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

B. Type B: Cellular Glass Board; ANSI/ASTM C552; 0.35 maximum 'K' value at 200ºF; 8.0 lb/cu ft.; suitable to 900ºF, 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

C. Type C: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'K' value at 300ºF; 2.5 lb/cu ft.; suitable to 850ºF, with all service jacket (ASJ) vapor retarder jacket having 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

D. Type D: Glass Fiber Board; ANSI/ASTM C612; 0.28 maximum 'K' value at 200ºF; 6.0 lb/cu ft; suitable to 850ºF, 25/50 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

E. Type E: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

F. Type F: Semi-Rigid Mineral Wool Fiberboard; ANSI/ASTM C612; 0.30 maximum 'K' value at 200ºF; suitable to 1200ºF.

G. Type G: Hydrous Calcium Silicate Blocks; ANSI/ASTM C533; 0.40 maximum 'K' value at 300ºF; suitable to 1200ºF.

2.2 INSULATION FINISHES

A. Type 1: Glass Fabric; ASTM D1668, woven glass fabric with two coats of mastic approved for insulation type. Use vapor barrier mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures less than 70°F and having maximum 0.013 perms/inch rating at 0.043 inch dry-film thickness when tested in accordance with ASTM E-96 Procedure B (Foster 30-80 or approved equivalent). Use breather mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures 70°F or greater (Foster 35-00 or approved equivalent).

B. Type 2: All Service Jacket; ASTM C921; Factory or Field Applied; Kraft paper bonded to aluminum foil reinforced with glass fiber; Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Seal all joints with manufacturer approved tape and adhesive to maintain vapor barrier. Indoor use only, if used outdoors add type 4 finish.

C. Type 3: Flexible Elastomeric Thermal Insulation; After adhesive has fully cured, apply two coats of latex enamel paint approved by insulation manufacturer for outdoor use.

D. Type 4: Aluminum Jacket; ASTM B209; 0.016” thick stucco embossed finish; install with 3/4” aluminum bands 12” on center.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all materials per manufacturer's instructions, codes and industry standards.

B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

C. Do not insulate factory insulated equipment.

D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.

F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.

G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.

H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.

I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60°F and/or above 100°F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.

J. Insulate all supports on equipment operating below ambient temperature.

3.2 INSULATION

A. Type A and G:

1. Apply with edges tightly butted and joints staggered.

2. Secure with 1/2" x 0.015” galvanized steel bands, 12” on center.

B. Type B:

1. Apply with edges tightly butted and joints staggered

2. Seal all joints with manufacturer approved adhesive.

3. Secure with 1/2" x 0.015 galvanized steel bands, 12” on center.

C. Type C, D and F:

1. Apply with edges tightly butted and joints staggered.

2. Secure with welded pins and washers, 4” from each edge and 16” on center, or 1/2" x 0.015” galvanized steel bands, 12” on center.

D. Type E:

1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is greater than 1" thick.

2. Do not wrap sheet insulation around square corners but cut and overlap insulation at corners to provide full insulation thickness on all sides. Seal all overlapping insulation surfaces with manufacturer approved adhesive.

3. Secure with manufacturer approved adhesive in accordance with installation instructions. Where applied to underside surfaces or on surfaces with temperatures 140°F and above, cover all surfaces with full application of adhesive. Seal all joints and seams with manufacturer approved adhesive.

3.3 SCHEDULE

Equipment		Insulation Type	Insulation Thickness	Insulation Finish
A.	Steam-to-Water Heat Exchanger			
	to 200ºF Water	D	2"	1 or 2
	200ºF to 299ºF	D	2"	1 or 2
	300ºF to 399ºF	D	2-1/2"	1 or 2
	400ºF to 499ºF	C	3"	1
	500ºF to 599ºF	C	3-1/2"	1
B.	Heating Water Air Separator/Coalescing Filter	C	2"	1 or 2
C.	Chilled Water Air Separator/Coalescing Filter	C	2"	1 or 2
D.	Chilled Water Buffer Tank	C	2"	1 or 2
E.	Heating Water Buffer Tank	C	2"	1 or 2
F.	Boiler Feed Water Storage Tank	D	2"	1 or 2
G.	Steam Condensate Receiver Tank	D	2"	1 or 2
H.	Cooling Tower Sump	E	1"	3
I.	Chilled Water Pumps	E	1"	3
J.	Chilled Water Flexible Connections & Expansion Joints	E	3/4"	3
K.	Chiller Cold Surfaces (not factory insulated)	E	1"	3
L.	Absorption Chiller Hot Surfaces (not factory insulated)	B	2"	4
M.	Incinerator Breechings	G	4"	4
		or A	2"	4
		plus C	1"	
N.	Boiler Breechings & Flues	F	4"	4
		or G	4"	4
O.	Plate and Frame Heat Exchanger	E	1”	3
P.	Exhaust Muffler	A	2"	
		plus C	2"	4

Equipment		Insulation Type	Insulation Thickness	Insulation Finish
	Or	F	(2) 2" layers w/staggered seams	4
	Or	G	4"	4
Q.	Deaerator	D	2”	1 or 2
R.	Surge Tank	D	2”	1 or 2
S.	Flash Tank	D	2”	1 or 2

END OF SECTION

SECTION 23 0719
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.

B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

3. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

D. ANSI/ASTM C534 - Elastomeric Foam Insulation.

E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.

I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

J. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.

K. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.

L. ASTM E84 - Surface Burning Characteristics of Building Materials.

M. NFPA 255 - Surface Burning Characteristics of Building Materials.

N. UL 723 - Surface Burning Characteristics of Building Materials.

O. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

P. California Title 24 - Building Energy Efficiency Standards

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white Kraft jacket for above grade installations.

D. Type D: Granular Inorganic Powder; non-toxic; non-flammable; totally free of asbestos; 0.65 maximum 'K' value at 40 lb./cu ft density and 300ºF; treated to resist moisture. Suitable from 35ºF to 800ºF.

E. Type E: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300ºF; 1200ºF maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

F. Type F: Semi-Rigid Mineral Wool Fiberboard; ANSI/ASTM C612; 0.30 maximum 'K' value at 200ºF. Suitable to 1200ºF.

G. Type G: Rigid Mineral Fiber Blocks; ANSI/ASTM C612; 0.625 maximum 'K' value at 800ºF. Suitable for 1900ºF.

H. Type H: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'K' value at 300ºF. 3.0 lb./cu ft density. Suitable for 850ºF.

I. Type I: Preformed rigid extruded polystyrene (Styrofoam); ANSI/ASTM C578; maximum 'K' value of 0.259 at 75ºF aged 180 days; moisture resistant; suitable for -297ºF to +165ºF.

J. Type J: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75ºF; moisture resistant; suitable for -297ºF to +300ºF.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

B. Stainless Steel Jackets: ASTM C1767. Type 304 316 stainless steel; 0.010" thick (thicker where required by ASTM C1729); smooth finish with Z edge seams and stainless steel bands for outdoor use.

C. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

2.4 REMOVABLE INSULATION JACKETS

A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.

B. Inner and outer covering shall be constructed from a minimum 16.5 oz./yd^2 PTFE fiberglass composite and suitable for insulating surface temperatures up to 550ºF.

C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:

1. Silica and glass-fiber insulation felts and blankets – minimum 6 lb./ft3 density.

2. E-type glass-fiber felts and blankets – minimum 6 lb./ft3 density.

D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550ºF surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.

E. No raw cut jacket edges shall be exposed.

F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1" slide buckles.

G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.

H. Acceptable Manufacturers: Firwin Corp, Lewco Specialty Products, ThermaXX Jackets LLC or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Neatly finish insulation at supports, protrusions, and interruptions.

2. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

3. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3”	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5” to 6"	18" long x 16 gauge
d.	8” to 14"	24" long x 14 gauge
e.	16” to 24"	24" long x 12 gauge

4. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

2. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.

2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Refrigerant Piping:

1. On refrigerant piping (25°F and above) and **not** required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360°, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.

F. Exposed Piping:

1. Locate and cover seams in least visible locations.

2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.2 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.

2. Insulate fittings with prefabricated fittings.

D. Type D Insulation:

1. Outdoor and Indoor, Underground: Compact insulation per manufacturer’s requirements to allow insulation to act as pipe bedding. Install padding at expansion loops or elbows.

2. Manufacturer’s representative shall visit site and approve installation procedures.

3. Thickness listed is nominal. Follow manufacturer's guidelines for actual dimensions.

E. Type E Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.

2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

F. Type F, G, and H Insulation:

1. Apply with edges tightly butted, joints broken.

2. Secure with 16 gauge galvanized, annealed steel wire or 1/2" x 0.015" galvanized steel bands, 12" maximum centers.

3. Install welding studs, clips and angles where required to anchor wires and bands.

G. Type I Insulation:

1. Indoors, above grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer’s recommendations for installation guidelines.

2. Insulate fittings with prefabricated fittings.

H. Type J Insulation:

1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.

2. Insulate pipe fittings with prefabricated insulation fittings.

3.3 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum stainless steel jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.

2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.

3. Interior joints do not need to be sealed.

4. Use metal covering on the following pipes:

a. All exterior piping.

b. Engine exhaust piping (interior).

c. Cover insulation with aluminum jacketing.

d. All Type E, F, G and H insulation.

e. _____.

5. Use colored aluminum jacket covers on the following pipes:

a. All exterior piping.

b. _____.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.

2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.

4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.

5. Use plastic insulation covering on all exposed pipes including, but not limited to:

a. All exposed piping in areas noted on drawings.

b. All exposed piping in locker rooms.

c. All exposed piping below 8'-0" above floor.

d. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

e. All kitchen areas.

6. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

7. Use colored plastic covering on the following pipes:

a. All interior piping.

b. _____.

3.4 SCHEDULE

Piping System	Insulation Type/Thickness		
A. Saturated Steam, Condensate Return, and Boiler Feedwater			
(Up to 29 psig, 250ºF)			
Up to 3" pipe size	A / 2-1/2”	OR	J / 1-1/2”
Above 3" pipe size	A / 3”	OR	J / 2”
Below Grade, below 6" pipe size	D / 4”		
Below Grade, 6" thru 10" pipe size	D / 5”		
Below Grade, above 10" pipe size	D / 6”		
B. Saturated Steam, Condensate Return			
(30 to 134 psig, 350ºF)			
Below 1" pipe size	A / 3”		
1" thru 1-1/4" pipe size	A / 4”		
1-1/2" and larger pipe size	A / 4-1/2”		
Below Grade, 6" pipe size and below	D / 5”		
Below Grade, 8" thru 14" pipe size	D / 6”		
Below Grade, above 14" pipe size	D / 7”		
C. Saturated Steam, Condensate Return			
(135 to 250 psig, 450ºF)			
Under 1” pipe size	A / 4-1/2”		
1” and larger pipe size	A / 5”		
Below Grade, 6" pipe size and below	D / 5”		
Below Grade, 8" thru 10" pipe size	D / 6”		
Below Grade, above 10" pipe size	D / 7”		

	Piping System	Insulation Type/Thickness		
D.	Chilled Water Supply & Return			
	All Sizes (located in air conditioned spaces)	A / 1-1/2”	OR	J / 1”B / 1-1/2”(2 layers of 3/4”)
	All Sizes (located in non-air conditioned spaces)	B / 2”	OR	J / 1-1/2”
	All Sizes (located in modular chiller enclosure)	B / 3/4”		
	All Sizes (located inside air handling unit airstream)	B / 1-1/2"		
E.	Cooling Coil Condensate Drains below 55°F	B / 1/2”		
F.	Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return			
	Under 1-1/2"	A / 1-1/2”	OR	J / 1”
	1-1/2" and above	A / 2"	OR	J / 1-1/2"
G.	Condenser Water Supply & Return (Indoor)	A / 1”	OR	B / 3/4”
			OR	J / 3/4”
	All Sizes (located in modular chiller enclosure)	B / 3/4”		
H.	Condenser Water Supply & Return (Outdoor)	A / 1”	OR	B / 3/4”
			OR	J / 1”
I.	Heat Recovery Water Supply & Return ≤ 140°F			
	Under 1-1/2"	A / 1”	OR	J / 3/4”
	1-1/2" and above	A / 1-1/2"	OR	J / 1"
	All Sizes (located in modular chiller enclosure)	B / 3/4”		
J.	Glycol/Water Supply & Return			
	Up to 1-1/2”	B / 1”	OR	J / 1”
	2” and above	B / 1-1/2” (2 layers of 3/4”)	OR	J / 1-1/2”
K.	Engine Exhaust Piping			
	From Engine to Muffler	E / 4”		
	From Muffler to Discharge	E / 4”	OR	F / (2) 2” layers with staggered seams
			OR	G / 2” plus H / 2”
	Drain piping from muffler to floor drain	E / 3”	OR	F / 3”
L.	Underground Heating Water Supply & Return	C / 1”	OR	J / 1”
M.	Underground Chilled Water Supply & Return			
	Up to 1-1/2”	C / 1”	OR	J / 1”
	2” and above	C / 1-1/2”	OR	J / 1-1/2”

	Piping System	Insulation Type/Thickness		
N.	Underground Refrigeration Lines	C / 1”	OR	J / 1”
O.	VRF Refrigerant Pipe Insulation	Refer to Section 23 81 45		
P.	Mini-Split System Refrigerant Pipe Insulation	Refer to Section 23 XX XX		
Q.	Refrig. Hot Gas Lines			
	Up to 1-1/4”	B / 1/2”		
	1-1/2” and up	B / 1”		
R.	Refrig. Suction Lines (25ºF & Above)			
	Up to 1-1/2”	B / 1-1/2”		
	1-1/2” and above	B / 1-1/2” (2 layers of 3/4”)		
S.	Refrig. Suction Lines (40ºF & Above)			
	Up to 1-1/4”	B / 1/2”		
	1-1/2” and above	B / 1”		
T.	Low Temp. Refrigeration Suction Lines (25ºF to 0ºF)			
	1/2" thru 1" pipe size	C / 1-1/2”	OR	J / 1-1/2”
	1-1/4" thru 5" pipe size	C / 2”	OR	J / 2”
	6" thru 10" pipe size	C / 2-1/2”	OR	J / 2-1/2”
U.	Low Temp. Refrigeration Suction Lines (-1ºF to -25ºF)			
	1/2" thru 1" pipe size	C / 2”	OR	J / 2”
	1-1/4" thru 5" pipe size	C / 2-1/2”	OR	J / 2-1/2”
	6" thru 10" pipe size	C / 3”	OR	J / 3”
V.	Low Temp. Refrigeration Suction Lines (-26ºF to -75ºF)			
	1/2" thru 1" pipe size	C / 2-1/2”	OR	J / 2-1/2”
	1-1/4" thru 5" pipe size	C / 3-1/2”	OR	J / 3-1/2”
	6" thru 10" pipe size	C / 4”	OR	J / 4”
W.	Low Temp. Refrigeration Suction Lines (-76ºF to -125ºF)			
	1/2" thru 1" pipe size	C / 3”	OR	J / 3”
	1-1/4" thru 5" pipe size	C / 4”	OR	J / 4”
	6" thru 10" pipe size	C / 5”	OR	J / 5”
X.	Insulation Inserts at hangers	C or E or J - Match pipe insulation thickness		
Y.	Medical Air Compressor Intake	A / 2”		
Z.	Medical Vacuum System Exhaust (within 10’ of outside wall/roof penetration)	A / 1”		

END OF SECTION

SECTION 23 0900
CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete System of Automatic Controls.

B. Control Devices, Components, Wiring and Material.

C. Instructions for Owners.

D. Meters

1.2 DISTRICT CAMPUS SYSTEMS

A. East Los Angeles College – Alerton-Climatec

B. Los Angeles City College - Alerton-Climatec-Niagara

C. Los Angeles Harbor College - Alerton-Climatec

D. Los Angeles Mission College - Alerton-Climatec

E. Pierce College - Alerton-Climatec/Johnson Control

F. Los Agneles Southwest College – Alerton-Climatec

G. Los Angeles Trade-Technical College – Siemens – Check with College for possible change

H. Los Angeles Valley College – Automated Logic Control

I. West Los Angeles College - Siemens

1.3 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.

B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.

C. Technician: Minimum five years' experience installing commercial temperature control systems.

D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 100 miles of the job site.

E. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under this section. Materials and installation to confirm to Class 1 or 2, California Administrative Code Title 24, Article E725, and as restricted under the Division 26 Electrical of these specifications.

F. Written sequence of operations should be provided for each equipment, Word document format, easy to understand, flow chart. Tech support shall be provided by telephone and/or on-line for a minimum of fire (5) years. Updated software shall be provided for a minimum of five (5) years.

1. Initial sequence of operation training

a. Orientation

b. Central plant equipment

2. End of project training

a. New equipment – operation and maintenance

b. New sequence of operations.

3. Formal training

a. Level 1 – Basic

b. Level 2 – intermediate

c. Level 3 – Programming

G. System sensors shall be percentage of open for each damper.

H. One sensor per data point.

I. System shall provide simple remote access, including alerts and notifications, via internet web based protocol. Mobile application for real time access to sensor, controller, and equipment data through use of standard communication or data exchange protocols.

J. The system shall have capabilities for modernization within the existing system.

K. System shall have provision for system growth. System shall be scalable.

L. System shall retain an audit trail of users, alarms and responses. The audit trail shall be easily accessed.

M. All valve and damper actuators shall be digital.

N. The control system shall utilize close loop control, full monitoring of components status and incorporate self-diagnostic and fault detection feature to automatically alert M & O Personnel.

O. Graphic and control monitoring and audit trail shall be WEB based.

P. All instructional areas including but not limited to classrooms, lab, gym, auditorium and lecture hall shall be individually zoned.

1.4 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/ASHRAE Standard 135-2001: BACnet® – A Data Communication Protocol for Building Automation and Control Networks, including all amendments.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).

E. ANSI/NFPA 70 - National Electrical Code.

F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

G. ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.

H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

I. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

J. ANSI/ASTM B32 - Solder Metal.

K. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.

L. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control Valves.

B. Flow Switches.

C. Temperature Sensor Sockets.

D. Gauge Taps.

E. Automatic Dampers.

F. Flow Meters.

1.6 AGENCY AND CODE APPROVALS

A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.

1. UL-916; Energy Management Systems.

2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “Signal Equipment.”

3. EMC Directive 89/336/EEC (European CE Mark).

4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.7 ACRONYMS

A. Acronyms used in this specification are as follows:

1. B-AAC BACnet Advanced Application Controller

2. B-ASC BACnet Application Specific Controller

3. BTL BACnet Testing Laboratories
4. DDC Direct Digital Controls
5. FMCS Facility Management and Control System
6. GUI Graphic User Interface
7. IBC Interoperable BACnet Controller
8. IDC Interoperable Digital Controller
9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

1.8 SUMMARY

A. Provide new standalone FMCS for this project.

[* * * * * OR * * * * *]

B. Extend Existing System:

1. Extend the existing FMCS for this project.
2. All controllers and accessories shall interface with the existing FMCS.
3. Update software if existing control software is 5 years old or older. Upgrade BMS campus interface with new building.

C. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

D. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.

E. All power requirements for control system is responsible by control contractor including 120V conduit and cable from panel to control panels

F. All control system shall be BACNET compatible and Tridium interface ready.

G. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

1.9 SYSTEM DESCRIPTION

A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.

B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Owner's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.

C. Provide materials and labor necessary to connect factory supplied control components.

D. Provide central and remote hardware, software, and interconnecting wire and conduit.

E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.

F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

G. For each operator workstation provided, furnish one legal copy of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be readily available in the market. Contractor shall convey to the Owner all software tools and their legal licenses at project closeout.

1.10 SOFTWARE LICENSE AGREEMENT

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID (**"orgid"**) of all software licenses. Owner shall be free to direct the modification of the **"orgid"** in any software license, regardless of supplier.

1.11 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Acceptable Manufacturers	**BACnet Protocol**	**LonTalk Protocol**
Alerton	●	
Automated Logic: WebCTRL	●	
Delta Controls: ORCA	●	
Honeywell	●	●
Johnson Controls: Metasys Extended Architecture	●	●
KMC	●	
Siemens Building Technologies: APOGEE	●	
TAC Andover	●	
TAC I/A Series		●
TAC I/A Series (Native BACnet - no UNC/ENC controllers)	●	
Trane Summit		●
Distech Controls	●	●

2.2 SYSTEM ARCHITECTURE

A. General:

1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

B. Open, Interoperable, Integrated Architectures:

1. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data are not acceptable.

2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.

3. Hierarchical or “flat” topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer’s internal intranet network.

a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE Standard 802.3.

2. Cable; 100 Base-T, UTP-8 wire, Category 6.

3. Minimum throughput; 100 Mbps.

C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high-power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.

D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and “safed” off in an appropriate manner.

E. There shall be no power wiring more than 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer’s wiring practices.

2.4 REMOTE NETWORK ACCESS

A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall determine the quantity and type of devices.

B. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:

1. Calendar functions.

2. Scheduling.

3. Trending.

4. Alarm monitoring and routing.

5. Time synchronization.

6. Integration of all controller data.

7. Network Management functions.

8. The Network Area Controller shall provide the following hardware features as a minimum:

9. One Ethernet Port – 10/100 Mbps.

10. One RS-232 port.

11. One LonWorks Interface Port – 78KB FTT-10A (for LonWorks systems only).

12. One RS-485 port.

13. Battery backup.

14. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity.)

15. The NAC must be capable of operation over a temperature range of 32°F to 122°F.

16. The NAC must be capable of withstanding storage temperatures of between 0°F and 158°F.

17. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.

C. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data stored within it.

D. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5) simultaneous users.

E. Event Alarm Notification and Actions:

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a LAN, remote via dial-up telephone connection, or WAN.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:

a. Alarm

b. Normal

4. Provide for the creation of a minimum of eight alarm classes with different routing and acknowledgement properties, e.g. security, HVAC, Fire, etc.

5. Provide timed (scheduled) routing of alarms by class, object, group, or node.

6. Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

F. Treat control equipment and network failures as alarms and annunciated.

G. Annunciate alarms in any of the following manners as defined by the user:

1. Screen message text.

2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-mail alarms based on:

a. Day of week.

b. Time of day.

c. Recipient.

3. Pagers via paging services that initiate a page on receipt of e-mail message.

4. Graphic with flashing alarm object(s).

5. Printed message, routed directly to a dedicated alarm printer.

H. The FMCS shall record the following for each alarm:

1. Time and date.

2. Location (building, floor, zone, office number, etc.).

3. Equipment tag.

4. Acknowledge time, date, and user who issued acknowledgement.

5. Number of occurrences since last acknowledgement.

I. Give defined users proper access to acknowledge any alarm.

J. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

K. Provide a “query” feature to allow review of specific alarms by user-defined parameters.

L. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

M. An error log to record invalid property changes or commands shall be provided and available for review by the user.

2.6 BACNET FMCS

A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device’s compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).

C. Interoperable BACnet Controller (IBC):

1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system’s compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.

2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:

a. BACnet Building Controller(s) (B-BC).

b. BACnet Advanced Application Controller(s) (B-ACC).

c. BACnet Application Specific Controller(s) (B-ASC).

3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.

4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.

5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.

6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:

    a. BACnet Device; MAC address, name, type and instance number.

    b. BACnet Objects; name, type and instance number.

7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.

D. Object Libraries

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.

4. All control objects shall conform to the control objects specified in the BACnet specification.

5. The library shall include applications or objects for the following functions, at a minimum:

    a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.

    b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.

d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.

e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.

6. The library shall include control objects for the following functions:

a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.

c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.

e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.

f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.

i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.

j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an “on” state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.

k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphic shell of this container.

7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:

a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.

b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.

c. For BACnet devices, provide the following objects:

1) Analog In.

2) Analog Out.

3) Analog Value.

4) Binary.

5) Binary In.

6) Binary Out.

7) Binary Value.

8) Multi-State In.

9) Multi-State Out.

10) Multi-State Value.

11) Schedule Export.

12) Calendar Export.

13) Trend Export.

14) Device.

d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

e. For BACnet devices, provide the following support at a minimum:

1) Segmentation.

2) Segmented Request.

3) Segmented Response.

4) Application Services.

5) Read Property.

6) Read Property Multiple.

7) Write Property.

8) Write Property Multiple.

9) Confirmed Event Notification.

10) Unconfirmed Event Notification.

11) Acknowledge Alarm.

12) Get Alarm Summary.

13) Who-has.

14) I-have.

15) Who-is.

16) I-am.

17) Subscribe COV.

18) Confirmed COV notification.

19) Unconfirmed COV notification.

20) Media Types.

21) Ethernet.

22) BACnet IP Annex J.

23) MSTP.

24) BACnet Broadcast Management Device (BBMD) function.

25) Routing.

2.7 TERMINAL AIR BOX (TAB) CONTROLLERS

A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.

B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.

C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.

D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator's terminal connected to the specific controller.

E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.

F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

2.8 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)

A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, configure the object for time of day, day of week and the sample collection interval.

3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so configured) or a standard Web browser.

C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

D. All log data shall be available to the user in ALL the following data formats:

1. HTML.

2. XML.

3. Plain text.

4. Comma or tab separated values.

E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties:

1. Archive on time of day.

2. Archive on user-defined number of data stores in the log (buffer size).

3. Archive when log has reached its user-defined capacity of data stores.

4. Provide ability to clear logs once archived.

2.9 AUDIT LOG

A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date.

2. User ID.

3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

2.10 DATABASE BACKUP AND STORAGE

A. The NAC shall automatically backup its database on a user-defined time interval.

B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of the most recently saved database shall depend on the user-defined database save interval.

C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as XML format is supported.

2.11 GRAPHIC USER INTERFACE SOFTWARE

A. Operating System:

1. Provide computer with the most current Microsoft-based operating system with which the GUI has proven compatibility.

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location and the selected object identification.

C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.

D. Real-Time Displays: The GUI shall support the following graphic features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.

3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be accomplished graphically.

   a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard entry from the operator.

   b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be made by selecting the object and the appropriate command from a pop-up menu. No text entry shall be required.

6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a graphic slider to adjust the value. No text entry shall be required.

E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable the operator to perform the following tasks with proper password access:

1. Create, delete or modify control strategies.

2. Add/delete objects.

3. Tune control loops by adjusting control loop parameters.

4. Enable or disable control strategies.

5. Generate hard copy records or control strategies on a printer.

6. Select alarm points and define the alarm state.

7. Select points to be trended and initiate the recording of values automatically.

8. View any trend as a graph.

F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available using hypertext. All system documentation and help files shall be in HTML format.

G. Security: Each operator shall be required to log on to that system with a user name and password to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall be able to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security data in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Annunciate the failure of any device to the operator.

I. Alarm Console:

1. The system shall have a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the alarm.

2. When the alarm console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable. The use of the alarm console can be enabled or disabled by the system administrator.

2.12 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Firefox™, or Chrome. Systems requiring additional software to enable a standard Web browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.

B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, are not permitted.

C. The Web browser client shall provide:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, display a blank web page. Implement security using Java authentication and encryption techniques to prevent unauthorized access.

2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client. The web browser interface shall support all animated graphic objects supported by the GUI.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics storage on the client machine.

5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

   a. Modify common application objects, such as schedules, calendars, and setpoints, graphically.

      1) Schedule times shall be adjustable using a graphic slider, without requiring any keyboard entry from the operator.

      2) Holidays shall be set using a graphic calendar, without requiring any keyboard entry from the operator.

   b. Commands to start and stop binary objects shall be made by right-clicking the selected object and selecting the appropriate command from a pop-up menu. No text entry shall be required.

   c. View logs and charts.

   d. View and acknowledge alarms.

   e. Setup and execute SQL queries on log and archive information

7. The system shall be able to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just his/her defined home page. From the home page, links to other views or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

2.13 SERVER FUNCTIONS AND HARDWARE

A. Provide a central server located at _____ . The server shall support all NACs connected to the customer’s network whether local or remote.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1, or dial-up connection.

C. It shall be possible to provide access to all NACs via a single connection to the server. In this configuration, each NAC can be accessed from a remote GUI or from a standard WBI by connecting to the server.

D. The server shall provide the following functions:

1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.

3. The server shall include a master clock service for its subsystems and provide time synchronization for all NACs.

4. The server shall accept time synchronization messages from trusted precision atomic clock Internet sites and update its master clock based on this data.

5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.

6. The server shall provide demand limiting that operates across all NACs. The server must be capable of running multiple demand programs for sites with multiple meters and/or multiple sources of energy. Each demand program shall be able to support separate demand shed lists.

7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to NACs.

8. Each NAC supported by the server shall be able to automatically archive its log data, alarm data and database to the server. Archiving options shall be user-defined, including archive time and archive frequency.

9. The server shall provide central alarm management for all NACs supported by the server. Alarm management shall include:

    a. Routing alarms to display, printer, e-mail, and pagers.

    b. Viewing and acknowledging alarms.

    c. Querying alarm logs based on user-defined parameters.

10. The server shall provide central management of log data for all NACs supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

    a. Viewing and printing log data.

    b. Exporting log data to other software applications.

    c. Querying log data based on user-defined parameters.

11. Reports shall be generated automatically or manually, and directed to LCD displays, printers, or disk files. The system shall allow the user to easily obtain the following types of reports:

    a. List all points in network.

    b. List all points in alarm.

    c. List all off-line points.

    d. List all points in override status.

    e. List all disabled points.

    f. List all points that are locked out.

    g. List all items defined in a "follow-up" file.

    h. List all weekly and holiday schedules.

i. List all limits and deadbands.

E. Server Hardware Requirements:

1. Provide an Intel Xeon E5 based computer (minimum processing speed of 2.4 GHz with 8.0 GB RAM and a 1-terabyte minimum hard drive). It shall include a CD/DVD+/-RW optical drive, one parallel port, one asynchronous serial port and four USB ports. Include a 21” minimum flat panel color monitor, 8ms response time.

2. The server operating system shall be Microsoft Windows 7 Professional, including Microsoft Internet Explorer.

3. Connect to the FMCS network via an Ethernet network interface card, 1 Gbps.

4. Provide a color laser printer with a minimum 600 x 600-dpi resolution and 12 ppm print speed.

5. For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a parallel port interface.

2.14 GRAPHIC USER INTERFACE COMPUTER HARDWARE (DESKTOP)

A. Provide a browser workstation with an Intel i7 processor with 8.0 GB RAM and a 1 terabyte minimum hard drive. It shall include a CD/DVD+/-RW combination drive, one parallel port, one asynchronous serial port and six USB ports. Include a 21” minimum flat panel color monitor, 8ms response time.

B. Connect to the FMCS network via a 1 Gbps Ethernet network interface card.

C. Provide a color laser printer with minimum 600 x 600-dpi resolution and 12 PPM print speed.

[* * * * * OR * * * * *]

2.15 GRAPHIC USER INTERFACE COMPUTER HARDWARE (LAPTOP COMPUTER)

A. Provide an Intel i7 processor based laptop computer with 8 GB RAM and 750-gigabyte minimum hard drive. It shall include a CD/DVD+/-R optical drive. Laptop computer shall be equipped with minimum 15” screen.

B. Connect to the FMCS network via a 10/100 Mbps Ethernet network interface card.

C. Provide a color laser system printer with a minimum 600 x 600-dpi resolution and 12 ppm print speed.

2.16 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. A UPS shall be provided for each of the following:

1. FMCS workstations and servers.

2. Network area controllers.

3. Chiller plant manager.

4. Boiler plant manager.

B. Provide a 120-volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for 5 minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.

C. Acceptable Manufacturers: Sola/Hevi-Duty, Eaton Powerware, APC.

2.17 SYSTEM PROGRAMMING

A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI software shall be through password access as assigned by the system administrator.

B. Provide a library of control, application, and graphic objects to enable creation of all applications and user interface screens. Applications shall be created by selecting the control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Provide all software tools or processes to create applications and user interface displays.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to the user’s application. Link objects with a graphic linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; e.g., internal, external, hardware, etc.

2. Configuration of each object shall be done through the object’s property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real time. Systems requiring the uploading, editing, and downloading of database objects are not allowed.

5. The system shall support object duplication in a customer’s database. An application, once configured, can be copied and pasted for easy reuse and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.18 DDE DEVICE INTEGRATION

A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet network. The NAC shall act as a DDE client to another software application that functions as a DDE server.

B. Provide the required objects in the library included with the Graphic User Interface programming software to support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:

1. DDE Generic AI Object.

2. DDE Generic AO Object.

3. DDE Generic BO Object.

4. DDE Generic BI Object.

2.19 MODBUS SYSTEM INTEGRATION

A. The NAC shall support integration of device data from Modbus RTU, ASCII, and TCP control system devices. Connect to the Modbus system via an RS-232, RS485, or Ethernet IP as required by the device.

B. Provide the required objects in the library included with the GUI programming software to support the integration of the Modbus system data into the FMCS. Objects provided shall include, at a minimum:

1. Read/Write Modbus AI Registers.

2. Read/Write Modbus AO Registers.

3. Read/Write Modbus BI Registers.

4. Read/Write Modbus BO Registers.

C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the Modbus system devices.

D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment using Modbus shall provide documentation of the system’s Modbus interface and shall provide factory support at no charge during system commissioning.

2.20 OPC SYSTEM INTEGRATION

A. The Network Area Controller shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP. The OPC client shall support third-party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

B. Provide the required objects in the library included with the GUI programming software to support the integration of the OPC system data into the FMCS. Objects provided shall include:

1. Read/Write OPC AI Object.

2. Read/Write OPC AO Object.

3. Read/Write OPC BI Object.

4. Read/Write OPC BO Object.

5. Read/Write OPC Date/Time Input Object.

6. Read/Write OPC Date/Time Output Object.

7. Read/Write OPC String Input Object.

8. Read/Write OPC String Output Object.

C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the OPC system devices.

D. The FMCS supplier shall provide an OPC client communications driver. The vendor that provided the equipment using OPC shall provide documentation of the system's OPC server interface and shall provide free factory support during system commissioning.

2.21 SOFTWARE

A. IDC/IBCs shall operate totally standalone and independent of a central computer for all specified control applications.

B. Software shall include a complete operating system (OS), communications handler, point processing, energy management application packages as specified herein, standard control algorithms and specific control sequences (IDC/IBC) and an Owner/user custom control calculation package complete with interpreter.

C. OS software shall be PROM resident, operate in real time, provide prioritized task scheduling, control time programs, monitor and manage communications, and scan inputs and outputs.

D. Each IDC/IBC panel shall include the following energy management routines:

1. Time of day scheduling.

2. Optimum start/stop.

3. Peak demand limiting.

4. Economizer control.

5. PID control.

6. Supply air reset.

7. Outdoor air reset.

E. Input/output point processing software shall include:

1. Update of all connected input and output points at least once per second.

2. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no response or failed sensors, and conversion of values to 32-bit floating point format. Retain both the maximum and minimum values sensed for each analog input in memory. It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-scale 32-bit conversion to achieve high accuracy readout.

3. A reasonability check on all analog inputs against previous values and discarding of values falling outside preprogrammed reasonability limits.

4. Assignment of proper engineering units and status conditions to all inputs and outputs.

5. Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and alarm) to an input or to assign a set of floating limits (alarm a reset schedule or FMCS control point) to the input. Assign each alarm a unique differential to prevent a point from oscillating in and out of alarm. Make alarm comparisons of each scan cycle.

6. Adjustment of timing from two seconds to two minutes in one-second increments to eliminate nuisance alarms on startup.

F. Command Control software shall manage the receipt of commands from the server and from control programs.

1. Provide command delay to prevent simultaneous energizing of loads. Delay must be programmable from 0 to 30 seconds.

2. Assign each command a command and residual priority to manage conflicts created by multiple programs having access to the same command point. Allow only outputs with a higher command priority to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.

3. A "fixed mode" option (override) shall allow inputs to and outputs from control programs to set to a fixed state or value. When in the "fixed mode", assign inputs and outputs high residual command priority to prevent override by application programs.

G. Alarm lockout software shall prevent nuisance alarms. On initial start-up of mechanical equipment, assign a "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period shall be programmable for each point from 0 to 90 minutes in one-minute increments.

H. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when a true alarm depends on the condition of an associated point. Hard lockout points and lockout initiators shall be operator programmable.

I. Runtime shall be accumulated based on the status of a digital input point. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Runtime counts shall reside in non-volatile memory and have DCP resident runtime limits assignable through the operator's terminal.

J. A transition counter shall count the number of times a device is cycled on or off. Counter shall be non-volatile and capable of counting 600,000 cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

K. Custom IDC/IBC programs shall meet the control strategies called for in the sequence of operation of these specifications. Each IDC/IBC shall have resident in its memory and available to the programs a full library of IDC/IBC algorithms, intrinsic control operators, arithmetic, logic, and relational operators. Provide the following features:

1. Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning). Use Adaptive Control where the controlled flow rate is variable (such as TAB units and variable flow pumping loops). The adaptive control algorithm shall monitor the loop response to output corrections and adjust the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of the system dynamics so that, on system shutdown and restart, the learning process starts from where it left off. Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

2. All IDC/IBC setpoints, gains and time constants associated with IDC/IBC programs shall be available to the operator for display and modification via the operator workstation.

3. The execution interval of each IDC/IBC loop shall be adjustable from 2 to 120 seconds in one-second increments.

4. IDC/IBC control programs shall assign initialization values to all outputs so controlled devices assume a failsafe position on start-up.

L. Provide time and event programming (TEP) capability to initiate a controlled sequence of events for execution at a specific time or upon the occurrence of an event. Minimum program features required are:

1. Analog points commandable to a specific value.

2. Digital points commandable to a specific state; e.g. on or off; fast, slow or off.

3. Initiator to be a specific day and time or a specific event; e.g. an alarm.

4. Manual initiation via operator's command.

5. Commands must honor command delays (to prevent current surges), and assigned minimum ON and OFF times.

6. Commands must honor command and residual priority structures allowing higher priority commands (like smoke control) to override lower priority commands (like time of day scheduling) and residual priority.

7. Ability to chain TEPs.

8. Ability to enable and disable TEPs individually.

9. Ability to enable/disable TEP initiators.

M. Store Energy Management application programs and associated data files in non-volatile or 72-hour battery backed RAM memory. Individual programs shall be accessible from the operator workstation for enabling/disabling and program parameter modification and shall include:

1. Time Programs:

a. Provide an independent start and stop program time for each system identified in the points list.

b. It shall be possible to assign two independent start and stop times/days to any equipment connected to a controller.

2. Exception Day Scheduling:

a. Provide an Exception Day program for holiday and other planned exceptions to time programs. Exception schedules shall be DSC resident and operator programmable up to one year in advance.

b. The program shall allow definition of up to 32 exception time spans. Define each span by calendar start day and calendar stop day.

3. An IDC/IBC resident temporary scheduler shall allow operators to modify present time program control of equipment. Minimum feature set required is:

a. Ability to alter time schedules as much as six days in advance.

b. Ability to alter either start time, stop time or both for each day.

c. Temporary schedule shall be in effect for all days specified.

d. Automatically delete the temporary schedule and restore program to normal schedule after execution.

e. Ability to assign schedule changes as permanent as well as temporary.

N. The IDC/IBC shall have built-in, non-descriptive, self-test procedure for checking the indication lights, digital display, and memory. It shall display advisories for maintenance, performance, and/or software problems.

O. All electronics shall be:

1. Standard locally stocked modular boards.

2. Plug-in type.

3. Furnish all ROM programs unlocked.

2.22 CONTROL DAMPERS

A. Rectangular Control Dampers - Standard Construction:

1. Shall be licensed to bear the AMCA Certified Rating Seal.

2. Test leakage and pressure drop per AMCA 500.

3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4” deep. Caulk or weld seams to prevent leakage.

4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6” wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).

5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.

7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.

8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.

10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.

11. Maximum Leakage: 9 cfm at 1” w.c. pressure differential for a 24”x24” damper.

12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8,000 cfm through a 24"x24" damper (2000 fpm).

13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8,000 cfm through a 24"x24" damper (2000 fpm).

B. Thermally Insulated Control Damper:

1. Shall be licensed to bear the AMCA Certified Rating Seal.

2. Test leakage and pressure drop per AMCA 500.

3. Frame: Extruded aluminum, minimum 4” deep, 0.080” minimum thickness. Frame shall be insulated with Styrofoam on three sides if installed in duct and four sides if flanged to duct.

[* * * * * OR * * * * *]

4. Thermally Broken Frame: Extruded aluminum, minimum 4” deep, 0.080” minimum thickness. Insulate frame with extruded polystyrene on four sides and flanged to duct. Entire frame shall be thermally broken using polyurethane resin pockets, complete with thermal cuts.

5. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6” wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).

6. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

7. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.

8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.

9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.

10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.

11. Maximum Leakage: 15 cfm at 1” w.c. pressure differential for a 24”x24” damper.

12. Maximum Pressure Drop: 0.21” for 8,000 cfm through a 24”x24” damper (2000 fpm).

C. Round Galvanized Steel Control Dampers:

1. Test leakage and pressure drop per AMCA 500.

2. Frame: Minimum 20 gauge galvanized steel, 10" long.

3. Bearings: Provide thrust bearings for vertical damper applications.

4. Blades: Two-layer galvanized steel, equivalent 14 gauge thickness with neoprene or polyethylene foam seal enclosed in two-piece blade construction up to 24", 10 gauge steel over 24".

5. Linkage: Stainless steel, minimum 1/2" diameter shaft through 24", 3/4" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

6. Maximum Leakage: 8 cfm maximum at 1" w.c. pressure differential for a 24"x24" damper.

7. Maximum Pressure Drop: 0.10" for 6,280 cfm through a 24" damper (2,000 fpm).

D. Round Stainless Steel Control Dampers:

1. Test leakage and pressure drop per AMCA 500.

2. Frame: Hat-shaped channel, minimum 10 gauge Type 304 stainless steel (304L or 316L for welded duct). Caulk or weld seams to prevent leakage.

3. Bearings: Provide thrust bearings for vertical damper applications.

4. Blades: Minimum 12 gauge Type 304 stainless steel construction. No seals are required.

5. Linkage: Stainless steel, minimum 1/2" diameter shaft through 12", 3/4" shaft through 24", 1" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.

6. Maximum Leakage: 26 cfm maximum at 1" w.c. pressure differential for a 24"x24" damper.

7. Maximum Pressure Drop: 0.15" for 6,280 cfm through a 24" damper (2,000 fpm).

2.23 DAMPER ACTUATORS

A. Damper Actuators - Electronic - Spring Return:

1. Damper actuators shall be UL listed, electronic direct coupled with spring return to normal position for modulating or two-position control as noted in the sequence of control. Actuator shall be 24 VAC with proportional control, electronic overload protection to prevent actuator damage due to over-rotation and “V” bolt clamp with matching “V” toothed cradle (single bolt or setscrew fasteners not acceptable).

2. Following power interruption, spring return mechanism shall close the damper. Mechanical spring shall be rated for a minimum of 60,000 full cycles. Provide breathable membrane in actuator housing to compensate for pressure differential and allow for 95% non-condensing relative humidity in the airstream.

3. Mount actuators with motor outside of airstream whenever possible. Unit casings shall have housing with proper weather, corrosive, or explosion-proof construction as required by application.

4. Actuators shall be rated for 60,000 full cycles at rated torque with 2-year unconditional warranty. Size actuators per damper manufacturer’s recommendations.

5. Provide end switches as required for the sequence of operation.

6. Provide analog feedback signal for positive position indication. Refer to FMCS points list.

7. Belimo actuator as base quality.

2.24 HYDRONIC CONTROL VALVES

A. General:

1. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 2 psi.

2. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 1 to 4 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 2 psi.

3. Two-way valves shall be 100% tight-closing. Three-way valves shall be 100% tight-closing in both extreme positions.

4. Modulating two-way valves shall have equal percentage flow characteristics.

5. Modulating three-way valves shall have linear flow characteristics.

6. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Two-position:

1. Ball 2” and under:

a. Design Pressure: 400 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 150 psi

b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470ºF melting point of 95-5 solder).

2. Ball 3” to 6”:

a. Design Pressure: 200 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.

3. Butterfly 2-1/2” to 12”:

a. Design Pressure: 125 psi

Design Temperature: -20 to 212ºF
Design Flow Differential Pressure Rating: 50 psi

b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.

C. Modulating:

1. Globe 1/2" to 2":

a. Design Pressure: 250 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel or bronze seat; EPDM or PTFE packing; threaded ends.

2. Globe 2-1/2" to 6":

a. Design Pressure: 125 psi

Design Temperature: 250ºF
Design Flow Differential Pressure Rating: 25 psi

b. Cast iron body, bronze or brass trim and plug; stainless steel stem; bronze seat; EPDM or PTFE packing; flanged ends.

3. Ball 2" and under:

a. Design Pressure: 400 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470ºF melting point of 95-5 solder).

4. Ball 3" to 6":

a. Design Pressure: 200 psi

Design Temperature: 212ºF
Design Flow Differential Pressure Rating: 35 psi

b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.

5. Butterfly 2-1/2" to 12":

a. Design Pressure: 125 psi

Design Temperature: -20 to 212ºF
Design Flow Differential Pressure Rating: 50 psi

b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.

2.25 STEAM CONTROL VALVES

A. General:

1. Two-position valves shall have a maximum pressure drop equal to 10% of the inlet pressure.

2. Modulating control valves shall have modified linear characteristics.

3. Two modulating control valves in parallel shall have 1/3 – 2/3 capacities sequenced so that the smaller valve opens first.

4. The pressure drop through a modulating control valve with an inlet pressure less than or equal to 15 psig shall be equal to 80% of the inlet pressure. In no case shall the inlet pressure of the equipment after the valve be less than 2 psig, except for integral face and bypass coils where the inlet pressure after the valve shall not be less than 5 psig.

5. The pressure drop through modulating control valves with inlet pressures greater than 15 psig shall be required to provide outlet pressure of 1 psi above the scheduled or specified inlet pressure of the equipment served.

6. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Two-Position or Modulating (Low Pressure: 15 psi or below):

1. Globe 1/2" to 2":

a. Design Pressure: 100 psi
Design Temperature: 337ºF

b. Bronze body; stainless steel trim, plug, stem and seat; EPDM or PTFE packing; threaded ends.

2. Globe 2-1/2" to 6":

a. Design Pressure: 100 psi
Design Temperature: 337ºF

b. Cast iron body; stainless steel trim, plug, stem and seat; EPDM or PTFE packing; flanged ends.

2.26 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.

2. Provide visual position indication.

3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Pneumatic:

1. Pneumatic piston type, with synthetic elastomer or rolling neoprene diaphragm. Actuator shall have 30 psi maximum safe operating pressure, -20ºF to 150ºF operating temperature.

2. Provide pilot positioner on all valve actuators, except for terminal units.

3. Select all actuators and spring ranges to operate their valves as indicated in the control sequences with 50% additional force for future friction increases.

C. Valve Actuators - Electronic:

1. Actuator shall be UL listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation, and “V” bolt clamp with matching “V” toothed cradle (single bolt or setscrew fasteners not acceptable).

2. Actuators shall be rated for 60,000 full stroke cycles at rated torque. Stall motor not acceptable.

3. Tri-state/floating actuators shall have auto-zeroing function for realigning valve position.

4. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.

5. Spring return actuators shall have an internal spring return mechanism. Non-mechanical forms of fail-safe operation are not acceptable.

6. Provide analog feedback signal for positive position indication as required by control diagrams.

2.27 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5ºF, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.

b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5ºF, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element can trigger the switch.

b. Provide 3” minimum radius capillary support clips at each turn.

c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.

d. Setpoint range shall be 15ºF to 55ºF with a permanent stop at 35ºF.

e. Differential shall be fixed at approximately 5ºF and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

a. Sensor Only: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, no setpoint adjustment or override button.

b. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a single warmer/cooler or red/blue visual scale), no override button.

c. Sensor with Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.

d. Sensor with Setpoint Adjustment and Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

a. Thermistor or RTD type. Pneumatic transmitters with transducers are not acceptable.

3. Water Temperature Sensor:

a. Install in immersion wells. Separate thermometers as specified elsewhere, also of the immersion well type, shall be installed within 2 feet of each temperature sensor.

C. Humidity Measuring Devices:

1. Humidity Sensors:

a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 5% of reading.

[* * * * * OR * * * * *]

b. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.

2. Humidistats:

a. Room Humidistats: Wall-mounted, proportioning type, with adjustable 2% RH throttling range, operating range from 30% to 80% at temperatures up to 110ºF, cover with concealed setpoint.

b. Duct Humidistats: Proportioning insertion type, with adjustable 2% RH throttling range and operating range from 20% to 80% at temperatures up to 150ºF.

c. High Limit Duct Humidistat: 2-position insertion type, with differential maximum 2% RH.

D. Enthalpy Sensors. Duct-mounted enthalpy sensor shall include solid state temperature and humidity sensors with electronics that shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

E. Pressure Measuring Devices

1. Differential Pressure Switches:

a. Standard Pressure Switches:

1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

2) Accuracy shall be ± 3% of full scale maximum throughout entire range at 70ºF.

3) Provide mounting brackets, probes, and shutoff valves required for proper installation.

4) The range and service shall be as required for application or as noted on the drawings.

[* * * * * OR * * * * *]

5) The range and services shall be as follows:

a)

6) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.

7) Provide latching relays that require manual reset once activated.

8) Acceptable Manufacturer: Dwyer Photohelic Series 3000.

b. High Pressure Switches (Manual Reset):

1) Differential pressure switch with single pole, double-throw snap switch and enclosure.

2) Rated for pressure specified in sequence of control.

3) Electrical rating shall be 15 amps at 120-480 volts.

4) Setpoint adjustment shall be screw type located inside enclosure.

5) Provide optional manual reset for overpressure protection with all tubing, brackets, and adapters.

6) Repeatability: ± 3%.

2. Pressure Transmitters/Transducer:

a. Select device suitable for intended application; water or air, static or differential.

b. Select for appropriate range, including negative if applicable.

c. 100% solid state device, temperature compensated, suitable for pressures of 200% rated range with averaging to stabilize output, accuracy of ± 1% full scale, and a 4-20 mA output.

d. Provide a NEMA 4 enclosure unless panel mounted.

e. Air service shall have a minimum of three field selectable ranges.

f. When used for room pressure control, the transducer shall be bidirectional with a range of ± 0.1" W.C.

g. Provide pressure line outlet cover on both sides of the wall when used for room pressure control.

h. Furnish with integral LED's to indicate Zero Pressure, Pressure In Range, and Pressure Out Of Range as a diagnostic aid.

3. Room Pressure Monitor System:

a. General:

1) The Room Pressure Monitor System shall include a room pressure monitor, remote pressure sensor, door switch, keyed switch, and low voltage control transformer.

2) The system shall continuously measure, display, and monitor the room pressure.

3) All components of the Room Pressure Monitor System shall be completely designed, tested, cataloged, and coordinated for single point responsibility.

4) TCC shall furnish and install all wiring as required to connect system components.

b. Room Pressure Monitor:

1) Shall measure and display room pressure and provide access to menu driven programming options via a keypad. Refer to drawings for room pressure monitor requirements.

2) A minimum of two indicator lights shall be provided on the front of the monitor to indicate ALARM and NORMAL conditions.

3) There shall be an alphanumeric digital display indicating the measured room pressure in inches of H_2O with a display accuracy of 0.001 and shall be updated every second.

4) There shall be low and high pressure audible alarms. Each alarm shall have a unique setpoint.

5) The room pressure monitor shall not be capable of changing the room mode without the use of a password or keyed switch.

6) The room pressure monitor shall accept an input from the door switch to silence the alarm.

7) The room pressure monitor shall accept an input from the FMCS system to change the room mode as indicated in the control sequences.

8) Provide the following inputs/outputs to the FMCS system:

a) Pressure (analog).

b) Room Mode (binary).

c) Alarm (binary).

c. Pressure Sensor:

1) Shall be temperature compensated over a range of 55°F to 95°F.

2) The assembly shall not compromise the fire rating of the wall.

3) Shall measure room pressure from -0.20000 to +0.20000 inches H_2O with an accuracy of ± 0.001 inches H_2O.

4) Shall be bidirectional to determine the proper direction of pressure. Unidirectional sensors are not acceptable.

5) Manufacturer shall provide cable between the pressure sensor and room pressure monitor.

d. Door Switch:

1) Magnetic door switch designed to interface with room pressure monitor.

e. Transformer:

1) The transformer shall have a primary-side voltage of 120 VAC and a secondary-side voltage of 24 VAC.

2) The transformer shall be UL and CSA listed.

3) Manufacturer shall provide cable between the transformer and room pressure monitor.

f. Keyed Switch:

1) Two-position rotating cam-type with key removable in both positions. Rated for 20A at 120V UL listed. Back and side wired. Provide key and stainless steel coverplate in a single gang electrical rough-in box. Provide black laminated three-layer phenolic nameplate with engraved white, 1/4" minimum letters for labels.

2) Provide with spare keys.

F. Flow Measuring Devices:

1. Flow Switches:

a. Suitable for the intended application (water or air system).

b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap switch.

2. Insertion Type Turbine Flow Meters:

a. General:

Each flow meter shall be an insertion type single dual turbine flow meter.

b. Service:

1) Chilled Water: Rated for 32°F through 140°F service.

2) Condensate and Heating Water: Rated for minimum of 240°F service.

c. Turbine Flow Meter:

1) Each meter shall be rated for system pressure and shall have adequate structural integrity for a flow rate equal to 150% of the scheduled maximum initial or future flow rate, whichever is greater.

2) Each turbine flow meter shall be complete with all insertion hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 PSI.

3) Each flow meter shall have one two contra-rotating axial turbines with electronic impedance based sensing (non-magnetic).

4) Dual turbine flow meters shall have an averaging circuit to reduce measurement error due to swirl and flow profile distortion.

5) Constructed of nickel plated brass 316 stainless steel with NEMA 4 powder coated cast aluminum enclosure.

6) Each meter shall be wet calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST.

d. Output:

1) Each transmitter shall produce an analog output signal, 4-20 mA, 0-10 V, or 0-5 V that is directly proportional to volumetric flow rate.

2) The output shall be connected with display unit BTU meter.

3) All wire shall be carried into 1/2" NPTM conduit connection. The meter shall include 25 feet of cable to connect with a remotely mounted display unit BTU meter.

4) Unless scheduled or indicated otherwise, the initial span adjustment of each transmitter shall be 0-120% of the scheduled maximum flow rate.

e. Accuracy:

1) The accuracy of each meter/transmitter assembly shall be ± 1.0% of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be ± 2.0%.

f. Display Unit:

1) Pair with Display Unit described below.

g. BTU Meter:

1) Pair with BTU Meter described below.

h. Calibration:

1) Each meter shall be calibrated on an NIST traceable flow stand at 1, 8, and 15 feet/second. Provide written documentation of calibration.

i. Installation Hardware:

1) The flow meter shall be supplied with standard hot tap installation hardware, which shall include, but not be limited to, full port bronze ball valve, brass close nipple, and weld-on carbon steel branch outlet.

j. Warranty:

1) Provide performance warranty of at least two years from the date of installation and startup. Warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.

k. Approved Manufacturers:

1) Onicon, Hoffer, Inflow.

3. Insertion Type Electromagnetic Flow Meter:

a. General:

1) Each flow meter shall be of the magnetic insertion type.

b. Service:

1) Chilled Water: Rated for 32°F through 140°F service.

2) Condensate and Heating Water: Rated for minimum of 240°F service.

c. Insertion Type Electromagnetic Flow Meter:

1) Each meter shall be rated for system pressure and shall have adequate structural integrity for a flow rate equal to 150% of the scheduled maximum initial or future flow rate, whichever is greater.

2) Each insertion type electromagnetic flow meter shall be complete with all hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 PSI.

3) Construction:

a) Wetted Components: 316 stainless steel

b) Sensor Head: Polypropylene

c) Electronics enclosure shall be NEMA 4 and aluminum.

4) Each meter shall be wet calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST.

d. Output:

1) Output signals shall be completely isolated and shall consist of the following:

a) High resolution frequency output for use with peripheral devices such as display module or BTU meter.

b) Analog output; 4-20mA, 0-10V, or 0-5V jumper selectable.

c) Scalable dry contact output for totalization.

2) The output shall be connected with display unit BTU meter.

3) The meter shall include 25 feet of cable to connect with a remotely mounted display unit BTU meter.

4) Unless indicated otherwise, the initial span adjustment of each transmitter shall be 0-120% of the scheduled maximum flow rate.

e. Accuracy:

1) The accuracy of each meter/transmitter assembly shall be ± 1.0% of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be ± 2.0%.

f. Display Unit:

1) Pair with Display Unit described below.

g. BTU Meter:

1) Pair with BTU Meter described below.

h. Calibration:

1) Each meter shall be calibrated on a NIST traceable flow stand at 1, 8, and 15 FPS. Provide written documentation of calibration.

i. Installation Hardware

1) The flow meter shall be supplied with standard hot tap installation hardware, which shall include, but not be limited to, full port bronze ball valve, brass close nipple and weld-on carbon steel branch outlet.

j. Warranty:

1) Provide performance warranty of at least two years from the date of installation and startup. Warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.

k. Approved Manufacturers:

1) ABB, Onicon, Magmeter.

4. Inline Electromagnetic Flow Meters:

a. General:

1) Each flow meter shall be of the electromagnetic type.

b. Service:

1) Chilled Water: Rated for 32°F through 140°F service.

2) Condensate and Heating Water: Rated for minimum of 240°F service.

c. Electromagnetic Flow Tube:

1) Each meter shall be rated for system pressure and shall have adequate structural integrity for a flow rate equal to 150% of the scheduled maximum initial or future flow rate, whichever is greater.

2) Each meter shall have flanged connections to match piping pressure class, an outer body constructed of painted carbon steel 316 stainless steel, a full line-size 304 stainless steel flow tube, 316 stainless steel electrodes, and a liner that is fully compatible with the chemical content of the flow media.

3) Each meter shall be provided with an adequate means for grounding the process fluid (e.g., grounding rings or a grounding electrode).

d. Transmitter:

1) Each meter shall incorporate an integral remote mounted programmable transmitter that incorporates a digital display. For remote mounted transmitters, 25 foot minimum cable length shall be provided with each unit unless otherwise scheduled or noted within the documents. The cable length shall be adequate to satisfy specific installation requirements.

2) Each transmitter shall calculate and display flow rate and net totalized flow, along with associated engineering units (e.g., GPM and Gal.).

3) Each transmitter shall produce an analog output signal that is directly proportional to volumetric flow rate. This signal shall be scalable to indicate flow rate in either direction. In lieu of such bidirectional scalability, two separate pulsed outputs shall be provided. One shall indicate incremental flow in one direction, while the other indicates incremental flow in the opposite direction such that net totalized flow can be calculated remotely.

4) Unless scheduled or otherwise indicated, the initial span adjustment of each transmitter shall be 0-120% of the scheduled maximum flow rate.

5) Each transmitter shall incorporate self-diagnostics and test functions to permit internal checks of all outputs and displays, and to verify the accuracy of the unit and the integrity of the current loop without any external equipment.

e. Accuracy:

1) Billing Purposes: The accuracy of each meter/transmitter assembly shall be ± 0.25% of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be ± 0.50%.

[* * * * * OR * * * * *]

2) Non-billing Purposes: The accuracy of each meter/transmitter assembly shall be ± 0.5% of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be ± 0.75%.

f. Display Unit:

1) Pair with Display Unit described below.

g. BTU Meter:

1) Pair with BTU Meter described below.

h. Calibration:

1) Each meter shall be calibrated on an NIST traceable flow stand at 1, 8, and 15 feet/second. Provide written documentation of calibration.

i. Installation and Startup:

1) Each meter assembly shall include detailed installation and operation instructions, including piping straight run requirements.

2) Provide on-site startup, commissioning, and training.

j. Warranty:

1) Each meter assembly shall carry a performance warranty of at least two years from the date of installation and startup. This warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.

k. Approved Manufacturers:

1) ABB, Yokogawa, Rosemount, Onicon, Badger.

5. Display Unit:

a. General:

1) The display shall compatible with virtually any flow meter.

2) The display module shall provide a local indication of liquid flow rate and net totalized flow, along with associated engineering units (e.g., GPM/second and gallons).

3) It shall have a network interface to communicate flow data to the building control network.

4) House in a steel wall-mounted enclosure with a built-in user interface/display.

5) Display unit shall accept 4-20 mA pulse or contact closure flow signals. It shall also function as a network interface for two (2) additional analog rate inputs and one (1) additional totalizing pulse input.

6) It shall support BACnet LonWorks communication protocols.

7) The display shall have two-line alphanumeric LCD displays of flow rate and flow total.

8) The display shall have non-volatile EEPROM memory that retains all program parameters and totalized values in the event of power loss.

9) Electrical Power Supply: 24VAC. 60Hz, 500mA max.

b. Approved Manufacturers:

1) Onicon, Yokogawa.

6. BTU Meter:

a. General:

1) Microprocessor based thermal energy meter with LCD display.

2) BTU meter shall work with all common types of flow meters, temperature sensors, and pressure sensors. It shall display total energy, total flow, energy rate, flow rate, supply temperature, and return temperature.

3) It shall be compatible with BACnet LonWorks network interface and shall input these values to the network area controller.

4) It shall be suitable for liquid temperature range of 25°F to 240°F and ambient temperature range: -20°F to 140°F.

5) BTU meter shall have LCD display as follows:

a) Alpha: 16 character, 0.2” high

b) Numeric: 6 digit, 0.4” high

c) Rate Display Range: 0-9,999,999

d) Total display Range: 0-9,999,999

6) The meter shall be compatible with liquid flow signal input of 0-15 V pulse output or 4-20 mA analog output from any flow meter.

7) The meter shall provide output signals as follows:

a) Isolated solid-state dry contacts for energy total, maximum contact rating: 100 mA, 50 V.

b) Multiple isolated analog or digital outputs for energy rate, flow rate, supply and return temperature and delta temperature. Output type: 4-20mA, 0-10 V, or 0-5 V.

c) Interval Data Logging: This option provides at least 24 hours of rate and total data logging in 15-minute intervals. Data includes date/time stamp, measured value, and scaling factors when appropriate.

d) Network interface: BACnet Modbus N2.

8) Electrical Input Power: 120 VAC, 60 Hz.

b. Accuracy:

1) The accuracy of BTU meter shall be ± 0.5% of flow rate reading over a range, with a repeatability of 0.1%.

c. Warranty:

1) Each BTU meter assembly shall carry a performance warranty of at least two years from the date of installation and startup. This warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.

d. Approved Manufacturers:

1) Onicon, Yokogawa.

7. Airflow Measuring Stations:

a. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, any AFMS used to measure outside air CFM shall have an accuracy of ±15% of the design minimum outdoor air flow rate (or better). The AFMS accuracy shall also comply with requirements outlined in the following paragraphs of this specification.

b. Duct Mounted Airflow Measuring Stations (AFMS) - Thermal Dispersion

1) Provide airflow/temperature measurement devices where indicated on the plans.

2) Each AFMS shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.

a) Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.

b) Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.

c) Devices using chip-in-glass or diode-case chip thermistors are not acceptable.

d) Devices using less than two thermistors in each sensor assembly are not acceptable.

e) Devices using platinum wire RTDs are not acceptable.

f) Devices having electronic circuitry mounted in or at the sensor probe are not acceptable.

g) Pitot tubes and arrays are not acceptable.

h) Vortex shedding devices are not acceptable.

3) All Sensor Probes

a) Each sensor assembly shall independently determine the velocity and temperature at its measurement point.

b) Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).

c) Airflow measuring station assembly accuracy shall be +/- 2% of Reading over the entire operating airflow range. Temperature accuracy shall be +/-0.15° F between -20° F and 160° F.

d) The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing).

e) Each sensor probe shall have an integral, UL listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.

f) The number of probes shall be as recommended by the manufacturer to achieve the specified accuracy.

4) Duct and Plenum Probes

a) Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.

b) Probe assembly mounting brackets shall be constructed of 304 stainless steel.

c) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5) Sensor Density

Area (sq. ft.)	Total # of Sensors Required
< 2	4
2 to < 4	6
4 to < 8	8
8 to < 16	12
≥ 16	16

6) Transmitters

a) The transmitter shall have an integral 16-character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.

b) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.

c) The operating temperature range for the transmitter shall be -20° F to 120° F.

d) The transmitter shall be capable of communicating with other devices using one of the following interface options:

(1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)

(2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.

(3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.

(4) LonWorks Free Topology

c. Fan Inlet Airflow Measuring Stations (AFMS) - Thermal Dispersion:

1) Sensor assemblies shall be mounted on 304 stainless steel housings.

2) Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.

3) Mounting feet shall be constructed of 304 stainless steel and securely riveted in place to prevent loosening over time due to vibration.

4) The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.

5) Transmitters

a) The transmitter shall have an integral 16-character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.

b) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.

c) The operating temperature range for the transmitter shall be -20° F to 120° F.

d) The transmitter shall be capable of communicating with other devices using one of the following interface options:

(1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)

(2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.

(3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.

(4) LonWorks Free Topology

6) The AFMS shall be UL listed as an entire assembly.

d. Fan Inlet Airflow Measuring Stations - Differential Pressure:

1) Fan Inlet Measuring Station Pressure Sensors, Transmitters and Transducers:

a) Select for appropriate pressure range, fan type, inlet velocity, and airflow volume.

b) Transmitter features and minimum performance requirements shall be as follows:

(1) Combined Accuracy: ± 0.50%.
(2) Terminal Point Nonlinearity: ± 0.40%.

(3) Hysteresis: ± 0.02%.
(4) Non-repeatability: ± 0.05%.
(5) Compensation Range:

(a) Zero Shift: ±0.025% FS/°F.
(b) Span Shift: 0.025% FS/°F.

(6) Differential Overpressure: 5 psi proof and 25 psi burst pressure.
(7) Output signal: 0 to 10 VDC.

c) Each transducer shall be provided with an integral manual zeroing valve to allow for field calibration of the zero-reference value without the need for shutting the operating system down.

d) System airflow (measured in CFM) shall be continuously displayed on an LCD display meter (0.5 inches high by 3.5 digits) located on the face of the air volume/velocity transducer control enclosure.

e. Mounting of fan inlet static pressure sensing elements shall be in accordance with manufacturer's published installation instructions to ensure accuracy of readings.

G. Current Measuring Devices:

1. Current Switches for Constant Speed Motors:

a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.

2. Current Switches for Motors Controlled by VFD:

a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.

H. Occupancy Sensors:

1. Use auxiliary contacts on sensor provided and installed by the Electrical Contractor. Refer to electrical drawings for sensor location and specifications. Coordinate with Electrical Contractor.

[* * * * * OR * * * * *]

2. Ceiling mounted, passive infrared, 360° coverage pattern, zero crossing circuitry, adjustable sensitivity and time delay (initial setting: Time delay - 5 minutes), integral isolated relay with normally open and normally closed outputs, LED indicator, five-year warranty, UL listed. TCC shall submit manufacturer supplied sensor layout drawing for shop drawing review. Provide full room coverage as recommended by manufacturer.

I. Carbon Monoxide Sensors:

1. Solid-state gas sensor/transmitter, NEMA 1 gasketed enclosure, normal operating temperature 0-120°F, normal relative humidity operation 5-95%, ± 5% accuracy, and detection range of 0-200 ppm.

2. Provide 4-20 mA output from the sensor to the FMCS system.

3. Provide local alarm whenever carbon monoxide level exceeds 100 ppm.

4. Install in accordance with OSHA requirements.

5. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer’s recommendations.

J. Combination Carbon Monoxide/Nitrogen Dioxide Sensors:

1. Solid-state gas sensor/transmitter for each gas, NEMA 1 gasketed enclosure, normal operating temperature 0-120°F, normal relative humidity operation 5-95%, ± 5% accuracy, and detection range of 0-200 ppm.

2. Provide separate 4-20 mA output from the sensor to the FMCS system for each gas.

3. Provide local alarm whenever carbon monoxide level exceeds 100 ppm or nitrogen dioxide level exceeds 5 ppm.

4. Install in accordance with OSHA requirements.

5. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer’s recommendations.

K. Carbon Dioxide Sensors:

1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO2 with ± 100 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas permeable membrane that prevents particulate contamination of the sensor. Unit shall have selectable IAQ mode with output signal and sum of CO2 and VOC levels.

L. Miscellaneous Devices:

1. Control Relays:

a. Form “C” contacts rated for the application with “push-to-test" contact transfer feature and an integral LED to indicate coil energization.

b. Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or controlled device and clearly label their functions.

2. Thermostat and Sensor Enclosures:

a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on the drawings.

b. Heavy Duty Enclosure:

1) Perforated steel, tamperproof locking thermostat and control device enclosure.

2) Box shall be nominally 8"x6"x2" deep or sized as required to fit devices to be enclosed.

3) Perforated cover shall be 16 gauge steel with maximum 3/16” perforations on maximum 1/4” staggered centers for a 55% free area.

4) Secure to wall from inside of box. Cover shall be secured by tamperproof screws to frame.

5) Color shall match electrical devices. Verify color with the Electrical Contractor.

3. Twist Timers:

a. Wall-mounted heavy duty, with rotary dial and face graduated in minutes or hours as noted. Unit shall fit behind standard "decorator" wall plate. Color of timer and face plate shall match remainder of project. Verify with Electrical Contractor. Provide wall plate and engraved plastic label indicating service.

b. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-1/2" deep electrical box.

c. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.

d. Acceptable Manufacturers: Paragon SWD Series, Tork A500 Series, Intermatic FD Series, or Marktime Series 93.

2.28 CONDUIT

A. Conduit and Fittings: Refer to Electrical Section 26 05 33 for materials and sizing.

2.29 WIRE AND CABLE

A. Wire and Cable Materials: Refer to Electrical Section 26 05 13 for wire and cable materials.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.

B. Install system and materials in accordance with manufacturer's instructions.

C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.

D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.

E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48”. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.

G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.

H. After completion of installation, test and adjust control equipment.

I. Check calibration of instruments. Recalibrate or replace.

J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.

K. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment served by emergency power shall be connected to the emergency power system. Control components shall be powered from the equipment branch optional standby branch of emergency power. In no instance shall panel be connected to the life safety or critical branch of the emergency power system. Panels may be connected to a common 20 amp, 120 volt circuit provided the total load on the circuit does not exceed 16 amps. Circuit conductors shall be sized per the table below. All power connections to the control panels shall be performed by a licensed electrician at the cost of this Contractor. Submit circuit information (total amperage on circuit, conductors length, and panel) for control panels to the Architect/Engineer for approval.

Circuit Load (Amps)	Circuit Max Length (feet)	Feeder Size
<=5	<=200	2#12 & 1#12 ground in 3/4" conduit.
<=10	<=100	2#12 & 1#12 ground in 3/4" conduit.
<=16	<=75	2#12 & 1#12 ground in 3/4" conduit.

Circuit Load (Amps)	Circuit Max Length (feet)	Feeder Size
<=5	<=325	2#10 & 1#10 ground in 3/4" conduit.
<=10	<=160	2#10 & 1#10 ground in 3/4" conduit.
<=16	<=100'	2#10 & 1#10 ground in 3/4" conduit.

L. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.

M. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.

2. Labels may be made with permanent marking pen in the control panels if clearly legible.

3. Use engraved labels for items outside panel such as outside air thermostats.

4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

N. VFDs:

1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.

2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.

3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.

4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.

5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

O. Airflow Stations:

1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.

2. Mount transmitter where they can easily be read (36” to 66” above floor). Do not fasten transmitters directly to ductwork or compromise duct insulation.

3. The manufacturer’s authorized representative shall visit the project site during construction prior to station installations to confirm all submitted sizes, mounting requirements and locations. Size adjustments shall be made at no additional cost. The representative shall meet on site with the TCC to support and train them on proper installation procedures and calibration.

4. Install labels at each sensor and transmitter identifying its service.

3.2 GRAPHIC DISPLAY

A. Create a customized graphic for each piece of equipment indicated on the itemized points list.

B. Components shall be arranged on graphic as installed in the field.

C. Include each graphic point listed in the itemized points list using real time data.

D. Provide a graphic representation of the following:

1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.

2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.

3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.

4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.

5. Show the location of each thermostat on the floor plan.

6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:

1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.

2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.

3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a minimum.

4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.

F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:

1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.

2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.

3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

3.3 CONDUIT INSTALLATION

A. Conduit Sizing and Installation: Refer to Electrical Section 26 05 33 for execution and installation.

1. Thermostats/temperature sensors shall be installed in junction boxes, flush with the wall, and shall be coordinated for orientation with Architect/Engineer.

3.4 WIRE AND CABLE INSTALLATION

A. Wire and Cable Materials Installation: Refer to Electrical Section 26 05 13 for execution and installation.

B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.

2. Torque test conductor connections and terminations to manufacturer's recommended values.

3. Perform continuity test on all conductors.

4. Protection of cable from foreign materials:

a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced.

In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

C. Installation Schedule:

1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be connected using flexible conduit rated for the environment.

3.5 FMCS INSTALLATION

A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for full ampacity of wiring or overcurrent protection of circuit controlled.

B. Naming Conventions: Coordinate all point naming conventions with Owner standards. In the absence of Owner standards, naming conventions shall use equipment designations shown on plans.

3.6 COMMISSIONING

A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.

C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.

D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner’s Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 PREPARATION FOR BALANCING

A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).

B. Check the calibration and setpoints of all controllers.

C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.

D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.

E. Verify the operation of all interlock systems.

3.8 TEST AND BALANCE COORDINATION

A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.

C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.

D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.9 DEMONSTRATION AND ACCEPTANCE

A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.10 TRAINING

A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 24 hours of training on consecutive days for 12 Owner’s representatives. The training course shall enable the Owner’s representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

2. One month after completion of commissioning, the manufacturer shall provide 40 hours of training on consecutive days for 2 4 Owner’s representatives. The training course shall enable the Owner’s representatives to perform Advanced Operations and System Management as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

3. Nine months after completion of commissioning or one month prior to the end of the warranty period, the manufacturer shall provide 24 hours of training on consecutive days for 12 Owner's representatives. The training course shall update the Owner's representatives on Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

B. Off-Site:

1. Thirty days prior to the final completion of the project, the manufacturer shall provide 8 hours of training at an established manufacturer training facility for 2 Owner's representatives. The training course shall include an introduction of the specified FMCS system and be taught by a factory-trained instructor with experience in presenting the training material. The local manufacturer's representative for the Owner shall accompany the Owner's representatives on the trip. The manufacturer shall be responsible for all transportation, lodging, meals, and training materials for each Owner's representative.

2. Nine months after completion of commissioning or one month prior to the end of the warranty period, the manufacturer shall provide 40 hours of training on consecutive days at an established manufacturer training facility for 4 Owner's representatives. The training course shall update the Owner's representatives on Advanced Operations and System Management as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training. The manufacturer shall be responsible for all transportation, lodging, meals, and training materials for each Owner's representative.

3. All classroom training shall be done using a network of working controllers representative of the installed hardware for this project.

C. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.

2. Understand control system architecture and configuration.

3. Understand FMCS systems components.

4. Understand system operation, including FMCS system control and optimizing routines (algorithms).

5. Operate the workstation and peripherals.

6. Log-on and off the system.

7. Access graphics, point reports, and logs.

8. Adjust and change system setpoints, time schedules, and holiday schedules.

9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.

10. Understand system drawings and Operation and Maintenance manual.

11. Understand the job layout and location of control components.

12. Access data from FMCS controllers and ASCs.

13. Operate portable operator's terminals.

D. Advanced Operations - Training Description:

1. Make and change graphics on the workstation.

2. Create, delete, and modify alarms, including annunciation and routing of these.

3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and at user-definable time intervals.

4. Create, delete, and modify reports.

5. Add, remove, and modify system's physical points.

6. Create, modify and delete programming.

7. Add panels when required.

8. Add operator interface stations.

9. Create, delete, and modify system displays, both graphic and others.

10. Perform FMCS system field checkout procedures.

11. Perform FMCS controller unit operation and maintenance procedures.

12. Perform workstation and peripheral operation and maintenance procedures.

13. Perform FMCS system diagnostic procedures.

14. Configure hardware including PC boards, switches, communication, and I/O points.

15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.

16. Adjust, calibrate, and replace system components.

E. System Management - Training Description:

1. Maintain software and prepare backups.

2. Interface with job-specific, third-party operator software.

3. Add new users and understand password security procedures.

F. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

3.11 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12” apart and within 6” of the top and bottom of the area.

F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.

H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

3.12 INSTALLATION OF FLOW METERS

A. Provide manufacturer’s recommended lengths of straight piping upstream and downstream of the flow meter. Up to 30 diameters upstream of the flow meter may be required depending on the piping arrangement and flow meter type.

B. Maintain adequate pull/service space.

C. Meters:

1. LACCD buildings over 10,000 square feet shall have sub-meters installed subject to this policy.

    a. All central utility plants in any size structure or any configuration, shall also have sub-meters installed subject to this standard.

2. Building-level sub-meters shall be configured to interface and exchange data with the District's existing metering software.

3. Building-level sub-meters shall include an Ethernet communications port or wireless communication capability or other networking capability.

4. Building level utility sub-meters shall be installed to capture the following data at a minimum of 15-minute intervals:

    a. Electricity consumption (kWh)

    b. Power demand (kW)

    c. Power Factor

    d. Natural gas consumption (therms) (if applicable)

5. Building level utility sub-meters may be installed to capture the following data at a minimum of 15-minute intervals:

    a. Chilled water (if applicable)

b. Hot water (if applicable)

c. Domestic water

d. Sewer discharge

6. Individual Meters shall retain data for a period of no less than 12 months.

7. Solar photovoltaic arrays installed in or on a building shall have a dedicated meter to track PV productions. This is in addition to the building level sub-meter and must be in compliance with all the requirements outlined in the standards.

END OF SECTION

SECTION 23 0913
INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Positive Displacement Meters.

B. Pressure Gauge.

C. Pressure Gauge Accessories.

D. Thermometers.

E. Test Plugs.

F. Static and Differential Airflow Pressure Gauges.

1.2 REFERENCES

A. ANSI/AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.

B. ANSI/AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.

C. ANSI/AWWA C702 - Cold Water Meters - Compound Type.

D. ANSI/AWWA C706 - Direct Reading, Remote Registration Systems for Cold Water Meters.

E. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

F. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

G. ASTM E1 - Specification for ASTM Thermometers.

PART 2 - PRODUCTS

2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

A. Provide water meters with bronze case with cast iron breakaway bottom cap.

B. Meters downstream of utility company meters shall be same manufacturer as utility company meter.

C. Acceptable Manufacturers: Neptune, Badger, or Hersey.

2.2 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for air, steam, water or oil application, 1/4" or 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze brushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Acceptable Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Trerice, U.S. Gauge Figure 1901, Weiss, Weksler, Wika.

[***OR*****]**

C. Gauges shall be 4-1/2" diameter with phenolic turret style, glycerin fillable filled, safety case with phosphor bronze or 316 stainless steel bourdon tube, brass socket for air, steam, water or oil applications. Gauges shall be 1/2% full scale accurate per ANSI B40.1 with brushed stainless steel movement and hair spring guard. Standard ranges to be either pressure or pressure and vacuum as required of application.

D. Acceptable Manufacturer: Ashcroft, Marshalltown, Marsh, Miljoco, Trerice, U.S. Gauge Figure 1980, Weiss, Weksler, Wika.

E. Select gauge range for normal reading near center of gauge.

2.3 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.

B. Shutoff Valve: 1/4" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.4 THERMOMETERS

A. Dial Type:

1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.

2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.

3. Stem lengths as required for application with minimum insertion of 2-1/2".

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.

5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

B. Alcohol/Spirit Filled Type:

1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, and locking device to allow rotation of thermometer to any angle.

2. Select thermometer for appropriate temperature range.

3. Stem: Copper plated steel, aluminum, or brass for separable socket. Stem lengths as required for application with minimum insertion of 3”.

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.

5. Acceptable Manufacturer: Marsh, Miljoco, Trerice, Weiss, Weksler, Wika.

C. Digital Type:

1. 1/2" LCD digital display, solar powered, with high impact ABS case. Accuracy of 1% of reading or 1°F, whichever is greater. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.

2. Fahrenheit/Celsius switchable with -50/300°F or -45/150°C range.

3. Through-case potentiometer recalibration adjustment.

4. Stem lengths as required for application, with minimum insertion of 2-1/2".

5. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.

6. Digital display shall operate at 10 Lux (one foot-candle) or more. Use this thermometer only where ambient temperatures are below 140°F and there is sufficient light under normal occupied space conditions for the digital display to function. Use a different type thermometer where there is inadequate light available (i.e., dark mechanical rooms, locations where the thermometer is shielded from light, etc.).

7. Acceptable Manufacturer: Miljoco, Trerice, Weiss, Weksler, Wika.

D. Select scales to cover expected range of temperatures.

2.5 TEST PLUGS

A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

B. Provide extended units for all plugs installed in insulated piping.

C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.

D. Acceptable Manufacturers: Sisco, Flow Design, Peterson Equipment, MG Piping Products Co., Miljoco, Trerice, Watts Regulator.

2.6 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70°F.

C. Provide mounting brackets, probes, and shutoff valves required for proper installation.

D. The range and service shall be as required for application or as noted on the drawings.

[***OR*****]**

E. The range and services shall be as follows:

F. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.

2. Coil and conceal excess capillary on remote element instruments.

3. Install gauges and thermometers in locations where they are easily read from normal operating level.

4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Positive Displacement Meters:

1. Install positive displacement meters with shutoff valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.

C. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.

2. Provide snubber for each pressure gauge.

3. Provide coil syphon for each pressure gauge connected to steam piping.

D. Thermometers:

1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.

2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

3. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

END OF SECTION

SECTION 23 2100
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.

B. Valves.

C. Heating Water Piping System.

D. Glycol Water Piping System.

E. Chilled Water Piping System.

F. Condenser Water Piping System.

G. Heating/Cooling Water Piping System.

H. Cryogen Vent Pipe.

I. Acoustical Lagging.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

A. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.

B. ANSI/AWS D1.1 - Structural Welding Code.

C. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

D. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.

E. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

F. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.

G. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

H. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.

I. ASME - Boiler and Pressure Vessel Code.

J. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

K. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

L. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

M. ASME B16.5 - Pipe Flanges and Flanged Fittings.

N. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

O. ASME B16.12 - Cast Iron Threaded Drainage Fittings.

P. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings

Q. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.

R. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

S. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).

T. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

U. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.

V. ASME B18.2.2 - Square and Hex Nuts, Inch Series.

W. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.

X. ASME B31.9 - Building Services Piping.

Y. ASME Section 9 - Welding and Brazing Qualifications.

Z. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.

AA. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

BB. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

CC. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

DD. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

EE. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.

FF. ASTM B32 - Standard Specification for Solder Metal.

GG. ASTM B88 - Seamless Copper Water Tube.

HH. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.

II. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.

JJ. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.

KK. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.

LL. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.

MM. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

NN. ASTM D2992 – Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.

OO. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.

PP. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.

QQ. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.

RR. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

SS. ASTM E413-87 - Classification for Rating Sound Insulation

TT. ASTM F2389 – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

UU. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

PART 2 - PRODUCTS

2.1 HEATING WATER
CHILLED WATER
GLYCOL WATER
HEATING/COOLING WATER

A. Design Pressure: 125 psig.
Maximum Design Temperature: 225ºF. (230ºF for mechanical couplings)

B. Piping - 2" and Under:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.

2. Joints: Butt-welded or flanged.

3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.

4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges.

D. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, grooved ends, ASTM A53, Type E or S, Grade B.

2. Joints: Grooved type, with Grade E EPDM molded pressure-responsive gaskets suited for 32°F to 230°F per ASTM D2000 with stainless steel bolt and nut.

3. Fittings: ASTM A536 Grade 65-45-12 ductile or A47 malleable iron, grooved type.

4. Flanges: Grooved end, flanged adapter.

E. Shutoff Valves:

1. Gate Valves:

a. GA-1: 2" and under, 125 psi S @ 353ºF, 300 psi WOG @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131.

b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, NIBCO F-617-O.

c. GA-5: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, solder bronze. Crane #1334, Stockham #B108, Walworth #4SJ, Watts #B-3101, NIBCO #S-111.

2. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

3. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

b. BF-5:

1) 14" through 24", 150 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or nickel plated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 150 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system). Weatherproof gear operator. Cv of at least 12,000 in 16" size. Victaulic #709, Center Line Series 200, Keystone #AR2, Watts DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #W761, Milwaukee CL series, Hammond 5200 series.

F. Throttling Valves:

1. Globe Valves:

a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.

b. GL-2: 2-1/2" thru 10", 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.

c. GL-5: 2" and under, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T, Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.

2. Butterfly Valves:

a. BF-4:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size. Victaulic #300, Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, NIBCO N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20ºF to 225ºF at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, NIBCO N200 Series or LD2000 Series, Victaulic #300, Milwaukee CL series, Hammond 5200 series.

b. BF-5:

1) 14" through 24", 150 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or nickel plated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 150 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system). Weatherproof gear operator. Cv of at least 12,000 in 16" size. Victaulic #709, Center Line Series 200, Keystone #AR2, Watts DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #W761, Milwaukee CL series, Hammond 5200 series.

G. Check Valves:

1. CK-1: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.

2. CK-4: 2" and under, 200 psi WOG @ 150ºF, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, or NIBCO #S-413.

3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

H. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.2 CONDENSER WATER (UNDERGROUND)
CHILLED WATER (UNDERGROUND)

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150°F.

B. Ductile Iron Pipe:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

2.3 UNDERGROUND PIPING - OUTSIDE BUILDING - PREINSULATED
HEATING/COOLING WATER

A. Design Pressure: 125 psig.
Maximum Design Temperature: 210ºF.

B. Piping - All Sizes:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.

2. Joints: Butt-welded.

3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.

C. Design Pressure: 125 psig.
Maximum Design Temperature: 210ºF.

D. Piping:

1. Fiberglass pressure pipe, Class 200 ANSI/AWWA 950, ASTM 2996, approved, bell and spigot ends. Filament wound or centrifugally cast glass fabric/epoxy with chemical resistant resin liner of at least 80% epoxy resin. Liner shall be at least 0.020" thick and pipe wall at least 0.115" thick for 2” and larger sizes.

2. Flanges: Shall be manufactured using same materials as pipe with bell and spigot pipe connection and have ANSI B16.5 Class 150 (300) bolt pattern. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

3. Manufacturers: Bondstrand - Series 2000, Smith Fiberglass Products - Red Thread, Fibercast - Centricast II.

E. Pipe Insulation:

1. Polyurethane foam with "K" factor not over 0.14 (Btuh/Sq. Ftxºfxin.) at 75ºF.

2. Density at least 2.25 lbs. per cubic foot.

3. Capable of continuous operation at 210ºF.

4. Minimum insulation thickness of _____ ".

F. Outer Jacket:

1. Class 1, Grade 1, white seamless pressure rated PVC pipe, ASTM D1784.

2. Jacket thickness at least _____ mils.

G. Accessories:

1. Fitting insulation and covers shall match the pipe insulation.

2. Install gland seal terminations at all building and manhole entrances. Gland seals shall allow the inside pipe to move freely to allow for pipe expansion.

3. Provide 3/8" minimum thickness, integral pipe anchor plates where required. Secure plates to inner carrier pipe. Plate shall extend beyond outer jacket for anchoring in concrete. Seal plate completely to prevent entrance of any moisture.

4. Provide foam insulation sleeves, fitting covers and all other items needed to field insulate pipe joints.

5. Seal all field joints watertight with heat shrink bands. Bands shall extend at least 6" beyond each end of the joint sleeve.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron screwed drainage type, ASME B16.12.

2. Joints: Screwed.

3. Service: Not allowed on boiler drains and overflow.

B. Steel Pipe: ASTM A53. [for boiler drains only]

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4.

C. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.

1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

D. Piping 4” and Under (Contractor’s Option):

1. Tubing: Type M (or thicker) drawn temper seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, NIBCO Press System Fittings and Valves, Mueller Streamline PRS.

E. Piping Under 1-1/4" Size:

1. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding are acceptable.

F. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2.5 CRYOGEN VENT PIPE

A. Design Pressure: 125 psig.
Maximum Design Temperature: 210ºF.

B. Piping - All Sizes:

1. Pipe: 304 stainless steel pipe non-ferromagnetic: ASTM A240; ASTM A666, 304, seamless, Schedule 5; butt-welded joints.

2. Joints: Butt-welded.

3. Fittings: Butt welding, 304 stainless steel, seamless, Schedule 5; ASTM A403, and MSS SP-43.

C. Additional Requirements:

1. All piping and connections shall comply with MRI manufacturer's requirements and standards.

2. Discharge: Cut discharge at 45° angle. Provide 3/8" stainless steel wire mesh at outlet, covering at least 2.5 times the cross-sectional area of the cryogenic vent pipe.

3. Bracing: Piping shall be installed with bracing to withstand the forces encountered during a cryogenic release event. Coordinate forces required with MRI manufacturer.

4. Insulation: Cover piping with 1" thick EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

5. Provide plastic jacket and fitting covers over insulation where exposed within room: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

2.6 AIR VENTS

A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.7 AUTOMATIC AIR VENTS

A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, Taco, or Watts.

B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8" minimum outlet. B&G #107, Armstrong, Spirotherm, Taco, or Watts.

2.8 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 8"	10" and Up
Air and Gases	1/32"	3/64"	1/16"
Water and Glycol/Water	1/32"	1/16"	1/8"

B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.9 BASKET STRAINERS

A. Cast iron body, 125 lb. flanged ends, quick release bolted, rated for 125 psi @ 350°F, 175 psi WOG @ 150°F. Strainer to have 1/8” perforated basket or equivalent. Pressure drop not to exceed 5 ft. head maximum.

B. Basket strainer shall be supported from floor. Hanging strainer from pipes will NOT be acceptable.

C. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

D. Furnish hinged cover for strainers below 6” in size. Furnish lifting lug and lifting device to remove cover of strainers 8” and larger. Provide O-ring gaskets on all covers.

E. Furnish ASTM stamped 126-B or A216 grade WCB.

F. Acceptable Manufacturers: Keckley GFV, Mueller 125F-CI, SureFlow BFC 125C, Watts 97FB-CIB, Metraflex B-1-TC.

2.10 MAKE-UP WATER ACCESSORIES

A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.

2. Pressure reducing valve. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225°F maximum temperature.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Thrush, Watts.

B. Relief Valve:

1. For water fill lines to hydronic systems.

2. Cast iron or bronze body, 1/2" or 3/4” screwed connections, 125 psig working pressure, 225°F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Taco, Watts.

C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.

2. Provide an air gap fitting and piping to drain.

3. If not indicated on the drawings, unit shall be same size as pipe.

4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

2.11 SAFETY RELIEF VALVES

A. SRV-1 (Hydronic Heating Systems): Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250ºF. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled. Acceptable Manufacturers: Kunkle # 537, B&G, Conbraco, McDonnell & Miller, or Watts.

2.12 TRIPLE DUTY VALVE

A. Type TD-1: 2" and above, 175 psi working pressure, flanged, cast iron, non-slam check valve, calibrated throttling, shutoff capabilities, angle or straight pattern. Pressure drop with design flow at 100% open shall not exceed 10 feet. Size to match pipe (not pump outlet) size, but reduce size by not more than one (1) if needed to provide at least 3 feet of differential pressure across the flow measuring taps at scheduled flow rate. Acceptable Manufacturers: Armstrong, Bell & Gossett, Taco, Wheatley, Victaulic.

2.13 SUCTION DIFFUSER

A. Furnish and install on base mounted pumps with inlet size same as pipe size shown on the drawing.

B. In no case shall pressure drop exceed 3.0 psi.

C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to blowdown connection. Provide 16 mesh bronze startup strainer. The startup strainer shall be removed after the system has been started, cleaned, and is operating under normal conditions, but before the system is turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.

D. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Patterson, Taco, Wheatley, Victaulic.

2.14 SELF-CONTAINED CONTROL VALVES

A. Thermostatic hot water control valves, self-contained bellows, nickel-plated body with EPDM disc, stainless steel spindle, and lifetime lubricated packing gland. Gland shall be replaceable with valve in operation.

B. Size for maximum pressure drop of 1 psi.

C. Configuration SCCV-1: Mount sensor and operator on valve body. Provide tamper-proof cover.

D. Configuration SCCV-2: Mount operator on valve body with remote sensor and capillary connection. Provide tamper-proof cover.

E. Configuration SCCV-3: Mount actuator on valve body with remote sensor, remote operator and capillary connections.

F. Acceptable Manufacturers: Danfoss, Type RA, Bell & Gossett, Honeywell Braukmann, Sterling, Rittling.

2.15 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:

1. Carrying case with handle.

2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.

3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.

D. Valves in copper piping shall be brass or bronze.

1. Quarter-Turn Ball Valve Style:

a. Bell & Gossett "Circuit Setter Plus",

2. Quarter-Turn Venturi Style:

a. Presso “B+”

b. Griswold “Quickset”

c. Gerand “BALVALVE Venturi”

d. HCI “Terminator B”

e. Nexus Valve “UltraXB Orturi”

f. MI Hydronic Engineering “Accusetter”

3. Multi-Turn Style:

a. Tour & Anderson (STAD)

b. Armstrong "CBV"

c. Victaulic 785

d. Macon STVL/STV

e. MEPCO MBV

f. Wheatly GS

g. NIBCO 1710

E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style:

   a. Bell & Gossett "Circuit Setter Plus"

2. Quarter-Turn Venturi Style:

   a. Presso “B+”

   b. Gerand “BALVALVE Venturi”

   c. HCI “Terminator B”

   d. Nexus Valve “UltraXB Orturi”

   e. IMI Hydronic Engineering “Accusetter”

3. Multi-Turn Style:

   a. TA Hydronics “786-789”

   b. Armstrong "CBV"

   c. Victaulic 787

   d. Macon STVL/STV

   e. MEPCO MBV

   f. Wheatly GSNIBCO 1710 (T1710L)

F. Balancing valves in ferrous piping over 2" size shall have flanged or grooved ends and steel or cast iron construction. Option to balancing valves noted above are flow sensor specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style:

   a. B&G “Circuit Setter”

2. Quarter-Turn Venturi Style:

   a. Presso “B+”,

   b. Taco “Accu-flo”,

   c. HCI “Terminator G”

   d. Nexus Valve “Nextrol NXFB”,

   e. IMI Hydronic Engineering “Accusetter”,

3. Multi-Turn Style:

   a. Armstrong "CVB-II",

b. Tour & Anderson (STAF, STAG),

c. Victaulic 788/789

d. Macon STVA

e. MEPCO MBV

f. NIBCO 737

[***OR*****]**

G. Balancing valves in ferrous piping over 2" size shall consist of flow sensors as specified in Section 23 09 00 combined with specified throttling valves.

H. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.16 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVES)

A. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within ± 10% of the specified GPM over at least 95 percent of the control range.

B. Pump Head Requirements:

1. The permanent pressure loss added to the pump head shall not exceed 7 feet.

C. Each valve shall have two P/T ports.

D. Five-year product warranty and first year cartridge exchange, up to 10 percent.

E. The internal wear surfaces of the valve cartridge shall be stainless steel or polyphenylsulfone orifice with an elastomeric diaphragm.

F. The internal flow cartridge shall be permanently marked with the GPM and spring range.

G. Valve body shall be brass on all valves 2” and under and ductile iron on all valves 2-1/2” and larger.

H. All valves shall be factory leak tested at 100 psi air under water.

I. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2” diaphragm gauge equipped with 10 foot hoses and P/T adapters all housed in a vinyl case. Calibration shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.

J. Acceptable Manufacturers: Griswold, Autoflow, Versa Flow, Nexus, B&G, Victaulic, Hays Fluid Controls.

K. Complete integral piping package, which integrate shutoff valves, automatic flow control valves, vents, strainers and drains, are acceptable.

2.17 COMBINATION PIPING PACKAGES

A. Combination piping packages are allowed in lieu of individual components specified for hydronic coils and devices containing hydronic coils. Combination piping packages shall include shutoff valves, wye strainers, 1/4 turn strainer blow down valves with hose thread and cap, manual balancing valves with memory stop, test plugs, manual air vents, and unions. Automatic flow control devices are not allowed. Configuration of combination pieces shall match layouts on the drawings. Each component of the combination piping packages shall meet these specifications for the individual components being combined.

B. Acceptable Manufacturers: FDI Flowset, Griswold, Hays Fluid Controls, HCI Terminator, Nexus Coil Pak, NIBCO, Victaulic.

2.18 EXPANSION TANK

A. Compression Type:

1. Tank shall be welded steel, guaranteed air-tight and leakproof, ASME construction, stamped for 125 psig working pressure.

2. Furnish with air control fitting and drain valve.

3. 375ºF maximum operating temperature.

4. Furnish bronze 3/4" gauge glass, tested for at least 200 psi, hand wheel automatic valves with rubber washer for glass and 1/4" drain cock.

5. Acceptable Manufacturers: Bell & Gossett, Adamson, Taco, Armstrong, Ace Buehler, Wessels, Wheatley, Amtrol, Patterson.

B. Bladder Type:

1. Tank shall be welded steel, ASME construction and stamped.

2. Tank shall be complete with heavy-duty replaceable butyl bladder, charging valve, lifting ring, drain tapping, and system connection.

3. 125 psig working pressure and 240ºF maximum operating temperature.

4. Acceptable Manufacturers: Thrush, Taco, Bell & Gossett, Armstrong, Watts, Wessels, Wheatley, Amtrol, Patterson.

2.19 HEATING WATER STORAGE (BUFFER) TANK

A. ASME constructed and certified tank capable of 125 psi at 375°F.

B. Self-supporting legs or base ring for vertical installation.

C. Unit shall have an internal baffle the width of the tank and extend at least 3/4 of the length of the tank from heating water inlet/outlet locations.

D. Provide minimum 3/4” diameter air vent connection at top of tank. Provide minimum 1” diameter drain connection at bottom of tank. Provide hand hole on tanks with diameters larger than 36 inches.

E. Tank exterior and support structure shall receive factory applied red-oxide primer coating.

F. Unit shall be field insulated. Refer to Section 23 07 16.

G. Acceptable Manufacturers: Cemline, Laars, Taco, Wessels Company.

2.20 CHILLED WATER STORAGE (BUFFER) TANK

A. ASME constructed and certified tank capable of 125 psi at 375°F.

B. Self-supporting legs or base ring for vertical installation.

C. Unit shall have an internal baffle the width of the tank and extend at least 3/4 of the length of the tank from chilled water inlet/outlet locations.

D. Provide minimum 3/4” diameter air vent connection at top of tank. Provide minimum 1” diameter drain connection at bottom of tank. Provide hand hole on tanks with diameters larger than 36 inches.

E. Tank exterior and support structure shall receive factory applied red-oxide primer coating.

F. Unit shall be field insulated. Refer to Section 23 07 16.

G. Acceptable Manufacturers: Cemline, Laars, Taco, Wessels Company.

2.21 BYPASS/SIDE STREAM FILTER

A. Cartridge filtration system rated for up to 50 gpm.

B. Filter vessel shall be 304 stainless steel and suitable for use up to 150 psi maximum operating pressure.

C. Vessel shall be equipped with an automatic air vent, manual air vent, and pressure gauge.

D. Filter shall be capable of removing 90% of all particles 5 microns and larger with each pass through the media.

E. Filter cartridge shall have a PVC core to prevent cartridge from collapse.

F. Filtration system shall be suitable for use up to 200°F.

G. System shall be provided with close coupled centrifugal pump with strainer capable of providing flow as scheduled on drawings.

H. System shall be provided with control panel with disconnect, transformer to provide 120V 24V control power, overload and short circuit protection, dry contacts for connection to the building automation system, and single-point electrical supply connection.

I. Filtration system components shall be pre-piped and skid mounted as a single unit.

J. Mechanical Contractor shall provide and install shutoff valves on both up and downstream sides of filtration system, a check valve on suction side of pump between shutoff valve and pump, and drain piping to nearest trench drain.

K. Acceptable Manufacturers: PEP, Lenntech Filters, Parker Hannifin, United Filtration Systems, Lakos.

2.22 COALESCING TYPE COMBINATION AIR ELIMINATOR AND DIRT SEPARATOR

A. Coalescing type air eliminator and dirt separator shall be fabricated from steel and ASME constructed and certified for 125 psi working pressure and 270ºF operating temperature. Units 2-1/2 inches and smaller shall have threaded connections. Units 3 inches and larger shall have flanged connections.

B. Air elimination and dirt separation shall be by coalescing action by either:

1. Stainless steel PALL rings.

2. Copper tubes with continuous wound, permanently attached copper wire and followed by a separate continuous wound permanently affixed copper wire.

C. Provide unit with factory mounted air vent at the top of the air elimination chamber.

D. Provide brass flushing cock on the separator side to facilitate system fast-fill and to blow down impurities from the water surface within the separator.

E. Provide factory mounted blow-down valve on the unit bottom to allow for draining and cleaning.

F. Coalescing separators shall be as sized on the construction drawings, but in no case shall it have less than line size connections nor shall pressure drop exceed 1 psi at design flow. Include on submittal the pressure drop of each unit at its design flow rate.

G. Coalescing separators shall be equipped with removable cover to allow for removal, inspection and cleaning of the internal coalescing media.

H. Acceptable Manufacturers: Spirotherm VDN Series, Taco 4900ADR Series, Wessels WVA.

2.23 AIR SEPARATORS

A. Separators shall be ASME constructed and stamped for 125 psi working pressure and 350ºF operating temperature.

B. Provide openings for inlet, outlet, blowdown, and expansion tank.

C. Separators shall be line size or larger, with maximum pressure drop of 1 psi. Refer to drawing for separator sizing.

D. Separators shall not include strainers, unless noted on the drawings. When furnished, strainers shall be removable and the blowdown fittings shall have drain valves.

E. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Taco, Wheatley, Patterson, Wessels.

2.24 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

2.25 ACOUSTICAL LAGGING

A. Type A: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 1” thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 28, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer’s recommendations.

1. Acceptable Products: Sound Seal B-10 Lag/QFA-3, McGill Air Pressure PDL-3, Kinetics KNM 100ALQ-1.

B. Type B: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 2” thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 30, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer’s recommendations.

1. Acceptable Products: Sound Seal B-10 Lag/QFA-9, McGill Air Pressure PDL-9.

C. Refer to drawings for acoustical lagging locations.

2.26 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 647, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.27 ETHYLENE GLYCOL

A. Fill glycol systems with a mixture of water and ethylene glycol based low temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. Water shall meet the glycol manufacturer's recommendations (generally < 25ppm chloride, sulfite, and hardness). Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the manufacturer. Solution shall contain a fluorescent dye to facilitate leak detection.

B. Fluid suitable for use from -60ºF to 250ºF.

C. Glycol shall pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals). Glycol supplier shall provide a certificate of assurance.

D. A 50% solution by weight shall depress the freezing point to at least -29ºF. At 40ºF the solution shall have viscosity of not over 6 centipoise, thermal conductivity of at least 0.21 Btu/hr*ft*ºF, specific heat of at least 0.79 Btu/lbm*ºF, and specific gravity of at least 1.08.

E. The glycol manufacturer shall analyze the fluid biannually to ensure the corrosion protection properties continue to meet industry standards. This shall be at no cost to the Owner. No chemical additions shall be made to the glycol solution until an analysis is completed.

F. Automotive glycol containing sodium silicate is not acceptable.

G. Acceptable Manufacturers: Dow Chemical "Dowtherm SR-1", Interstate Chemical “Intercool NFE”, Houghton Chemical “Wintrex”, and Texaco.

[***OR*****]**

2.28 PROPYLENE GLYCOL

A. Fill systems with a mixture of water and industrially inhibited propylene glycol low temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. Water shall meet the glycol manufacturer's recommendations (generally < 25ppm chloride, sulfite, and hardness). Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the manufacturer. Solution shall contain a dye to facilitate leak detection.

B. Fluid suitable for use from -28ºF to 250ºF.

C. Glycol shall pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals). Glycol supplier shall provide a certificate of assurance.

D. A 50% solution by weight shall depress the freezing point to at least -34ºF. At 40ºF the solution shall have viscosity of not over 14 centipoise, thermal conductivity of at least 0.199 Btu/hr*ft*ºF, specific heat of at least 0.839 Btu/lbm*ºF, and specific gravity of at least 1.06.

E. Manufacturer shall offer a testing service to determine if inhibitor addition is needed.

F. Acceptable Manufacturer: Dow Chemical “Dowfrost HD”, Interstate Chemical “Intercool NFP”, Houghton Chemical “Safe-T-Therm HD”, and Texaco.

[***OR*****]**

2.29 PROPYLENE GLYCOL - FOOD GRADE

A. Fill systems with a mixture of water and industrially inhibited propylene glycol low temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. Water shall meet the glycol manufacturer's recommendations (generally < 25ppm chloride, sulfite, and hardness). Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the manufacturer.

B. All ingredients shall be FDA recognized as safe food additives. Fluid suitable for use from -28ºF to 250ºF.

C. Glycol shall pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals). Glycol supplier shall provide a certificate of assurance.

D. A 50% solution by weight shall depress the freezing point to at least -34ºF. At 40ºF the solution shall have viscosity of not over 14 centipoise, thermal conductivity of at least 0.199 Btu/hr*ft*ºF, specific heat of at least 0.839 Btu/lbm*ºF, and specific gravity of at least 1.06.

E. Manufacturer shall offer a testing service to determine if inhibitor addition is needed.

F. Acceptable Manufacturer: Dow Chemical “Dowfrost”, Interstate Chemical “P-323”, Houghton Chemical “Safe-T-Therm”, and Texaco.

2.30 GLYCOL FEED SYSTEM

A. Package system complete with storage tank, pump(s) and controls with audio and visual alarm, designed to add glycol solution to a closed loop water system. System shall automatically maintain pressure in the piping system.

B. Provide cut-off and alarm to stop pump in case of low level or high pressure. Provide dry contact for alarm point to the DDC.

C. Complete with polyethylene storage tank and lid. Mount on floor above pumping assembly in a steel frame with legs. Lid shall be removable for filling and provide means for system relief valve outlet to be piped back to tank without removal of piping from relief valve or automatic air vent

D. Pumping system shall consist of a pump, starter, pressure tank with pressure control, pressure reducing valve, shutoff valve and pressure gauge. Refer to schedule for pump requirements.

E. Acceptable Manufacturer: Wessels GMP, Advantage Controls AGF, B&G GMU, Patterson.

2.31 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120°F and as indicated on the drawings.

END OF SECTION

SECTION 23 2123
HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All pumps except where integral with a manufactured piece of equipment.

B. Pump controls where self-contained.

1.2 SUBMITTALS

A. Submit certification that pumps, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

[* * * * * OR * * * * *]

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Manufacturer shall provide special seismic certification per OSHPD CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.

PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Heating pumps shall be suitable for 225ºF water.

F. Motors shall comply with Section 23 05 13.

G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 SPLIT CASE BASE MOUNTED PUMPS

A. Type: Centrifugal, single stage, double suction, horizontal or vertical split case, direct connected.

B. Casing: Cast iron, rated for greater of 150 psi or 1.50 times actual working discharge pressure, suction and discharge flanges with gauge ports, soldered case rings, and cast bearing supports integral with bottom section for bearing alignment.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: Carbon steel with O-ring seals and bronze or stainless steel shaft sleeves.

E. Bearings: Grease lubricated roller or ball bearings with grease fittings. Bearings shall be L-10 rated for 200,000 hours. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.

F. Drive: Flexible coupling with OSHA approved guard.

G. Seals: Mechanical type with internal flushing rated for -20 to 225ºF and comprised of Buna elastomer, carbon primary ring, and ceramic stationary ring.

H. Seals: Mechanical type with internal flushing rated for 0 to 300ºF with unitized EPR or EPT elastomer, carbon primary ring, and silicon-carbide stationary ring.

I. Seals: Mechanical type with internal flushing rated for 0 to 300ºF and comprised of cartridge EPR or EPT elastomer, silicon-carbide primary ring, and silicon-carbide stationary ring.

J. Baseplate: Reinforced heavy steel.

K. Acceptable Manufacturers: Bell & Gossett, Taco, Aurora, Armstrong, Grundfos/Peerless/PACO, Patterson, Weinman/Crane.

2.3 BASE MOUNTED END SUCTION PUMPS

A. Type: Centrifugal, single stage.

B. Casing: Cast iron, single suction, rated for greater of 150 psi or 1.25 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.

E. Bearings: Grease lubricated roller or ball bearings with grease fittings. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.

F. Drive: Flexible coupling with OSHA approved guard.

G. Seals: Mechanical type with internal flushing rated for -20 to 225ºF with Buna elastomer, carbon primary ring, and ceramic stationary ring.

H. Baseplate: Heat treated cast iron or reinforced heavy steel.

I. Acceptable Manufacturers: Bell & Gossett, Taco, Aurora, Armstrong, Grundfos/Peerless/PACO, Patterson, Weinman/Crane.

2.4 IN-LINE PUMP

A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.

B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.

D. Shaft: Steel or stainless steel.

E. Seals: Mechanical type with internal flushing rated for -20 to 225ºF and comprised of Buna elastomer, carbon primary ring, and ceramic stationary ring.

F. Seals: Mechanical type rated for -20 to 250ºF with EPR or EPT bellows and seat gasket, carbon primary ring, and silicon-carbide stationary ring.

G. Acceptable Manufacturers: Bell & Gossett, Taco, Aurora, Armstrong, Grundfos/Peerless/PACO, Patterson, Weinman/Crane.

2.5 POSITIVE DISPLACEMENT PUMPS

A. Type: Single stage, rotary gear.

B. Pumps: Cast or ductile iron casing, hardened shaft with stainless steel sleeves and mechanical seal, self-lubricating bronze bearings, inlet and outlet connections, and integral bypass type adjustable relief valve.

C. Drive: Flexible coupling with coupling guard.

D. Base: Cast iron common mounting for pump and motor with drop rim and drain tapping.

E. Acceptable Manufacturers: Viking, Oberdorfer, Tramont.

END OF SECTION

SECTION 23 2300
REFRIGERATION PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping and Pipe Fittings

B. Moisture and Liquid Indicators

C. Check Valves

D. Pressure Relief Valves

E. Filter-Driers

F. Suction Filters

G. Solenoid Valves

H. Expansion Valves

I. Receivers

J. Suction Accumulators

1.2 QUALITY ASSURANCE

A. Remanufactured specialties are not acceptable.

1.3 REFERENCES

A. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.

B. ANSI/ASME SEC 9 - Boilers and Pressure Vessels Code, Welding and Brazing Qualifications.

C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ANSI/ASME B31.5 - Refrigeration Piping.

E. ANSI/ASTM B32 - Solder Metal.

F. ANSI/ASTM B88 - Seamless Copper Water Tube.

G. ANSI/AWS A5.8 - Brazing Filler Metal.

H. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

PART 2 - PRODUCTS

2.1 PIPING

A. Design Pressure: 450 psig.

1. Maximum Design Temperature: 250ºF.

B. Piping - 4" and under.

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Brazed with silver solder.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

2.2 MOISTURE AND LIQUID INDICATORS

A. UL listed, with copper, brass, or copper-plated steel body, flared or solder ends, extended fittings in units up to at least 1-1/8” to allow brazing without removing the cartridge, sight glass, color coded paper moisture indicator that is replaceable without breaking piping connections for units up to 1-1/8” size, and plastic cap; maximum working pressure of 500 psi, and maximum temperature of 200ºF. Sporlan, Henry Valve Company, Alco Valve.

2.3 VALVES

A. BA-14: Refrigerant Ball Valve: 3/8” thru 3-1/8”, 500 psi, -40ºF to +300ºF, full-port up to 2-1/8” size, blow-out proof, PTFE seals, brass ball with equalizing orifice, visible position indication, seal cap, extended copper connections, replaceable stem seals, compatible with all CFC, HCFC, and HFC refrigerants. Henry Valve Company, Superior Valve, Alco Valve.

2.4 CHECK VALVES

A. CK-10: 1/4" thru 3-5/8", 500 psi, globe or angle pattern, brazed, brass body, cleaned-dried-plugged and tagged at factory for refrigerant service. Henry Valve Company, Mueller, Wolf-Linde.

2.5 PRESSURE RELIEF VALVES

A. RV-5: Straight Thru or Angle Type: Brass body and disc, Teflon seat, factory sealed and stamped with ASME UV and National Board Certification NB; selected to ANSI/ASHRAE 15.

2.6 FILTER-DRIERS

A. Replaceable Cartridge Angle Type: ANSI/AHRI 710, UL listed, brass or epoxy-coated steel shell, molded desiccant high-water capacity filter core(s); maximum working pressure of 500 psi; maximum temperature of 275ºF; maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at system flow rate.

B. Permanent Straight Thru Type: ANSI/AHRI 710, UL listed, steel shell with molded desiccant filter core, maximum working pressure of 500 psi, maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at system flow rate.

2.7 SUCTION FILTERS

A. Replaceable Cartridge Angle Type: UL listed for 500 psi up to 2-18" size, and 400 psi for larger sizes, steel shell that passes 1000-hour salt spray test with copper fittings, replaceable pleated filter element(s); maximum pressure drops of 3 psi with R410a or 2 psi with R134a at system flow rate, capable of accepting molded desiccant core for cleanup after compressor burnout, access valve in the removable end plate. Install with side refrigerant inlet.

2.8 SOLENOID VALVES

A. Valve: AHRI 760; pilot operated; copper or brass body and internal parts; synthetic seat; stainless steel stem and plunger assembly; extended solder ends to permit installation without disassembly; maximum working pressure of 500 psi; normally closed. Maximum pressure drop at system flow of 5 psi for R410a and 3 psi for R134a.

B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, surge protector and color-coded lead wires, integral junction box, Class F temperature rated, ANSI/UL 429.

2.9 EXPANSION VALVES

A. Angle or Straight Thru Type: ANSI/AHRI 750; materials suitable for system refrigerant, external equalizer, adjustable super heat setting, balanced port design, suitable for horizontal or vertical installation, with replaceable capillary tube and remote sensing bulb.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10ºF super heat. Select to avoid being undersized at full load or excessively oversized at part load.

2.10 RECEIVERS

A. All receivers shall have capacity to hold the entire refrigerant charge when 90% full at 90ºF per ASHRAE 15-78.

B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 450 psi working pressure, with tappings for inlet, outlet, and relief valve or fusible plug.

C. Over 6" Internal Diameter: ANSI/AHRI 495, welded steel; ASME U or UM stamped for 400 psi, with tappings for inlet, outlet and pressure relief valve.

2.11 SUCTION ACCUMULATORS

A. All accumulators shall have capacity to hold 50% of the refrigerant charge when 90% full at 90ºF per ASHRAE 15-78, pressure drop equivalent to under 0.5ºF at peak capacity, a finish that survives a 500-hour salt spray test, vertical design with dip tube and screened oil inlet orifice, and a hot gas boil-out coil to evaporate liquid refrigerant.

B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 400 psi pressure rating, with tappings for inlet, outlet, and pressure relief valve or fusible plug.

C. Over 6” Internal Diameter: ANSI/AHRI 495, welded steel, ASME U or UM stamped for 450 psi, with tappings for inlet, outlet and pressure relief valve.

END OF SECTION

SECTION 23 25 00
CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Treatment for Closed Systems (Water).

B. Treatment for Closed Systems (Glycol).

C. Treatment for Steam Systems.

D. Treatment for Open (Cooling Tower) Systems.

E. Chemical Feed Equipment.

1.2 REFERENCES

A. ASTM D 859-00: Test Method for Silica in Water

B. ASTM D 1066-97: Practice for Sampling Steam

C. ASTM D 1067-92: Test Methods for Acidity or Alkalinity in Water

D. ASTM D 1068-03: Test Methods for Iron in Water

E. ASTM D 1126-02: Test Method for Hardness in Water

F. ASTM D 1129-03a: Terminology Relating to Water

G. ASTM D 3370-95a: Practices for Sampling Water from Closed Conduits

H. AWWA C700-02: Cold-Water Meters – Displacement Type

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Include system schematics, equipment locations, and controls schematics.

C. Submit product data indicating chemicals and equipment.

D. Submit manufacturer's installation instructions.

E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

F. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports indicating analysis of system water after cleaning and after treatment.

G. Manufacturer shall provide special seismic certification per OSHPD CAN 2-1708A.5 with submittal. Submittals without certification will be returned and not reviewed.

1.4 EXTRA STOCK

A. Provide clean cartridges or bags in all bypass (pot) feeders with filters and sidestream filters.

B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters and sidestream filter installed. Deliver to Owner at job site.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include data on pumps and other equipment including spare parts lists, procedures, and treatment programs.

C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.

D. Include list of treatment chemicals and associated SDS.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall have local representatives with water analysis laboratories and full-time service personnel.

1.7 REGULATORY REQUIREMENTS

A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.

B. Provide only chemicals approved for use and disposal by local authorities. Contact the Architect/Engineer if any specified chemicals are prohibited.

1.8 MAINTENANCE SERVICE

A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems for one year from Date of Substantial Completion:

1. Provide technical service visits to perform field inspections and make water analysis on site. Visits shall be twice annually for closed systems and monthly for steam and cooling tower systems. For cooling tower systems, monthly testing shall have dipslide culture counts, and quarterly water samples shall be sent to a CDC Elite lab for culturing to establish baseline total organism and Legionella counts. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit copies of the field service report after each visit to the Owner and to the Mechanical Contractor. Any problems related to the operation of the chemical treatment program shall be reported to the Architect/Engineer.

2. Provide laboratory and technical assistance services for warranty period.

3. Include 8 hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.

4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

5. Provide sufficient chemicals for treatment and testing during warranty period.

B. The Chemical Treatment Subcontractor shall be responsible for assisting the Mechanical Contractor by adding the chemical solutions required for cleaning each piping system. During the remainder of the warranty period, the Chemical Treatment Subcontractor will be responsible for adding chemicals and doing other work related to the operation of system such as boiler blowdown. The Chemical Treatment Contractor shall make periodic tests of the chemical treatment program as called for above and recommend changes to Owner when needed.

1.9 WATER ANALYSIS

A. Sample feedwater to determine appropriate chemical treatment. Contact the Architect/Engineer if test indicates treatment required is different than that specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. US Water.

B. Nalco.

C. Betz.

D. America's Best Water Treaters.

E. H-O-H Chemicals, Inc.

F. Industrial Water Management.

G. Garratt-Callahan Company.

H. Lakeland Chemical Specialties, Inc.

I. Iowa Water Management Corp.

J. Butler Chemical Company.

K. Eldon Water.

L. ChemTreat.

M. Watertech of America

N. Earthwise Environmental, Inc.

O. Rhomar Water Management, Inc.

2.2 MATERIALS

A. Closed System Treatment (Water):

1. Provide one bypass feeder on each system. Install inlet, outlet and drain valves, and necessary piping.

2. Provide a 3/4" water meter in the domestic cold water line that provides makeup water to steam systems.

3. Provide coupon rack around main system pumps for all systems

4. Proprietary blend containing the following items:

a. Corrosion Inhibitors for Water Systems Operating Above 145°F: Sodium nitrite-borax or molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 1,000 ppm nitrite or 100 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).Adjust borax content to keep correct pH for type of system. Though the system is mainly steel or copper, aluminum is present. Inhibitors shall be selected to properly protect aluminum. pH shall not exceed 8.5 to avoid disruption of the aluminum oxide film.

b. Corrosion Inhibitors for Chilled Water Systems and Heating Systems operating at ≤145°F: Sodium molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 50 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).

c. Scale Inhibitor: Organic phosphonates such as aminomethylene-phosphonate; phosphonates such as hydroxyethylidenediphosphonate or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, poly-methacrylates and polyacrylanides. Inorganic phosphates are not acceptable. Maintain residual concentration as recommended by the manufacturer.

B. Closed System Treatment (Glycol):

1. The specified glycols contain initial charge of corrosion inhibitors, however, the pH after installation must be checked and adjusted to maintain between 8.0 and 10.0 using inhibitors recommended by the manufacturer (normally dipotassium phosphate).

2. The specified glycols contain an initial charge of corrosion inhibitors. However, the pH after installation shall be checked and adjusted to maintain between 8.0 and 8.5 using inhibitors recommended by the manufacturer (normally dipotassium phosphate). Though the system is mainly copper or steel, aluminum is present. Inhibitors shall be selected to properly protect aluminum. pH shall not exceed 8.5 to avoid disruption of the aluminum oxide film.

3. Provide coupon rack around main system pumps for all systems.

C. Steam System Treatment (Up to 15 psig Closed System):

1. Proprietary blends containing the following items:

a. Boiler Corrosion Inhibitor: Sodium nitrite-borax blend to maintain 3,000 ppm nitrite and a pH of 7.0 to 10.0 in the boiler.

b. Piping Corrosion Inhibitor: Neutralizing amine such as cyclohexylamine, morpholine, or diethyl-aminoethanol to keep condensate pH of 7.5 to 8.5.

D. Steam System Treatment (over 15 psig and/or not 100% condensate returned to boiler):

1. Provide solution tank and metering pump to feed scale inhibitor and pH raising agent directly to each boiler.

2. Provide separate solution tank and metering pump to feed corrosion inhibitor, oxygen scavenger, and antifoam agent into storage section of deaerator.

3. Provide automatic proportioning feed system for each solution tank. Solution shall be fed whenever the associated boiler feed pump runs. If solution feed pump capacity is not low enough to permit this it shall run for an amount of time proportional to the boiler feed pump. Solution shall be fed in piping as close to boiler as possible.

4. Provide automatic blowdown controller for each boiler.

5. Provide a 3/4" impulse contact register type water meter in the domestic cold water line that provides makeup water to the steam system.

6. Proprietary blends containing the following items:

a. Scale Inhibitor: Phosphate polymer combination to maintain 40 ppm sodium phosphate in the boiler.

b. Corrosion Inhibitor: Neutralizing amine such as cyclohexylamine, morpholine or diethylaminoethanol (DEAE) to maintain condensate pH between 7.5 and 8.5.

c. pH Raising Agent: Sodium hydroxide (caustic soda) to maintain pH between 10.5 and 11.5. Sodium carbonate (soda ash) is not acceptable.

d. Oxygen Scavenger: Hydrazine 0.3 ppm for electrode boilers; catalyzed sodium sulfite (40 ppm) for all other boilers.

e. Anti-Foam Agent: Polyalkylene glycol or polyamides (50 ppm).

E. Open (Open Cooling Tower and Evaporative Closed Circuit Cooling Tower) System Treatment:

1. Provide coupon rack around circulating pumps with space for test specimens.

2. Cooling Tower Systems:

a. Provide solution pumps to feed dispersant, scale inhibitor, and corrosion inhibitor from solution tank into condenser water return to tower.

b. Provide controller to operate solenoid bleed valve and solution pumps based on water makeup.

c. Introduce biocide with continuous feed solution pumps. Provide two solution tanks and timer suitable for control of both solution pumps.

d. Provide water meter in makeup water pipe to tower to activate solution pumps for preset time.

e. Provide control panel to activate chemical and biocide feed pumps for adjustable amounts of time per adjustable quantity of makeup water.

3. Cooling Tower Systems:

a. Provide solution pump to feed scale inhibitor, dispersant, and corrosion inhibitor from solution tank into condenser water return to tower.

b. Provide conductivity controller to sample water and operate solenoid bleed valve and solution pumps.

c. Introduce biocide to tower with shock feed solution pumps. Provide two solution tanks and timer suitable for control of both solution pumps.

4. Cooling Tower Systems:

a. Provide automatic cooling tower water control systems for inhibitor feed, blowdown, and biocide feed. Corrosion inhibitor, scale inhibitor, and dispersant application shall be meter activated, blowdown shall be conductivity activated, and biocide shall be meter fed with blowdown locked out to ensure biocide retention time.

b. Control system shall incorporate solid state integrated circuits and digital displays in NEMA-12 steel enclosure. Provide gasketed lockable door.

c. Base dissolved solids (blowdown) control on conductivity and include:

1) Digital conductivity display micromho/cm.

2) Temperature compensated sensor probe.

3) High, low, and normal conductance indicator lights (LED).

4) High or low conductance alarm light (flash or steady switch), trip points field adjustable. Flash or steady switch shall have silence position.

5) Illuminated legend shall indicate "ALARM" whenever alarm condition exists.

6) Hand-off-automatic switch for solenoid bleed valve.

7) Illuminated legend shall indicate "BLEED" when valve opens.

8) Adjustable hysteresis or dead-band (internal).

d. Base corrosion inhibitor, scale inhibitor, and dispersant feed control on makeup volume and include:

1) Water meter with impulse contact register.

2) Solid state timer (adjustable 1/4 to 5 minutes) to control run time of feed pumps.

3) Test switch.

4) Hand-off-automatic switch for chemical pump.

5) Illuminated legend shall indicate "FEED" when pump is activated.

6) Solid state lockout timer (adjustable 1/4 to 3 hours) and indicator light. Lockout timer shall deactivate the pump and activate alarm circuits.

7) Panel totalizer (amount of makeup), electro-mechanical type.

e. Biocide programmer to include:

1) 24-hour timer with 14-day skip feature to permit activation any hour of the day.

2) Precision solid state bleed-off lockout timer (0 - 9 hours) and biocide pump timer (0 - 2-1/4 hours), clock controlled.

3) Solid state alternator to enable the use of two different formulations.

4) Digital display of the time of day (24 hours).

5) Digital display of day of week (14 days).

6) Fast and slow clock set controls (internal).

7) Battery backup so clock is not disturbed by power outages; quartz timekeeping accuracy.

8) Hand-off-automatic switches for biocide pumps.

9) Illuminated legend shall indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.

f. Provide water meter on system makeup, wired to control system.

g. Provide solution pumps to feed dispersant, scale inhibitor, and corrosion inhibitor from solution tank into condenser pipe to tower.

h. Provide conductivity controller to sample condenser water and operate bleed valve.

5. Corrosion Inhibitor: Molybdate-based inhibitor.

6. Scale Inhibitor: Organic phosphonates such as aminiomethylene-phosphonate; phosphonates such as hydroxyethylidene diphosphonicacid or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, polymeth-acrylates and polyacrylanides. Inorganic poly-phosphates are not acceptable.

7. Biocide: The primary biocide shall be an oxidizing biocide such as chlorine or bromine. The second biocide shall be a dispersing (non-oxidizing) type such as a quaternary amine compound.

8. Dispersant: Polymer to maintain mud and dirt particles in suspension.

9. Passivation: Provide to the Owner a passivation plan for all cooling towers and evaporative coolers that have wetted galvanized steel components, e.g. basins, coils, water distributing sections. Include initial passivation and recommendations for future “re-passivation” (if needed). Customize plan based on the feed water properties.

2.3 EQUIPMENT

A. Bypass (Pot) Feeder: 5.0 gal; quick-opening cap with 3-1/2” minimum diameter opening and opening wrench, legs to raise fill cap to 30” to 36”, drain valve, air cock, working pressure of 200 psig at 200°F, 20 to 25-micron cartridge or bag filter. Acceptable Manufacturers: Griswold, Vector Industries, J.L. Wingert, or Neptune.

B. Water Meter: (Steam systems with Bypass feeder) Positive displacement type meter with bronze housing. 3/4" meter size. Meter to handle 1/2 - 30 GPM.

C. Solution Metering Pump: Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous duty, fully enclosed electric motor and drive, and built-in relief valve.

D. Solution Tanks: May be shipping drum, 50 gallon capacity, polyethylene, self-supporting, one gallon markings, molded cover, and liquid level switch. Provide level switch in each solution tank to deactivate pump and sound local alarm.

E. Liquid Level Switch: Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low-level alarm light.

F. Solenoid Valves: Forged brass globe pattern body, normally open or closed as required, general purpose solenoid enclosure, and continuous duty coil.

G. Timers: Electronic timers, infinitely adjustable over full range, 150 second and five-minute range, mounted together in cabinet with hand-off-automatic switches and status lights.

H. Water Meter: Displacement type water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.

I. Automatic Boiler Blowdown Controller: 100-6000 microhm range, fixed or adjustable sample frequency, adjustable sample time, high and low limit alarms, 120V power requirement, nickel electrode probe, test switch, automatic blowdown valve and throttling valve.

J. Multi-Function Controllers: Electronic controllers that perform several functions such as boiler bleed-off and chemical feed are acceptable.

K. Coupon Test Rack: Compliant with ASTM D 2688-05. Fabricated of 1" diameter, Schedule 40 carbon steel or Schedule 80 PVC or CPVC, rated for the maximum expected system pressure and temperature and including the following minimum components: inlet and outlet shutoff valves, flow control valve to provide a constant velocity between 1.5 ft/s and 6 ft/s (5 GPM is acceptable for all pipe types), one coupon holder for each metal in the piping system (four minimum), and sample drain port. Support test rack independently from piping connected to sides of system piping with flow upward through test rack. Provide a coupon test rack for each open and closed loop hydronic system.

2.4 TEST EQUIPMENT

A. Provide white enamel test cabinet with light, capable of accommodating four 10 ml zeroing titrating burettes and associated reagents.

B. Provide the following test kits:

1. Alkalinity titration test kit.
2. Chloride titration test kit.
3. Sulfite titration test kit.
4. Total hardness titration test kit.
5. Organic phosphate test kit for steam and cooling tower system.
6. pH test kit.
7. Portable electronic conductivity meter with 0-10, 0-100, 0-1,000 and 0-10,000 microhm scales.
8. High nitrite test kit.
9. Chlorine test kit.
10. Kits to test residuals of all chemicals added to all systems.
11. Test kit for microbiological population and biocide effectiveness.

PART 3 - EXECUTION

3.1 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS

A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic systems within the more stringent of either the equipment manufacturer's requirements or those listed below:

Measured Value	**Multi-Metal Systems with Aluminum**	**Multi-Metal Systems with Stainless Steel**	**Multi-Metal Systems with Copper**
pH Range	7.0 – 8.5	7.0 – 8.5	7.0 – 9.0
Alkalinity as CaCO3	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l
Hardness as CaCO3*	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
Suspended Solids	< 10 mg/l	< 10 mg/l	< 10 mg/l
Dissolved Solids	< 1,000 mg/l	< 1,000 mg/l	< 1,000 mg/l
Chlorides	< 150 mg/l	< 150 mg/l	< 150 mg/l
Iron	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Manganese	< 0.4 mg/l	< 0.4 mg/l	< 0.4 mg/l
Nitrate	< 100 mg/l	< 100 mg/l	< 100 mg/l
Sulfate	< 200 mg/l	< 200 mg/l	< 200 mg/l
Ammonia	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Free Copper	< 0.10 mg/l	< 0.10 mg/l	< 0.10 mg/l
Free Aluminum	< 3.0 mg/l		

* Minimum hardness only applies to softened water. If water from rivers or lakes is below 100 mg/l, remineralizing is not required.

END OF SECTION

SECTION 23 3100
DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork

B. Aluminum Ductwork

C. Stainless Steel Ductwork

D. Carbon Steel Ductwork

E. Phenolic Non-Fibrous Closed Cell Ductwork

F. Ductwork Reinforcement

G. Ductwork Sealants

H. Rectangular Ductwork

I. Round and Flat Oval Ductwork

J. Exposed Ductwork (Rectangular, Round, or Oval)

K. Flexible Duct

L. Grease Exhaust Duct

M. Dishwasher Exhaust Duct

N. Fume Exhaust Duct

O. Welding Exhaust Duct

P. Automotive Exhaust Duct

Q. Underfloor Duct

R. Acoustical Lagging

S. Leakage Testing

T. Ductwork Penetrations

U. Duct Cleaning

V. Painting

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.

D. ASHRAE - Handbook 2012 Systems and Equipment; Chapter 19 - Duct Construction.

E. ASHRAE - Handbook 2013 Fundamentals; Chapter 21 - Duct Design.

F. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.

G. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

H. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

K. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

L. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

M. ASTM E413-87 - Classification for Rating Sound Insulation.

N. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.

O. AWS D9.1M/D9.1 - Sheet Metal Welding Code.

P. NADCA ACR 2002 - Assessment, Cleaning, and Restoration of HVAC Systems.

Q. NADCA Standard 05 1997 - Requirements for the Installation of Service Openings in HVAC Systems.

R. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

S. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.

T. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.

U. SMACNA – Air Duct Leakage Test Manual – 1985 Edition.

V. SMACNA - HVAC Duct Construction Standards - 2005 Edition.

W. SMACNA - Phenolic Duct Construction Standard 022.

X. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.

Y. UL 181 - Factory-Made Air Ducts and Air Connectors.

Z. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors

AA. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

BB. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

CC. CMC California Mechanical Code

DD. CBC California Building Code

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.

3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.

4. Ductwork reinforcement shall be of galvanized steel.

5. Ductwork supports shall be of galvanized or painted steel.

6. Strap hanger shall be a minimum of 1 inch, 18 gauge galvanized steel attached to the bottom of ducts at 8'-0" OC and as required by CMC/UMC and SMACNA guidelines.

7. Slip cable hangers are acceptable. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

8. All fasteners shall be galvanized or cadmium plated.

2.2 ALUMINUM DUCTWORK

A. General Requirements:

1. Material: ASTM B209; aluminum sheet, Alloy 3003-H14. Aluminum connectors and bar stock: Alloy 6061-T6. Aluminum or stainless steel fasteners are acceptable.

2. All duct gauges and reinforcement shall be as called for in Tables 2-50, 2-51, 2-52, and 3-14 of the SMACNA HVAC Duct Construction Standards.

3. Ductwork reinforcement shall be of aluminum.

4. Ductwork supports shall be of aluminum, galvanized steel or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

5. All other requirements are as noted for galvanized rectangular sheet metal duct.

2.3 STAINLESS STEEL DUCTWORK

A. General Requirements:

1. Ductwork shall be Type 304L stainless steel, 16 gauge minimum.

2. Exposed ductwork shall have a #3 finish. Concealed ductwork may have milled finish.

3. Ductwork reinforcement shall be of stainless steel.

4. Ductwork supports shall be of stainless steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

5. All fasteners shall be cadmium plated or stainless steel.

2.4 CARBON STEEL DUCTWORK:

A. General Requirements:

1. Ductwork shall be black carbon steel. Refer to Grease Exhaust Duct below for thicknesses.

2.5 DUCTWORK REINFORCEMENT

A. General Requirements:

1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.

a. Ducts must be over 18” wide.

b. Duct dimensions must be increased 2” in one dimension (h or w) for each row of tie rods installed.

c. Tie rods must not exceed 1/2” diameter.

d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.6 DUCTWORK SEALANTS

A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

B. Two-part joint sealers shall consist of a minimum 3” wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards: LEED [v4] [_____] – Low Emitting Materials – Adhesives and Sealants.

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

E. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.7 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.

2. Transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.

2. Snap lock seams are not permitted.

3. Turning vanes shall be used in all radius elbows, 90° mitered elbows are not allowed. Vanes shall be as follows:

a. Type 1:

1) **Description**: Single wall type with 22-gauge (0.029”) or heavier vanes, 3-1/4" blade spacing, and 4” to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.

2) **Usage**: Limited to 3,000 fpm and vane lengths 36” and under.

b. Type 2:

1) **Description**: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.

2) **Usage**: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48” long.

c. Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):

1) **Description**: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.

2) **Usage**: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48” long.

d. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

e. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

f. Omitting every other vane is prohibited.

4. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

5. Rectangular branch and tee connections in ducts over 1” pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1” pressure class.

6. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

7. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1” or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.

8. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.

9. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.

10. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6” in length.

11. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    a. Apply sealant to all inside corners. Holes at corners are not acceptable.

    b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

12. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    a. Apply sealant to all inside corners. Holes at corners are not acceptable.

    b. Flanges shall be 24-gauge minimum (not 26 gauge).

    c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

2.8 RECTANGULAR DUCT – DOUBLE WALL

A. All applicable portions of Rectangular Duct – Single Wall shall apply.

B. Furnish and install double-wall insulated airtight duct as shown on the drawings.

C. Duct Construction:

1. Galvanized steel exterior wall with solid galvanized steel interior wall.

2. Rectangular double wall duct shall be suitable for pressures listed in the ductwork application schedule.

3. All ductwork gauges and reinforcement shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space-consuming reinforcement.

4. Ducts shall be thick and completely metal enclosed with annular space completely filled with 1-1/2# density glass fiber insulation. Insulation shall have flame spread/smoke developed ratings of less than 25/50 per ASTM E84, NFPA 255, or UL 723.

5. Divided flow fittings may be separate fittings or factory installed taps with the following construction requirements:

   a. Airtight, continuous welds at intersection of fitting body and tap.

   b. Tap liner spot welded to inner liner with weld spacing not over 3".

   c. Insulation packed around the tap area for complete cavity filling.

   d. Carefully fit branch connections to cut-out openings in inner liner without spaces for air erosion of insulation or sharp projections for noise and airflow disturbance.

6. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

7. Support inner liner of ducts and fittings with metal spacers welded to maintain spacing and concentricity.

8. Formed-on flanged transverse joint systems are acceptable if they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

   a. Apply sealant to all inside corners. Holes at corners are not acceptable.

   b. Flanges shall be 24-gauge minimum (not 26 gauge).

   c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

2.9 ROUND AND FLAT OVAL DUCTWORK - SINGLE WALL

A. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

B. Snap lock seams are not permitted.

C. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.

D. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.

E. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.

F. Ductwork shall be suitable for velocities up to 5,000 fpm.

G. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

H. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

I. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.

J. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.

K. Transverse Joint Connections:

1. Crimped joints are not permitted.

2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.

3. Ducts and fittings larger than 36" shall have flanged connections.

4. Secure all joints with at least 3 sheet metal screws before sealing.

5. Slide-on flanges as manufactured by Ductmate Industries, Accuflange, or Sheet Metal Connectors are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward “Keating Coupling”).

2.10 ROUND AND FLAT OVAL DUCTWORK - DOUBLE WALL

A. Conform to applicable portions of Rectangular Duct Section. Spiral seam round or flat oval double wall ductwork may be substituted for double wall rectangular ductwork where approved by the Architect/Engineer. Double wall spiral seam ductwork shall meet the standards set forth in this specification. Ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation. Interior wall shall be perforated if substituting for lined or double wall rectangular ductwork.

B. Interior ducts shall have an airtight outer pressure shell, a 1" insulation layer, and a solid inner wall that completely covers the insulation.

C. Exterior ducts shall have an airtight outer pressure shell, a 2" insulation layer, and a solid inner wall that completely covers the insulation.

D. All perforated inner walls shall have a 25/50 compliant liner between the insulation and the perforated inner wall to prevent contact between fiberglass and air stream. For exterior ductwork this shall form a continuous vapor barrier.

E. Insulation shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

F. 90° elbows shall be smooth radius or have a minimum of 5 mitered joints, and R/D of at least 1.5.

G. Duct and Fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA standards for the specified pressure class. Ribbed and lightweight duct are not permitted.

H. Ductwork shall be suitable for up to 5,000 fpm velocity.

I. Divided flow fittings may be separate fittings or factory installed taps with the following construction requirements:

1. Sound airtight, continuous welds at intersection of fitting body and tap.

2. Tap liner welded to inner liner with weld spacing not over 3".

3. Insulation packed around the tap area for complete cavity filling.

4. Carefully fit branch connections to cut-out openings in inner liner without spaces for air erosion of insulation or sharp projections for noise and airflow disturbance.

J. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

K. Support inner liner of ducts and fittings with metal spacers welded to maintain spacing and concentricity.

L. Ducts with minor axis under 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.

M. Transverse Joint Connections:

1. Crimped joints are not permitted.

2. Provide couplings to align the inner liners. Butt joints are not permitted for inner liners. Make alignment by extending the liner of the fitting into the duct or by using a double concentric coupling with the two couplings held by spacers for rigidity and wall spacing.

3. Above 34" ID provide a separate coupling for inner alignment with the pressure shells joined by angle ring flanged connections.

4. Use outside slip couplings for fitting-to-fitting joints.

5. Secure all joints with at least 3 sheet metal screws before sealing.

6. Slide-on flanges as manufactured by Ductmate Industries, Accuflange or Sheet Metal Connectors are acceptable. Self-sealing duct system is also acceptable (Lindab, Ward “Keating Coupling”).

2.11 EXPOSED DUCTWORK (RECTANGULAR, ROUND, AND FLAT OVAL)

A. The following applies to all ductwork exposed in finished areas in addition to requirements noted above:

1. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.

2. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.

3. Remove all identification stickers and thoroughly clean exterior of all ducts.

4. Locate fitting seams on least visible side of duct.

5. Provide exterior finish suitable for field painting without further oil removal.

6. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct. Slide-on flanges as manufactured by Ductmate Industries, Accuflange or Sheet Metal Connectors are acceptable. Self-sealing duct system is also acceptable (Lindab, Ward "Keating Koupling").

7. The system shall be free of visible dents and scratches when viewed from normal occupancy.

8. All insulation shall be internal, except at reheat coils.

B. In addition to the paragraphs above, this section applies to all ductwork specified or shown as "Architecturally Exposed":

1. All spiral ductwork fittings shall be carbon arc welded.

2. Grind all welds to remove irregularities.

3. Conical taps shall be one piece. Taps for grilles and takeoffs shall be factory installed with a continuous weld and ground smooth.

4. Welds shall be ground smooth and painted.

5. All architecturally exposed ducts shall be round or flat oval except where not possible (grilles, reheat coils, etc.).

C. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:

1. Metal gauge of duct and fittings.

2. Fitting type and construction.

3. Type and size of reinforcement.

2.12 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.

D. Inner liner shall be airtight and suitable for 6" WC static pressure through 16” diameter through 10” diameter and shall be airtight and suitable for 4” WC static pressure 12” through 16” diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. ”R” value shall not be less than 4.0 ft^2*ºF*hr/Btuh. Temperature range of at least 0-180ºF. Maximum velocity of 4,000 fpm.

E. Usage:

1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.

2. Connections to air inlets and outlets. Do not exceed 6'-0" in length.

F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

2.13 GREASE EXHAUST DUCT FIELD FABRICATED

A. Exposed All ductwork shall be 16 gauge minimum, Type 304L stainless steel. Concealed ductwork may be 16 gauge black steel.

B. Concealed Ductwork:

1. Range hood/grease exhaust ducts having an area of 4 sf or less shall be 16 gauge carbon steel.

2. Range hood/Grease exhaust ducts having an area greater than 4 sf shall be 14 gauge carbon steel.

C. All joints and fittings shall be continuously welded and liquid-tight.

D. Exposed ductwork shall have a #3 finish. Concealed ductwork may have a mill finish.

E. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

F. Provide pre-fabricated access doors and labels required by NFPA 96 and California Mechanical Code on sides of duct at least 1.5” from bottom. Provide access at each change in direction and at maximum 20-foot intervals in horizontal ducts. Provide access at every floor for vertical ducts.

G. Install grease traps in kitchen grease and dishwasher ducts at base of all vertical risers and low points in the system.

H. Where grease ducts are 20” x 20” or larger, install access for personnel to enter duct. Duct supports must be sized to support the duct weight and an additional 800 lbs per NFPA 96.

I. Install ducts with proper clearance to combustible and limited-combustible materials.

J. Grease ducts installed with volume dampers shall conform to the damper specified in ductwork accessories.

K. Refer to Section 23 07 13 for duct insulation material and insulated access door when required to provide proper enclosure of ductwork.

2.14 GREASE EXHAUST DUCT (ROUND) PREFABRICATED SYSTEM

A. Ductwork shall have a 0.035" Type 304 stainless inner wall and 0.025" aluminized steel outer wall.

B. 4" annular space between inner and outer walls shall be filled with 4" of high temperature ceramic fiber insulation.

C. Seal ductwork liquid-tight by mechanical joint consisting of integral flanges, with stainless steel flange band and sealed with type P080 sealant.

D. Ductwork shall include hood and fan transitions, cleanout ports, fire suppression and washdown nozzles, expansion joints, and other ductwork provided by manufacturer to ensure completely rated system.

E. Ductwork shall require zero clearance to combustibles. Seal and/or firestop ductwork through non-rated and up to two hour rated penetrations. Firestop with ductwork manufacturer approved materials.

F. Provide all duct access doors and labels required by NFPA 96. Provide access at each change in direction and at maximum 12-foot intervals.

G. Where grease ducts are 20” diameter or larger, install access for personnel to enter duct. Duct supports must be sized to support the duct weight and an additional 800 lbs per NFPA 96.

H. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

I. Anchor duct with manufacturer approved materials of a minimum 5/8" diameter.

J. Ductwork shall be rated for continuous operation at 500°F and intermittently at 2000°F.

K. Acceptable Manufacturers: Metal-Fab No Chase, Schebler.

2.15 DISHWASHER EXHAUST DUCT

A. Ductwork shall be 16 gauge minimum Type 304L 316L stainless steel.

B. All joints and fittings shall be continuously welded and liquid-tight.

C. Ductwork exposed in kitchens shall have a #3 finish. Concealed ductwork may have a standard mill finish.

D. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

2.16 FUME EXHAUST DUCT

A. Unless shown otherwise on the drawings, all fume exhaust ductwork shall be 14 gauge Type 304L stainless steel with continuously welded joints. Ductwork shall meet all requirements of SMACNA Class 5-6” pressure class industrial ductwork. Use heavier gauge and/or transverse reinforcements if required.

B. Elbows up to 30° shall be mitered two-piece type. Elbows 31° to 50° shall be mitered three-piece type. Elbows 51° to 90° shall be mitered five-piece type. All elbows shall have a minimum centerline R/D of 1.5. Elbows 10" in diameter and smaller may be die-formed.

C. Expanders in horizontal ducts shall be eccentric type with a minimum length of (diameter change x 10) and shall maintain a positive pitch for drainage to the fume hood or exhaust outlet. Expanders in ducts over 30º from horizontal shall be concentric with a minimum length of (diameter change x 5).

D. Ducts shall maintain the maximum possible pitch toward their inlets unless a different drainage location is indicated on the drawings. If at least 1/8" per foot pitch cannot be maintained, notify the Architect/Engineer before installing ductwork or other items with which ductwork may conflict.

E. All welds shall conform to AWS D9.1M. Welds shall be Gas Tungsten Arc Weld (TIG) or Gas Metal Arc Weld (MIG) type. All filler metal shall conform to AWS A5.9 or A5.22 and be AWS Classification ER308L or ER308LSi with a carbon content of not over 0.03%.

F. Supports shall not penetrate duct surfaces. Ductwork shall be completely leak-tight from the inlet to the discharge to the atmosphere, at pressures up to 10" WG. Install caps to seal the ductwork for pressure testing. Plug all spray and drain connections when testing ductwork.

G. Where flanged joints are indicated, they shall have 1/4" "Gore-Tex Joint Sealant" gaskets (W. L. Gore & Associates, Industrial Products Division, 100 Airport Road, Box 1550, Elkton, MD 21921 (410) 392-4440 or (410) 392-3200). PTFE gaskets are also acceptable.

H. Furnish one 50' spool of gasket material or 10 spare gaskets of each size used to the Owner for future use.

I. All ducts indicated as "316SS" shall be constructed of Type 316L stainless steel. The specification above for 304L stainless steel ductwork also applies to 316L stainless steel ductwork except all filler metal shall be AWS Classification ER316L or ER316Lsi with a carbon content of not over 0.03%.

J. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

K. Hot-lab exhaust duct shall meet CMC material requirements.

2.17 WELDING EXHAUST DUCT

A. Ductwork shall be spiral seam single wall type. Construct to requirements of SMACNA Class I Industrial Duct with a pressure rating of 7" negative. Flexible ducts shall be weld proof tubing. Furnish magnetic receptors at each welding table.

B. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

C. Acceptable Manufacturers for Tubing and Receptors: Car-Mon Products, Inc., Engwald, or National.

2.18 AUTOMOTIVE EXHAUST DUCT

A. Ductwork shall be spiral seam single wall type. Construct to requirements of SMACNA Class I Industrial Duct with a pressure rating of 7" negative. Flexible ducts shall be high temperature fiberglass with wire reinforcing.

B. Provide tailpipe adaptors, winches and all other required accessories.

C. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

D. Acceptable Manufacturers for Tubing: Car-Mon Products, Inc., Engwald, or National.

2.19 UNDERFLOOR DUCT (1" WC OR LESS)

A. Construct underfloor duct systems of steel duct.

B. Fittings shall use standing seam construction for sizes up to 30" diameter. Larger sizes shall be riveted and bonded. Seal all seams with bonding material.

C. Metal thickness shall be:

1. 3” through 8” diameter - 26 gauge

2. 9” through 15” diameter - 24 gauge

3. 16” through 22” diameter - 22 gauge

4. 24” through 32” diameter - 20 gauge

5. Larger than 32” diameter - 18 gauge

D. Provide heavier gauge ductwork and/or duct reinforcement as required to support the loading due to backfilling. Manufacturer shall provide calculations of load capacity of the ductwork system.

E. Seal all joints with waterproof sealant.

F. Cut boots or take-offs neatly into ducts for smooth airflow. Tap area shall be at least 1.5 times branch duct size.

G. Touch up all exposed metal surfaces or damage to coating with a brush-on PVC coating. Aerosol sprays are not acceptable. Clean all surfaces with soap and water. Dry thoroughly before painting. All bare metal surfaces including cut ends of ducts, ends of fittings, crews, rivets, etc. shall be coated.

H. Do not install any ductwork below the water table.

I. Set ductwork on a 3" thick bed of sand or pea gravel.

J. Wrap the entire underfloor duct system with 2 layers of 8-mil polyethylene film, taped securely in place.

K. Fully encase all underfloor ducts, fittings and branches in a minimum 3" of concrete. Set ducts on concrete blocks or bricks at least 3" above trench bottom and anchor to prevent flotation. Pour concrete half way up side of duct. After concrete sets, pour concrete to at least 3" over top of duct. Refer to Figures 10-3 and 10-4in the SMACNA HVAC Duct Construction Standard. Do not dump concrete directly on duct and do not damage the vapor barrier film on the duct.

L. Install all ducts per manufacturer's recommendations. Slope ductwork to plenum.

2.20 UNDERFLOOR FIBERGLASS REINFORCED PLASTIC DUCT

A. Material: Polyester impregnated, filament wound fiberglass. Type 1, Grade 2 polyester, Class E per ASTM D2310. The duct and fittings as a finished composite shall meet the flame/smoke spread rating of 25/50 per ASTM-E84.

B. All ducts shall be designed for not less than 12 inches water column pressure and 5 inches water column vacuum. A minimum structural safety factor of 5 shall be used in the design of duct wall thickness, which shall be at least 0.125” for ducts up to 20” diameter, 0.187” for ducts 21” to 36” in diameter, and 0.25” for ducts 37” to 60” in diameter. Determine rectangular duct thickness by substituting the long side of the duct for the round diameter above.
Maximum deflection of rectangular ducts under deadload and operating conditions shall not exceed 1 percent of the width of the longest side.

C. Corrosion resistance: Resistant to hydrogen sulfide and other gases from raw water. Fillers shall not exceed 5% by weight.

D. Elbows shall have at least two gores (one miter) to 30°, 3 gores 31° to 60°, and 5 gores 61° to 90°. Centerline radius must be 1.5 times the duct diameter.

E. Temperature limit: 180ºF, continuous service.

F. Joints: Butt or flanged type of the same material as the duct, and totally watertight.

G. Do not install any ductwork below the water table.

H. Set ductwork on a 4" thick bed of sand or pea gravel.

I. Backfill ductwork with pea gravel or sand. Spread backfill material evenly around the duct in 3" lifts and tamp in place. Do not dump fill directly on duct and do not damage the vapor barrier film on the duct.

J. Install all ductwork per manufacturer's recommendations. Slope ductwork as shown on drawings.

K. Acceptable Manufacturers: Perry Fiberglass Products, Yankee Plastic Company, ABC-Peabody Spunstrand, Inc. “Spunstrand”, Ershigs, Harrington Plastics.

2.21 ACOUSTICAL LAGGING

A. Type A: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 1” thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 28, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer’s recommendations.

1. Acceptable Products: Sound Seal B-10 Lag/QFA-3, McGill Air Pressure PDL-3, Kinetics KNM 100ALQ-1.

B. Type B: Lagging shall be a loaded vinyl noise barrier, fiberglass scrim facing, and 2” thick quilted fiberglass decoupling layer. Lagging shall have a minimum STC of 30, and Class A flammability (maximum 25/50) rating per ASTM E-84. Install lagging per manufacturer’s recommendations.

1. Acceptable Products: Sound Seal B-10 Lag/QFA-9, McGill Air Pressure PDL-9.

C. Refer to drawings for acoustical lagging locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.

D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with level “B” of the SMACNA Duct Cleanliness for New Construction Guidelines.

E. Repair all duct insulation and liner tears.

F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.

K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

L. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California Building Codes.

M. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

N. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

O. Kitchen Grease and Dishwasher Ductwork:

1. All kitchen grease and dishwasher ductwork shall be installed with a continuous slope and grease tight welds on all seams and joints.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS †	INSULATION (Refer to Section 23 07 13 for insulation types) ±
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Rectangular	+3"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Round	+3"	A	1-1/2" thick Type A (R=4.5) or 1" Type G (R=4.3) 2" thick Type A (R=6.0) or 2" thick Type G (R=7.1)
Supply Duct from Fan to Terminal Air Boxes	Galvanized Sheet Metal w/Slide-On Flange System or Formed-on Flanges	+3" (+6")	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)
Supply Duct from Fan to Terminal Air Boxes – Double Wall	Galvanized Sheet Metal (round or rectangular)	+3"	A	1" thick Type E (R=3.7) 2" thick Type E (R=7.4)
Exterior Supply Duct from Fan to Terminal Air Boxes – Double Wall	Galvanized Sheet Metal (round or rectangular)	+3"	A	2" thick Type E (R=7.4) 4" thick Type E (R=14.8)
Exterior Supply Duct from Fan to Terminal Air Boxes – Single Wall with Aluminum Jacket	Galvanized Sheet Metal (round or rectangular)	+3"	A	2" thick Type B with aluminum jacket (R=8.0) 3" thick Type B (R=12)
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	+2"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	+2"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type G (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type G (R=7.1)
Constant Volume from Fan to Outlet	Galvanized Sheet Metal - Rectangular	+2"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS †	INSULATION (Refer to Section 23 07 13 for insulation types) ±
Constant Volume from Fan to Outlet	Galvanized Sheet Metal - Round	+2”	A	1-1/2" thick Type A (R=4.5) or 1" thick Type G(R=4.3) 2" thick Type A (R=6.0) or 2" thick Type G (R=7.1)
Return Duct	Galvanized Sheet Metal	-2"	A	None None 1" thick Type C (R=3.6)
Exterior Return Duct	Galvanized Sheet Metal	-2”	A	1 1/2” thick Type B (R=6) 3” thick Type B (R=12)
General Exhaust Duct	Galvanized Sheet Metal	-1"	A	None or 1" thick Type C (R=3.6)
Combustion Air Duct	Galvanized Sheet Metal	-1"	A	1 1/2" thick Type B (R=6.0)
AHU Exhaust Air Duct	Galvanized Sheet Metal	+2"	A	1" thick Type C (R=3.6)
Relief/Exhaust Air Duct from fan to Exhaust Outlet	Galvanized Sheet Metal	+2"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) or None 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1) or None
Grease Exhaust Duct	Refer to “Grease Exhaust Duct”	-2"	---	None (with Metal-Fab System). Where concealed 1-1/2" thick Type A where no fire rating is needed; or type F where fire rating is needed.
Dishwasher Exhaust Duct	Refer to “Dishwasher Exhaust Duct”	-1"	A	None or 1-1/2" thick Type A (R=4.5)
Fume Exhaust Duct	Refer to “Fume Exhaust Duct”	---	---	1-1/2” thick Type A (R=4.5) within 15’of penetration of exterior wall or roof
Outside Air Intake from Louver to Heating Coil	Galvanized Sheet Metal	-2"	A	1 1/2" thick Type B (R=6.0)
Mixed/Make-up Air Duct	Galvanized Sheet Metal	-2"	A	1-1/2" thick Type A (R=4.5) 2" thick Type A (R=6.0)
Tempered Outdoor or Makeup Air Duct from Fan to Outlet	Galvanized Sheet Metal	+2"	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS †	INSULATION (Refer to Section 23 07 13 for insulation types) ±
Relief Air Louver to Backdraft Damper	Galvanized Sheet Metal	+2"	A	1 1/2" thick Type B (R=6.0) 1 1/2" thick Type B (R=6.0)
Transfer Ducts	Galvanized Sheet Metal	-1/2"	---	1" thick Type C (R=3.6)
Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)	---	---	---	1-1/2" thick Type A (R=4.5) 2" thick Type A (R=6.0)
All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers	--	--	(Note 2)	1-1/2" thick Type A (R=4.5)
Linear Diffuser Supply Plenum	-	-	-	1/2" thick Type C (R=1.8) 1-1/2" thick Type A (R=4.5) 2" thick Type C (R=7.1) 2" thick Type A (R=6.0)
Supply Duct from Fan to Terminal Air Boxes	Phenolic Non-Fibrous Closed Cell - Indoor	+3" +4"	A (Note 1)	None
Exterior Supply Duct from Fan to Terminal Air Boxes	Phenolic Non-Fibrous Closed Cell – Outdoor.	+6"	A	None
Supply Duct from Terminal Air Boxes to Outlets	Phenolic Non-Fibrous Closed Cell - Indoor	+3" +4"	A (Note 1)	None
Constant Volume from Fan to Outlet	Phenolic Non-Fibrous Closed Cell - Indoor	+3" +4"	A	None
Return Duct	Phenolic Non-Fibrous Closed Cell - Indoor	-3"	A	None
Exterior Return Duct	Phenolic Non-Fibrous Closed Cell – Outdoor.	-6"	A	None

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS †	INSULATION (Refer to Section 23 07 13 for insulation types) ±
General Exhaust Duct	Phenolic Non-Fibrous Closed Cell - Indoor	-3”	A	None
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual ± Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression). Note 1: Apply aluminum based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant. Note 2: Apply aluminum based adhesive sealant tape on TAB boxes (all seams and joints of the box and duct connections) serving dedicated outside air supply (DOAS) system.				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.

2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.

3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer’s data sheet specifies other application methods or requirements.

B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.

2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Duct - 3" WG and Above (positive or negative):

1. A minimum of 25% of interior ductwork and all exterior ductwork shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.

[***OR*****]**

2. Duct system shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.

2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.

3. All joints shall be felt by hand, and all discernible leaks shall be sealed.

4. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.

6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.

8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.

9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

D. Fume Exhaust Duct:

1. Testing shall be done before any exterior insulation is applied.

2. Cap each exhaust system at all inlets and at the discharge to atmosphere. Fans, dampers and flexible connections shall be included in the testing.

3. Pressurize each duct system to 7" water column. Leakage shall not exceed 4 cfm regardless of system size.

4. Where several fans discharge into a large collection duct, the collection duct and each individual exhaust duct may be treated as separate systems.

E. Grease Exhaust Duct:

1. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of ductwork to be tested. The lamp shall be open to emit light equally in all four directions.

2. Testing of the entire exhaust duct system including the hood-to-duct connection shall be performed. Ductwork shall be permitted to be tested in sections provided every joint is tested.

3. Leakage testing shall occur prior to use or concealment of the duct system. Ducts shall be considered concealed where installed in shafts or covered by insulation or wrap that prevents ductwork from being visibly inspected on all sides. The test shall be performed in the presence of the code official.

3.5 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

3.6 DUCTWORK CLEANING

A. General:

1. This section applies to the cleaning of ductwork and HVAC system components.

2. The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA) or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

3. The HVAC system cleaning contractor shall furnish all necessary equipment, materials, and labor to adequately perform the specified services.

4. The HVAC system cleaning contractor shall be capable of remediation of exposed damaged insulation in air handlers and/or ductwork requiring replacement.

5. Regulatory Requirements:

   a. Contractor shall submit to the Owner SDS for all chemical products proposed to be used in the cleaning process.

B. Perform the services specified here in accordance with current NADCA standards.

C. System Component Inspections and Site Preparations:

1. Prior to beginning any cleaning work, perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment needed. The cleanliness inspection should include air handling units, other air moving equipment, and ductwork. In systems with multiple air handling units, a representative sample of the units should be inspected.

2. Coordinate any system shutdowns with the Owner a minimum of 24 hours in advance of any needed shutdowns.

3. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification, or other debris.

4. Damaged system components found during the inspection shall be documented and brought to the attention of the Owner and Architect/Engineer.

5. Conduct a site evaluation, and establish a specific, coordinated plan detailing how each area of the building will be protected during each phase of the project.

D. HVAC System Cleaning Requirements:

1. Collect debris removed during cleaning and take precautions to avoid dispersing debris from cleaning operations outside the HVAC system.

2. Use HEPA filters if particulate collection equipment exhausts inside the building.

3. When particulate collection equipment exhausts outside the building, precautions shall be taken to locate the equipment downwind and away from all air intakes and other points of entry into the building.

4. Cleaning operations shall be undertaken only with particulate collection equipment in place, including adequate filtration to contain debris removed from the HVAC system.

5. Take measures to control odors, mist, and vapors during the cleaning process.

6. All HVAC system components must be visibly clean as defined in the NADCA Standards.

7. Volume dampers, control dampers, and other mechanical devices inside the HVAC system must have their positions marked prior to cleaning and, upon completion, must be restored to their marked positions.

8. Service Openings:

    a. Use existing service openings where possible.

    b. Create openings where needed. Seal openings per the original duct pressure and leakage classification after use.

    c. Closures must not significantly restrict or alter the system airflow.

    d. Closures must be insulated to prevent heat transfer and condensation.

    e. Openings must not compromise the structural integrity of the system.

    f. Openings shall conform to applicable NFPA and SMACNA standards, and NADCA Standard 05.

    g. Do not cut openings in flexible duct. Disconnect flexible duct at the ends as needed for proper cleaning and inspection.

    h. Clearly mark all service openings that can be reopened and mark their locations in the final report.

9. Clean all connected inlets and outlets.

10. Air Handling Unit Cleaning (Unit Identification):

    a. Thoroughly clean supply, return, and exhaust fans. Clean fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies. Remove all visible surface deposits in accordance with NADCA Standards. Contractor shall:

        1) Clean all internal surfaces, components, coils (including fins), condensate pans, and drains.

        2) Assure that a suitable operative drainage system is in place prior to beginning washdown procedures. Take care not to wet any insulation during washdown.

11. Duct System Cleaning:

    a. Create service openings as needed for cleaning inaccessible areas.

    b. Mechanically clean all duct systems such that the systems are capable of passing NADCA cleaning verification tests.

    c. Seal all openings, grilles, diffusers, etc. in the system to be cleaned.

    d. Attach high-pressure vacuum unit to ductwork near fan. Do not exceed the negative pressure rating of ductwork.

    e. From farthest opening, work dirt from duct back to extraction point using compressed air, brushes, and scrapers.

    f. Do not damage lining or devices during cleaning. Replace any damaged material.

E. Cleaning Methods

1. Source Removal Cleaning Method:

a. Clean the HVAC system using source removal mechanical cleaning methods designed to extract contaminants from the HVAC system and safely remove contaminants from the facility. Select source removal methods that will render the HVAC system visibly clean and capable of passing cleaning verification and other specified tests included in this section. No cleaning method or combination of methods shall be used that could potentially damage the HVAC system or negatively alter the system integrity.

b. Operate vacuum collection devices continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned. The vacuum collection device must maintain sufficient negative pressure in all areas being cleaned to contain debris and protect the indoor environment.

c. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters, including hand-held vacuums and wet vacuums.

d. All vacuum devices exhausting outside the facility shall be equipped with particulate collection devices including a washable cloth filter bag to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any codes or regulations.

e. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces such that debris may be safely conveyed to vacuum collection devices. Acceptable methods include those that will not potentially damage the integrity of the ductwork nor damage porous surface materials, such as liners inside the ductwork, or system components.

f. Exterior gas-fired vacuum collection equipment shall be located at least 20 feet away from the building.

g. Where vacuum collection hoses run into the building, the Contractor shall seal the opening airtight so dust from the collection equipment cannot re-enter the building.

h. Hoses for mechanical agitation devices should not enter the building in the same location as the vacuum hoses. Utilize a remote building opening for the tool entry location.

2. Coil Cleaning:

a. Any cleaning method may be used that renders the coil visibly clean and capable of passing NADCA Coil Cleaning Verification tests. Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement or erosion of, or inhibit heat transfer of the coil surface and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water.

3. Biocide Agents and Coatings:

   a. Biocide agents shall only be applied if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified through testing.

   b. Biocide agents shall only be used where the Owner agrees in writing that he/she accepts coating the contaminated materials instead of replacement.

   c. Application of any biocide shall be performed after removal of surface deposits and debris.

   d. When used, apply biocides and coatings in strict accordance with manufacturer's recommendations, including minimum surface thickness for effectiveness and the EPA registration listing.

   e. Coatings shall be sprayed directly onto interior ductwork surfaces rather than “fogged” downstream onto surfaces. A continuous film must be achieved on the surface to be treated by the coating application.

F. Verification of Cleanliness:

1. The HVAC system cleaning contractor shall verify the cleanliness of the system, with help from the Owner.

2. Cleanliness of HVAC systems shall be verified immediately after mechanical cleaning, before application of any treatment or introduction of any treatment-related substance to the HVAC system (including biocides and coatings), and before the HVAC system is restored to normal operation.

3. The HVAC system shall be inspected visually. If no contaminants are evident, the system shall be considered clean. However, the Architect/Engineer and Owner reserve the right to require further verification of system cleanliness through Surface Comparison Testing or the NADCA vacuum test.

4. NADCA vacuum test analysis shall be performed by a qualified third party experienced in testing of this nature.

5. If visible contaminants are evident, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection at the Contractor's expense.

6. Verification of Coil Cleanliness:

   a. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured or cataloged when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if it is free of foreign matter or residue based on a thorough visual inspection.

G. Final Report:

1. At the conclusion of the project, the Contractor shall provide a report to the Owner and Architect/Engineer indicating the following:

a. Success of the cleaning project as verified through visual inspection and/or gravimetric analysis.

b. Areas of the system found to be damaged and/or in need of repair.

c. Locations of service openings.

H. Systems to be cleaned are as follows:

3.7 ACOUSTICAL LAGGING

A. Where indicated on drawings, completely wrap ductwork with lagging and seal all joints airtight with tape recommended by the lagging manufacturer to prevent acoustical leakage at joints. Overlap lagging 2” at any wall, floor, or structural deck penetration to prevent acoustical leakage.

END OF SECTION

SECTION 23 3300
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Volume Dampers.

B. Grease Duct Volume Dampers.

C. Fire Dampers.

D. Ceiling Fire Dampers.

E. Fire/Smoke Dampers.

F. Control/Fire/Smoke Dampers.

G. Smoke Dampers.

H. Pressure Relief Doors.

I. Backdraft Dampers.

J. Fabric Connectors.

K. Drip Pans.

L. Duct Access Doors.

M. Duct Test Holes.

N. Air Blenders.

O. Duct Silencers.

P. Remote Volume Control Devices.

Q. Ultraviolet (UVC) Germicidal Lamps.

1.2 REFERENCES

A. ASTM E477-06a - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

B. ASTM E2336-04 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

C. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

D. SMACNA - HVAC Duct Construction Standards – Third Edition - 2005.

E. UL 33 - Heat Responsive Links for Fire-Protection Service.

F. UL 555 - Fire Dampers and Ceiling Dampers.

G. UL 555C – Ceiling Dampers.

H. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit manufacturer's installation instructions.

C. Include UL ratings, California State Fire Marshal approval and NFPA 90A, dynamic ratings, leakage, pressure drop and maximum pressure data.

D. Submit certification that ductwork accessories will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

[***OR*****]**

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

E. Provide locking quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

2.2 GREASE DUCT VOLUME DAMPERS

A. Venturi style damper comprised of an adjustment regulator control rod and casing.

B. Materials: 16 gauge galvanized steel front panel and casing, 18 gauge stainless steel balancing panels.

C. Damper shall provide access to duct to facilitate cleaning of the ductwork.

D. Damper shall be UL 710 listed and fabricated in compliance with NFPA 96.

2.3 DYNAMIC CURTAIN BLADE FIRE DAMPERS (FD)

A. Furnish and install fire dampers in ducts, where shown on the drawings, at the point where they pass through a fire wall or a floor and in all other locations required by the local fire department, The National Fire Protection Association's Pamphlet No. 90A and all other applicable codes.

B. Fire dampers shall be UL 555 listed for 1-1/2-hour fire resistance unless noted otherwise, dynamic rated with heated airflow at 2,000 fpm and 4" WC, and have all blades stacked out of the airstream (Type B).

C. Where dampers are in aluminum or stainless steel duct, provide stainless steel dampers.

D. Fire dampers shall be held open by a fusible link rated at 165ºF unless otherwise called for on the drawings or by local codes.

E. Dampers shall be installed in sleeves of sufficient thickness to comply with the UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, the sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with a factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the factory installed access door.

F. Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

2.4 DYNAMIC MULTIPLE BLADE FIRE DAMPERS (FD)

A. Furnish and install fire dampers in ducts, where shown on the drawings, at the point where they pass through a fire wall or a floor and in all other locations required by the local fire department, The National Fire Protection Association's Pamphlet No. 90A and all other applicable codes.

B. Fire dampers shall be UL 555 listed for 1-1/2-hour fire resistance unless noted otherwise, dynamic rated at 2,000 fpm and 4" WC, with the blades located in the air stream.

C. Where dampers are in aluminum or stainless steel duct, provide stainless steel dampers.

D. Blades shall be airfoil shaped, double skin construction with stainless steel bearings.

E. Fire dampers shall be held open by a fusible link rated at 165ºF unless otherwise called for on the drawings or by local codes.

F. Dampers shall be installed in sleeves of sufficient thickness to comply with the UL 555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, the sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with a factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the factory installed access door.

G. Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

2.5 CEILING FIRE DAMPERS

A. Furnish and install ceiling fire dampers where shown on the drawings, at the point where they pass through a rated ceiling, and in all other locations required by the local fire department, the NFPA Standard 90A, and all other applicable codes.

B. Ceiling fire dampers shall be UL 555C listed for the applicable ceiling and fire resistance rating and shall be held open by a fusible link rated at 165ºF unless otherwise called for on the drawings or by local code.

C. A means for balancing airflow shall be incorporated in the damper.

2.6 FIRE/SMOKE DAMPERS (FSD)

A. Furnish and install California State Fire Marshal approved combination smoke/fire dampers where shown on plans. The units shall incorporate a low friction design that provides overlapping. The blade edge seals shall be silicone and provide a minimum Class 2 seal at 350°F as per UL 555S. The damper shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. The fire releasing device shall be a UL 33 listed HS10. Provide PI50 end switch and wire to RCP-1 (remote control panel) mounted on ceiling below respective fire smoke damper. The fire releasing device must also be listed by the CSFM for use with the damper assembly. Melting fusible links are not acceptable. The dampers shall be provided in sleeves with pre-mounted motor actuators and dual position indicators for remote annunciation. The damper must be able to fail open or close for smoke, depending on the system requirements. The motors must be FSLF120 Belimo, and both damper and motor are to have a minimum 5-year warranty. The motors must be mounted on a bracket that allows for use of slip joint connections or "Duct-mate" type connections without modification. Provide Belimo Air Controls FSNF 120 actuator. Actuator operating time shall be 15 seconds or less to drive open or spring closed from 32°F to 350°F and have UL 555S listing. Actuator shall draw no more than 27 VA running or 10 VA holding for 70 inch/# torque. Actuator shall carry a manufacturer’s 5-year warranty. Motor must reopen damper fully even if power failed for less than 2 seconds. Inexpensive stall motors will not be accepted. The complete assembly must be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. All smoke/fire dampers shall be tested by the Contractor in the presence of the field inspector and the State Fire Marshal. This test shall be performed prior to the installation of the ceilings.

B. Furnish and install fire/smoke dampers in ducts, where shown on the drawings, at the point where they pass through a fire/smoke partition and in all other locations required by the local Fire Department, the National Fire Protection Association Pamphlet No. 90A, and all other applicable codes.

C. Fire/smoke dampers shall be furnished complete with operators factory mounted and the damper/operator assemblies shall meet all requirements listed below.

D. Assemblies shall be 1-1/2 hour rated under UL Standard 555 unless noted otherwise; and be dynamic rated at 2,000 fpm and 4" WC.

E. Assemblies shall be UL 555S listed as leakage rated dampers for use in smoke control system with a 250ºF temperature rating and a leakage rating of not over 10 cfm per square foot at 1" WC (Class II).

F. Where dampers are located in aluminum or stainless steel duct, provide stainless steel dampers.

G. FSD shall be held open by fusible link or electric resettable link rated at 165ºF unless otherwise called for on the drawings or by local codes.

H. Dampers shall be rated for at least 20,000 complete cycles.

I. Locate access door in ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high reading "FIRE DAMPER".

J. All operators shall be located with easy access for servicing.

K. Dampers shall be installed in sleeves of sufficient thickness to comply with the UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, the sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with an actuator or factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the actuator or factory installed access door.

L. FSD shall be held open by 120V 24 VAC, single phase operator. Motors shall be direct coupled gear type with power open and spring return. Torque type (stall) motors are not acceptable. Wiring by Mechanical Electrical Contractor.

[* * * * * OR * * * * *]

M. FSD shall be held open by normally closed pneumatic actuator. Spring range shall be 5-10 lb., unless noted otherwise. No electric connection to FSD shall be required. Damper shall be equipped with pneumatic fuse link.

N. Damper shall have airfoil type blades and the static pressure drop shall not exceed 0.15" at 2,000 FPM in a 24" x 24" damper.

2.7 CONTROL/FIRE/SMOKE DAMPERS (CFSD)

A. Furnish and install California State Fire Marshal approved combination smoke/fire dampers where shown on plans. The units shall incorporate a low friction design that provides overlapping. The blade edge seals shall be silicone and provide a minimum Class 2 seal at 350°F as per UL 555S. The damper shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. The fire releasing device shall be a UL 33 listed HS10. Provide PI50 end switch and wire to RCP-1 (remote control panel) mounted on ceiling below respective fire smoke damper. The fire releasing device must also be listed by the CSFM for use with the damper assembly. Melting fusible links are not acceptable. The dampers shall be provided in sleeves with pre-mounted motor actuators and dual position indicators for remote annunciation. The damper must be able to fail open or close for smoke, depending on the system requirements. The motors must be FSLF120 Belimo and both damper and motor are to have a minimum 5-year warranty. The motors must be mounted on a bracket that allows for use of slip joint connections or "Duct-mate" type connections without modification. Provide Belimo Air Controls FSNF 120 actuator. Actuator operating time shall be 15 seconds or less to drive open or spring closed from 32°F to 350°F and have UL 555S listing. Actuator shall draw no more than 27 VA running or 10 VA holding for 70 inch/# torque. Actuator shall carry a manufacturer's 5-year warranty. Motor must reopen damper fully even if power failed for less than 2 seconds. Inexpensive stall motors will not be accepted. The complete assembly must be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. All smoke/fire dampers shall be tested by the Contractor in the presence of the field inspector and the State Fire Marshal. This test shall be performed prior to the installation of the ceilings.

B. Furnish and install control/fire/smoke dampers in ducts, where shown on the drawings, at the point where they pass through a fire/smoke partition and in all other locations required by the local Fire Department, the National Fire Protection Association Pamphlet No. 90A, and all other applicable codes.

C. CFSD dampers shall be furnished complete with operators factory mounted and the damper/operator assemblies shall meet all requirements listed below.

D. Assemblies shall be 1-1/2 hour rated under UL Standard 555 unless noted otherwise; and be dynamic rated at 2,000 fpm and 4" WC.

E. Where dampers are located in aluminum or stainless steel duct, provide stainless steel dampers.

F. Assemblies shall be UL 555S listed as leakage rated dampers for use in smoke control system with a 250ºF temperature rating and a leakage rating of not over 10 cfm per square foot at 1" WC (Class II).

G. CFSD shall be held open by fusible link or electric resettable link rated at 165ºF unless otherwise called for on the drawings or by local codes.

H. CFSD shall be suitable for continuous modulating operation.

I. CFSD operators shall be electric direct coupled for modulating control. Actuator shall be 120V with control proportional to 4-20 mA output signal. Wiring by Mechanical Electrical Contractor. "Stall type" actuators are NOT acceptable.

J. Locate access door in ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high reading "FIRE DAMPER".

K. All operators shall be located with easy access for servicing.

L. Dampers shall be installed in sleeves of sufficient thickness to comply with UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, the sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with an actuator or factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the actuator or factory installed access door.

M. Damper shall have airfoil type blade and the static pressure drop shall not exceed 0.15" at 2,000 FPM in a 24" x 24" damper.

2.8 SMOKE DAMPER (SD)

A. Furnish and install California State Fire Marshal approved smoke dampers where shown on plans. The units shall incorporate a low friction design that provides overlapping. The blade edge seals shall be silicone and provide a minimum Class 2 seal at 350°F as per UL 555S. The damper shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. The fire releasing device shall be a UL 33 listed HS10. Provide PI50 end switch and wire to RCP-1 (remote control panel) mounted on ceiling below respective fire smoke damper. The fire releasing device must also be listed by the CSFM for use with the damper assembly. The dampers shall be provided in sleeves with pre-mounted motor actuators and dual position indicators for remote annunciation. The damper must be able to fail open or close for smoke, depending on the system requirements. The motors must be FSLF120 Belimo and both damper and motor are to have a minimum 5 year warranty. The motors must be mounted on a bracket that allows for use of slip joint connections or "Duct-mate" type connections without modification. Provide Belimo Air Controls FSNF 120 actuator. Actuator operating time shall be 15 seconds or less to drive open or spring closed from 32°F to 350°F and have UL 555S listing. Actuator shall draw no more than 27 VA running or 10 VA holding for 70 inch/# torque. Actuator shall carry a manufacturer's 5 year warranty. Motor must reopen damper fully even if power failed for less than 2 seconds. Inexpensive stall motors will not be accepted. The complete assembly must be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. All smoke dampers shall be tested by the Contractor in the presence of the field inspector and the State Fire Marshal. This test shall be performed prior to the installation of the ceilings

B. Furnish and install smoke dampers in ducts, where shown on the drawings, at the point where they pass through a smoke partition and in all other locations required by the local Fire Department, The National Fire Protection Association Pamphlet No. 90A, and all other applicable codes.

C. Smoke dampers and operators shall be supplied as a package meeting all of the requirements below.

D. Locate access door in ductwork for visual inspection. Each access door shall have a label with letters at least 1/2" high, reading "SMOKE DAMPER".

E. Smoke damper and operator assemblies shall be UL 555S listed as leakage rated dampers for use in smoke control systems, shall have a leakage rating of not over 10 cfm per square foot at 1" WC (Class II), a 250ºF temperature rating, a 2,000 fpm velocity rating, and 4" WC pressure rating.

F. Where dampers are located in aluminum or stainless steel duct, provide stainless steel dampers.

G. All operators shall be located with easy access for servicing.

H. Smoke dampers shall be held open by a 120V 24VAC, single phase operator. Motors shall be direct coupled gear type with power open, spring return. Torque type (stall) motors shall not be acceptable. Wiring by Mechanical Electrical Contractor.

I. Damper shall have airfoil type blade and the static pressure drop shall not exceed 0.15" at 2,000 fpm in a 24" x 24" damper.

2.9 PRESSURE RELIEF DOORS

A. Furnish and install pressure relief doors where shown on the drawings. Doors shall be installed to open outward to relieve pressure build-up or to open inward to prevent damage to negative pressure.

B. Door and frame shall be constructed of 12 gauge galvanized steel, with polyurethane foam seal around the door perimeter. A sign warning of the possibility that the door could open suddenly should be placed on the side of the door that swings outward.

C. The door shall be factory set to open at inches W.C. static pressure. The relief pressure shall be factory set and tested in an AMCA approved lab prior to shipment.

D. The door shall automatically reset after pressure drops below 3" W.C.

E. Leakage shall not exceed 40 CFM at 4" W.C.

F. Acceptable Manufacturer: Ruskin, Kees, Arrow.

2.10 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 inches x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer’s standard construction.

B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90º stop, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Acceptable Models: Ruskin CBD4, Arrow 655, Safe-Air/Dowco BRL, Greenheck EM.

2.11 FABRIC CONNECTORS

A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.

B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalis, grease and gasoline, and shall be noncombustible.

D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.

E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

F. Fabric connectors shall not be painted.

G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.

H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.

I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.

J. Acceptable Materials: Durodyne "Duralon MFD-4-100", Vent Fabrics, Inc. "Ventlon", or Proflex PFC3HGA.

2.12 DRIP PANS

A. Install drip pans under all rooftop exhaust fans, intake hoods, exhaust hoods and other roof penetrations that do not have ductwork below them to intercept dripping water.

B. Drip pans shall be 22 gauge minimum cross-broken or reinforced sheet metal with 2" welded upturned lips.

C. Pans shall extend 6" in all directions beyond the opening and shall have the top of the lip located 25% of the maximum throat dimension below the opening.

D. Insulate interior of drip pan with 1” thick elastomeric foam insulation. Adhere foam to drip pan with standard foam adhesive.

2.13 DUCT ACCESS DOORS

A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

C. Provide duct access door in all horizontal return ductwork at 20 foot intervals per NFPA 90A.

D. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

E. Access doors with sheet metal screw fasteners are not acceptable.

F. Minimum size for access doors shall be 24" x16" or full duct size, whichever is less.

G. Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. This will typically require one access door on the bottom and one access door on an accessible side of the duct for sizes 12x12 and smaller.

2.14 GREASE DUCT ACCESS DOORS

A. Provide pre-fabricated and pre-insulated duct access doors by the same manufacturer as the fire resistive duct wrap.

2.15 DUCT TEST HOLES

A. 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.

2.16 AIR BLENDER

A. Furnish and install air blenders as shown on the drawings. Blender shall be factory built and factory tested and installed in strict accordance with the manufacturer's recommendations.

B. Unit shall be completely fixed device capable of providing air temperature within 6ºF of the theoretical mixed air temperature on a plane one diameter downstream at all pressure drops above 0.035" WC. Blender shall be capable of providing effective mixing through full range of flows shown on drawings.

C. Blender shall be fabricated of heavy gauge aluminum with all welded construction.

D. Pressure drop shall not exceed value listed on drawings.

E. Acceptable Manufacturers: Blender Products, Inc.

2.17 DUCT SILENCERS

A. Straight Silencer

1. All silencers shall be factory fabricated by the same manufacturer, except that ‘No-Loss” silencers (thicker than normal double-wall ducts) may be Contractor fabricated.

2. Duct silencers shall have length, air pressure drop, and self-generated sound ratings not to exceed the values scheduled on the drawings. Dynamic insertion ratings shall not be less than those scheduled on the drawings. Silencer inlet and outlet dimensions must match the sizes on the drawings. Transitions are not acceptable unless shown on the drawings.

3. All silencer ratings shall be determined in accordance with the ASTM E477-06a test standard. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

4. Silencers shall be constructed of galvanized steel, have 26 gauge minimum perforated interior (22 gauge for transitional silencers), be able to withstand 8" of positive and 4" of negative pressure, and shall have inorganic, bacteria, and fungus resistant glass fiber filler with not less than 5% compression. Silencers shall meet SMACNA standards for the duct pressure class specified.

5. Fiberglass cloth or other scheduled liners shall completely separate the media from the airstream. No-media silencers shall not contain absorptive packing of any kind.

6. Silencers shall not exceed 25/50 flame spread/smoke developed per ASTM E84, NFPA 255, or UL 723.

7. Acceptable Manufacturers: Vibro-Acoustics, VAW, United McGill, Semco, Ruskin Sound Control (Rink), Dynasonics, Price. All silencers shall be by the same manufacturer.

B. Elbow Silencer

1. All silencers shall be factory fabricated by the same manufacturer, except that 'No-Loss" silencers (thicker than normal double-wall ducts) may be Contractor fabricated.

2. Duct silencers shall have length, air pressure drop, and self-generated sound ratings not to exceed the values scheduled on the drawings. Dynamic insertion ratings shall not be less than those scheduled on the drawings. Silencer inlet and outlet dimensions must match the sizes on the drawings. Transitions are not acceptable unless shown on the drawings

3. All silencer ratings shall be determined in accordance with the ASTM E477-06a test standard. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

4. Silencers shall be constructed of galvanized steel with an 18 gauge galvanized steel outer casing and 22 gauge galvanized perforated steel. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 48 shall have at least two half splitters and one full splitter. Silencers shall be able to withstand 8" of positive and 4" of negative pressure, and shall have inorganic, bacteria, and fungus resistant glass fiber filler with not less than 5% compression. Silencers shall meet SMACNA standards for the duct pressure class specified.

5. Fiberglass cloth or other scheduled liners shall completely separate the media from the airstream. No-media silencers shall not contain absorptive packing of any kind.

6. Silencers shall not exceed 25/50 flame spread/smoke developed per ASTM E84, NFPA 255, or UL 723.

7. Acceptable Manufacturers: Vibro-Acoustics, VAW, United McGill, Semco, Ruskin Sound Control (Rink), Dynasonics, Price. All silencers shall be by the same manufacturer.

2.18 REMOTE VOLUME CONTROL DEVICES

A. Volume control devices shall be supplied with either miter gears or right angle worm gears. Provide all damper shafts, gearboxes, couplings, U-joints, bearings, shafts, offsets, adapters, and adjustable concealed covers as required.

B. When distances, angles, or offsets prevent installing solid rods, the cable control system may be utilized. Provide all damper shafts, rack and pinion gear operator, cables and sleeves, and adjustable ceiling mounting cups.

C. Acceptable Manufacturers: Young Regulator Company, Metropolitan Air Technology.

2.19 DUCTWORK ACCESSORY SEALANTS

A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.

B. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

END OF SECTION

SECTION 23 3413

AXIAL FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vane Axial Fans.

B. Mixed Flow Fans.

1.2 QUALITY ASSURANCE

A. Sound Ratings: Bear the AMCA Certified Rating Seal - Sound and Air Performance.

B. Fabrication: Conform to AMCA 99.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA - HVAC Duct Construction Standards, 1995 Edition.

PART 2 - PRODUCTS

2.1 VANE AXIAL FAN

A. In-line vane axial type, suitable for up to 3" static pressure, non-overloading.

B. Belt drive, adjustable sheaves, drive sized for minimum 130% of motor horsepower. Select drives with operating point near the center of the adjustment range.

C. Externally mounted open drip-proof, ball bearing motor, with adjustable mounts for belt tightening. Motor shall be minimum 1/3 HP.

D. Aluminum air foil blades, heliarc welded to aluminum hub. Dynamically balanced.

E. Discharge straightening vanes welded in place.

F. Aluminum housing with inlet and outlet flanges.

G. Regreasable bearings rated for 40,000 hour B-10 life at the design operating point, with lubrication lines extended outside of the housing.

H. Suitable for horizontal or vertical mounting with removable belt-guard and mounting brackets.

I. Provide inlet and outlet screens when unit is not attached to ductwork or does not have an inlet or outlet cone. Attach screens directly to the fan.

J. Acceptable Manufacturers: Cook, Aerovent, Greenheck, Joy, or New York Blower.

2.2 VANE AXIAL FAN

A. Vane axial fan with enclosure, connecting flanges, drives and motor.

B. Aerodynamically designed air foil cast aluminum blades mounted on streamlined one piece cast aluminum hub.

C. V-belt drive with 1.5 design factor. Key and lock drives and driver sheaves to their shafts. Provide adjustable sheaves for 20 HP and below, and fix sheaves above 20 HP. Contractor shall provide replacement sheaves and belts as required for final air balance.

D. The motor shall be mounted external to the fan on an adjustable base. Refer to Section 23 05 13 for motor requirements.

E. Fans shall have self-aligning, grease-packed, pillow block bearings with a grease seal to prevent loss of lubricant and exclude dirt. Bearings shall absorb all the fan thrust. Extend grease fittings outside the fan. Bearings rated for 200,000 B-10 life at specified operating point.

F. Provide bases or hanger rods to mount the fans complete with vibration isolators as scheduled on the drawings.

G. Balance fans dynamically.

H. Provide inlet and outlet screens where unit is not attached to ductwork or does not have inlet or outlet cones. Attach screens directly to the fan.

I. Provide guard for the portion of the drive belt that is external to the fan.

J. Acceptable Manufacturers: Trane "Model Q", Joy, or Aerovent.

2.3 MIXED FLOW FAN

A. Mixed flow in-line fan with enclosure, connecting flanges, drives and motor.

B. Wheel: Wheel shall be steel, non-overloading, high efficiency mixed-flow type. Contoured single thickness blades shall incorporate 3-D curvature for maximum efficiency across the entire surface of the blade. Blades shall be continuously welded to the backplate and inlet shroud. Hubs shall be keyed and securely attached to the fan shaft. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.

C. Provide fan mounted in either vertical or horizontal arrangement and ceiling or floor mounted as shown on the drawings.

D. V-belt drive with 1.5 design factor. Key and lock drives and driver sheaves to their shafts. Provide adjustable sheaves for 5 HP and below, and fix sheaves above 5 HP. Contractor shall provide replacement sheaves and belts as required for final air balance.

E. The motor shall be mounted external to the fan on an adjustable base. Motor shall incorporate a universal mounting system that allows for field rotation of the motor in 90 degree increments. Refer to Section 23 05 13 for motor requirements.

F. Fans shall have self-aligning, grease-packed, pillow block bearings with a grease seal to prevent loss of lubricant and exclude dirt. Bearings shall absorb all the fan thrust. Extend grease fittings outside the fan. Bearings rated for 200,000 B-10 life at specified operating point

G. Provide hanger rods to mount the fans complete with vibration isolators as scheduled in Section 23 05 48.

H. Balance fans dynamically.

I. Provide inlet and outlet screens where unit is not attached to ductwork or does not have inlet or outlet cones. Attach screens directly to the fan.

J. Provide guard for the portion of the drive belt that is external to the fan.

K. Acceptable Manufacturers: Loren Cook QMX, Greenheck QEI, Twin City QSL.

END OF SECTION

SECTION 23 3413.13
MIXED FLOW LABORATORY EXHAUST FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mixed Flow Fans.

1.2 QUALITY ASSURANCE

A. Performance Ratings: Bear the AMCA Certified Rating Seal - Air Performance and Sound Performance.

B. Fabrication: Conform to AMCA 99.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 204 – Balance Quality and Vibration Levels for Fans

C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

D. AMCA 260 – Laboratory Methods of Testing Induced Flow Fans for Rating

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

G. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

H. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

I. Fans shall be UL and CUL listed per UL 705.

J. SMACNA - HVAC Duct Construction Standards, 1995 Edition.

K. NFPA 45 – Fire Protection for Laboratories Using Chemicals

PART 2 - PRODUCTS

2.1 LABORATORY EXHAUST FANS — MIXED FLOW INDUCED DILUTION TYPE

A. Acceptable Manufacturers: Strobic Air, Greenheck.

B. Impellers shall be mounted directly to the motor shaft to provide a direct drive arrangement 4 type fan arrangement 2 type fan. Motors shall be isolated from the primary exhaust airstream and shall be visible and accessible from the fan exterior for inspection and service.

C. Mixed flow impellers shall consist of combination axial/backward curved blades and shall be of welded steel construction. The impellers shall have non-stall and non-overloading characteristics with stable operation at any point on the fan curves.

D. Stationary discharge guide vane sections shall be provided to increase fan efficiencies.

E. Dynamically balance to Level BV-3 per AMCA 204.

F. Fan assemblies shall be designed for mounting on conventional roof curb without the need for guy wire supports.

G. Fan and all drive components shall have a minimum bearing life of L_{10} = 100,000 hours.

H. Fan shall be constructed to AMCA "C" standards with a nonferrous inlet bell provided to reduce sparking in the event of a motor bearing failure.

I. Fan and mixing box systems supplied by the manufacturer must have a footprint as shown on the drawings / schedule. Exhaust systems with larger footprints are not acceptable.

J. Maintenance shall only be required on a minimum of 18-month intervals. This maintenance shall be limited to re-greasing of the motor bearings.

K. Entrainment wind bands shall provide secondary induction of outside air. Induction shall take place downstream of the fan impeller and shall not influence BHP or static pressure requirements. Wind bands shall discharge at least _____ % of design flow rates. The manufacturer shall publish discharge volumes for all fans at specified exhaust flow.

L. Fans shall be modular construction and capable of being assembled on the roof.

M. PTFE gaskets shall be provided at all companion flanged joints.

N. Fasteners shall be 316 stainless steel.

O. A bolted access door shall be provided for impeller inspection on each fan.

P. Fans and accessories shall have internal drain systems to prevent rain water from entering building duct system.

Q. Electric motors shall be TEFC Mill & Chemical duty with a 1.15 service factor. Motors shall meet performance and shaft grounding requirements of Section 23 05 13.

R. A NEMA 3R non-fused disconnect switch shall be provided, mounted and wired to the motor.

S. Coating: All steel and aluminum surfaces shall be prepared for coating by blasting or chemical etching. Coating shall be 6 to 10 mils thick for protection against weather, chemical vapors and splashes.

T. Custom Inlet Mixing Plenum:

1. Inlet mixing plenums shall be provided by the fan manufacturer. Each plenum shall be sized to support the weight and performance requirements of the number of fans listed on the schedule. Multiple fan plenums shall be double wall construction with structural stiffeners or shall be continuously welded heavy gauge single wall construction. All plenums shall be capable of supporting the fan(s) without guy wires or supports. The plenums shall include hinged access doors and safety screens over primary air inlets. The primary air inlets shall be located on the bottom or side as noted on construction drawings. Coatings shall be the same as specified for the fans. Unless otherwise specified, plenums shall be suitable for mounting on roof curbs.

2. Bypass dampers shall be provided with plenums for mixing outside air with primary exhaust. Refer to Section 23 09 00 damper requirements.

    a. Bypass dampers shall be provided custom mounted on the side of the plenum.

    b. Bypass dampers shall be sized for VAV operation. Refer to drawings for maximum bypass flow rate.

    c. Bypass dampers shall be controlled by 24V electric operators.

3. Plenums shall be provided with a jib crane mounting bracket.

U. Extended motor lube lines of PTFE tubing covered with braided stainless steel shall be provided. Extended lube lines shall be mounted to a bracket located on the fan housing, with grease relief fittings on each line.

V. The static pressure shown in the schedule is based on the static pressure requirements at the inlet to the mixing box and does not include any losses of equipment provided by the fan manufacturer. All losses for the equipment provided by the fan manufacturer shall be detailed in the fan manufacturer's submittal.

W. Low leakage isolation dampers shall be constructed of aluminum airfoil extrusions and shall have a chemical resistant coating (6 to 10 mils). Operators shall be 2-position, spring return and shall be 24V electric. Electric operators shall be factory wired (via a transformer when required) to the fan disconnect switch to open when the fan is energized and close via a spring return when de-energized. When the fan ships separate from the plenum, all wiring and conduit shall be factory supplied for easy connection in the field.

X. Vortex breakers shall be provided on all side-inlet and multiple fan plenums.

Y. The inlet sound power shall be a maximum of _____ LwA, and the outlet sound power shall be a maximum of _____ LwA.

Z. Acoustical silencer nozzle shall be designed as an integral component of the exhaust fan discharge nozzle and shall not increase the height of the overall assembly.

1. The maximum air pressure drop shall be 0.1" W.C. when installed, and all associated losses shall be included in the fan performance curve.

2. The silencer shall be constructed with an outer shell of fiber reinforced plastic with a minimum of 3/16" wall thickness. The inner liner shall be perforated corrosion resistant steel. The silencer shall be colored to match the fans. Acoustic media shall be 3 LB/CF density fiberglass isolated from the airstream by a Tedlar film, non-fibrous acoustical media.

AA. A galvanized steel roof curb shall be provided to support the fans/plenums. The curb shall be fabricated from minimum 14 gauge galvanized sheet metal. The curb shall include minimum 1.5 inch, 3 LB/CF density rigid fiberglass insulation and a wood nailer.

END OF SECTION

SECTION 23 3416
CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Airfoil Centrifugal Fans.

B. Plenum Fans.

C. Utility/Vent Sets.

D. Fume Exhaust Fans.

E. In-line Centrifugal Fans.

F. Cabinet Fans.

1.2 QUALITY ASSURANCE

A. Sound Ratings: Bear the AMCA Certified Rating Seal - Sound and Air Performance.

B. Fabrication: Conform to AMCA 99.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA - HVAC Duct Construction Standards, 1995 Edition.

PART 2 - PRODUCTS

2.1 AIRFOIL CENTRIFUGAL FANS

A. Double width, double inlet non-overloading centrifugal fan with airfoil blades.

B. Heavy gauge steel plate housing, continuously welded, reinforced with inverted angles.

C. Flanged discharge collar drilled or punched at uniform intervals. Continuously weld flange to the fan housing.

D. Inspection door with waterproof gasketing.

E. 1-1/2" NPT drain with plug, continuously welded to lowest point of the scroll.

F. Deep contoured, spun or die-formed inlet cones.

G. Die formed, airfoil blades with moisture relief holes in the trailing edge. Formed from a single sheet of steel and welded at the trailing edge. Continuously weld blades to rim and bolt wheel to hub. Dynamically balanced.

H. Spun steel shroud. Cast iron hub with oversize flange, keyed to shaft.

I. ANSI 1040 or 1045 cold rolled solid steel shaft, accurately turned, ground and polished. Shaft shall be a constant diameter.

J. Shaft shall be straightened before and after cutting the keyways to maintain a maximum T.I.R. of 0.002".

K. First shaft critical speed at least 20% above maximum AMCA class speed.

L. Ball or roller bearings, grease packed or oil reservoir type.

M. Bearing B-10 life of at least 200,000 hours at specified operating conditions.

N. Extend lubrication lines beyond belt guards.

O. Inlet screens shall be minimum 8 gauge welded wire bolted to the fan for easy removal. Screens shall comply with OSHA opening size regulations.

P. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.

Q. V-belt drive selected for 1.5 times the brake horsepower. Adjustable pitch sheaves for 20 HP and below. Fixed sheaves above 20 HP. Contractor shall provide replacement sheaves and belts for final air balancing.

R. Mount fan and motor on a common vibration isolation base.

S. Install removable belt guard with shaft holes for tachometer. Construct from expanded metal or heavy gauge wire mesh with minimum 70% free area.

T. Fans shall operate with variable speed drives. Balance fans to operate at all speeds from zero RPM to full design speed. Motors shall be "Variable Frequency Drive rated" when controlled by VFDs. Refer to Section 23 05 13.

U. Acceptable Manufacturers: Aerovent, Twin City, Greenheck, Chicago Blower, Cook, Peerless, or PennBarry Blower.

2.2 AIRFOIL PLENUM FANS

A. Single width, single inlet non-overloading centrifugal fan with airfoil blades.

B. Deep contoured, spun or die-formed inlet cone.

C. Die formed, airfoil blades with moisture relief holes in the trailing edge. Formed from a single sheet of steel and welded at the trailing edge. Continuously weld blades to rim and bolt wheel to hub. Dynamically balanced.

D. Cast iron hub with oversize flange, keyed to shaft.

E. ANSI 1040 or 1045 cold rolled solid steel shaft, accurately turned, ground and polished. Shaft shall be a constant diameter.

F. Shaft shall be straightened before and after cutting the keyways to maintain a maximum T.I.R. of 0.002".

G. First shaft critical speed at least 20% above maximum AMCA class speed.

H. Ball or roller bearings, grease packed or oil reservoir type.

I. Bearing B-10 life of at least 200,000 hours at specified operating conditions.

J. Extend lubrication lines beyond belt guards.

K. Provide inlet screen. Inlet screen shall be bolted to the fan for easy removal. Screens shall comply with OSHA opening size regulations.

L. Provide safety screen enclosure around fan wheel. Enclosure shall be expanded metal screen bolted to heavy steel frame.

M. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.

N. V-belt drive selected for 1.5 times the brake horsepower. Adjustable pitch sheaves for 20 HP and below. Fixed sheaves above 20 HP. Contractor shall provide replacement sheaves and belts for final air balancing.

O. Mount fan and motor on a common vibration isolation base.

P. Install removable belt guard with shaft holes for tachometer. Construct from expanded metal or heavy gauge wire mesh with minimum 70% free area.

Q. Fans shall operate with variable speed drives. Balance fans to operate at all speeds from zero RPM to full design speed. Motors shall be "Variable Frequency Drive rated" when controlled by VFDs. Refer to Section 23 05 13.

R. Acceptable Manufacturers: Aerovent, Twin City, Greenheck, Chicago Blower, Cook, Peerless, or PennBarry Blower.

2.3 UTILITY BLOWER

A. Single inlet, single width. Forward or backward inclined wheel as shown on the drawings.

B. Arrangement 10 with motor below shaft.

C. Steel or aluminum construction with baked enamel finish.

D. Adaptable to any of 8 discharge positions in the field.

E. Suitable for ambient temperatures from -40ºF to +120ºF.

F. Motor per the drawings and Section 23 05 13.

G. Regreasable bearings rated for 40,000 hour B-10 life at specified operating point.

H. Furnish factory mounted and wired disconnect switch, non-fusible type with thermal overload protection.

I. Adjustable pitch sheaves with the specified operating point in the center of adjustment range. Sized for minimum 1.2 of motor horsepower.

J. Belt guards with tachometer knockouts on indoor fans. Removable weather covers on outdoor fans.

K. Acceptable Manufacturers: Twin City, Aerovent, Greenheck, Cook, Trane, ACME, or PennBarry Blower.

2.4 FUME EXHAUST FAN (300-20,000 CFM & 0-8" STATIC PRESSURE)

A. Single inlet, single width.

B. Arrangement 10 with motor below shaft.

C. Heavy gauge steel all welded construction (14 gauge min. sides), adaptable to any of 8 discharge positions in the field.

D. Suitable for exhaust streams from -40º to +200ºF and ambient temperatures from -40º to +120ºF.

E. Non-overloading horsepower characteristic. Stable performance from closed-off to wide-open at all speeds.

F. Lifting eyes.

G. 14 gauge minimum inlet collar, flanged outlet connection.

H. Belts and sheaves sized for a minimum 1.3 of motor horsepower.

I. Motor per the drawings and Section 23 05 13.

J. AMCA Type B spark resistant construction including aluminum wheel and non-ferrous shaft closure plate.

K. Regreasable bearings rated for 100,000 hour B-10 life at specified operating point.

L. Heavy-duty gas-tight shaft seals.

M. Backward inclined airfoil wheels suitable for handling fumes and gases at minimum noise levels, or backward inclined flat blades suitable for handling particulates. Refer to drawings for type required.

N. Furnish factory mounted and wired disconnect switch, non-fusible type with thermal overload protection in a NEMA 3R enclosure.

O. All surfaces in contact with the airstream shall be cleaned with solvent equal to Heresite 330 and given three 2 mil minimum thickness coats of air dried phenolic equal to Heresite VR-500 baked phenolic equal to Heresite P-403. Coat entire face of all flanges and entire length of inlet collars on both sides.

P. Adjustable pitch sheaves with the specified operating point in the center of adjustment range, anti-static type belts.

Q. Positive screw-type belt tensioning mechanism.

R. Factory tested before shipment.

S. Belt guards with tachometer knockouts on indoor fans. Removable weather covers on outdoor fans.

T. 1" drain connections in housing bottoms.

U. Lever operated access door near top of scroll for wheel inspection.

V. Acceptable Products: Aerovent 'BI' or 'BIA', Twin City 'BC', or Cook ‘CA’.

2.5 SMALL FUME EXHAUST FAN (0-300 CFM AND 0-8" STATIC PRESSURE)

A. Fan shall have identical features and construction as "Fume Exhaust Fan" with the following exceptions:

1. Flanged rectangular or 14 gauge minimum circular outlet.

2. Backward inclined or radial flat bladed wheel.

3. Arrangements 9 and 10 are acceptable.

B. Acceptable Products: Aerovent 'PB8A', Cook IMH, or Twin City ‘JRW’.

2.6 PERCHLORIC ACID FUME EXHAUST FAN

A. Fans shall be identical to "Fume Exhaust Fans" except for the following requirements:

1. 1" fan housing drain connection - 316L stainless steel or coated inside and out.

2. Install a spray nozzle in the fan housing for washdown.

3. Apply coatings after openings are made to insure coverage of all surfaces.

4. Flanged inlet.

5. All grease shall be fluorocarbon type.

2.7 HIGH TEMPERATURE FUME EXHAUST FAN (OVER 200ºF)

A. Fans shall be identical to "Fume Exhaust Fans" with the following exceptions:

1. Ceramic felt shaft seal suitable to 650ºF exhaust gas (not gas-tight).

2. 316SS wheel and shaft closure plate (not spark resistant).

3. Heat slinger with guard and accessories as needed for exhaust gases to 600ºF.

4. All surfaces in contact with the airstream constructed of Type 316SS.

5. No interior coating.

2.8 IN-LINE CENTRIFUGAL FAN

A. Galvanized steel construction with stainless steel or cadmium plated fasteners and galvanized steel belt guard.

B. Backward inclined, non-overloading, all aluminum wheel and hub. Dynamically balanced.

C. Cast iron, adjustable pitch sheaves. V-belt drive sized for 1.5 of maximum horsepower. Operating point near center of adjustment range.

D. Screw adjustment belt tightener.

E. Regreasable bearings rated for 40,000 hour B-10 life at specified operating point. Extend lubrication lines outside of housing.

F. Steel mounting brackets suitable for any mounting position.

G. Motor per the drawings and Section 23 05 13. Minimum 1/3 HP motors for all fans.

H. Factory installed and wired disconnect switch.

I. Acceptable Manufacturers: Jenco Fan, Carnes, Cook, PennBarry or Greenheck.

2.9 CABINET FANS

A. Housing:

1. Heavy gauge steel reinforced and braced with steel angle framework.

2. Cleaned, phosphatized and painted with enamel or constructed entirely of galvanized steel.

3. Removable access panels for fan removal.

4. Insulate fan section interior with 1" thick, 3/4 lb. density fiberglass.

5. Insulated, corrosion-resistant drain pan under fan sections.

6. Minimum 12" x 18" hinged access doors on both sides of fan housing.

B. Fan:

1. Double width, double inlet, forward curved centrifugal, dynamically balanced.

2. Grease lubricated ball bearings, rated for 200,000 hours L-50 life at design operating conditions.

3. Extend lubrication lines for all bearings to an easily accessible location.

4. OSHA belt guards with openings for tachometer readings.

C. Motors and Drives:

1. Motor shall have slide rails, adjusting screws, anchor bolts and bedplates.

2. Adjust motor mounting bracket for tightening belts.

3. Open drip-proof motors with grease lubricated bearings, minimum 1/3 HP. Motors on variable frequency drives shall be VFD rated. Refer to Section 23 05 13.

4. V-belt drives with adjustable pitch sheaves for units 20 HP and below, fixed sheaves for larger units. Contractor shall provide replacement sheaves and belts for air balancing of the unit.

5. Furnish factory mounted and wired disconnect switch, non-fusible type with thermal overload protection.

D. Acceptable Manufacturer: Greenheck, Cook, Aerovent.

END OF SECTION

SECTION 23 3423
POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Roof Exhaust Fans.

B. Rooftop Fan Curbs.

C. Wall Exhausters.

D. Propeller Fans.

E. Room Exhaust Fan.

F. In-Line Cabinet Fan.

G. Ceiling Fans.

H. HVLS (High Volume Low Speed) Ceiling Fans.

1.2 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

E. NFPA-13 – The Standard for Sprinkler Installation.

F. SMACNA - HVAC Duct Construction Standards, 1995 Edition.

PART 2 - PRODUCTS

2.1 ROOFTOP EXHAUST FAN - BELT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. All steel parts galvanized or epoxy coated. Non-corrosive fasteners.

E. V-belt drive with adjustable pitch drive sheave and adjustable motor mountings for belt tensioning.

F. Motor mounted outside of air stream and ventilated with outside air. Motor not less than 1/3 HP.

G. Aluminum or brass bird screen. Plastic mesh will not be allowed.

H. Disconnect provided by Electrical Contractor.

I. Furnish normally closed, electric motorized damper. Provide step down transformer if required. Install and wire damper to open when fan runs.

J. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq. ft @1" SP (or shall be AMCA Class 1 certified). Leakage shall not exceed 10 cfm/sq. ft @1" SP (or shall be AMCA Class 1 certified).

K. Permanently lubricated, permanently sealed, self-aligning ball bearings.

L. Furnish permanently lubricated sealed ball type motor and drive shaft bearings sized for 200,000 hours life at specified operating conditions. Drives sized for 150% of rated motor horsepower. Drive assembly and wheel supported by vibration isolators.

M. Acceptable Manufacturers: Aerovent "FACX", Cook "ACE-B", Greenheck "GB", Carnes "VEB", PennBarry DX, ACME PV, or ILG CRB, Twin City BCRD.

2.2 ROOFTOP EXHAUST FAN - DIRECT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. All steel parts galvanized or epoxy coated. Non-corrosive fasteners.

E. Direct drive, motor mounted outside of air stream and ventilated with outside air.

F. Aluminum or brass bird screen. Plastic mesh will not be allowed.

G. Disconnect provided by Electrical Contractor.

H. Furnish solid-state dial speed controller. Mount and wire inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.

I. Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs.

J. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq. ft @1" SP (or shall be AMCA Class 1 certified). Leakage shall not exceed 10 cfm/sq. ft @1" SP (or shall be AMCA Class 1 certified).

K. Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.

L. Acceptable Manufacturers: Aerovent "FACX", Cook "ACE-D", Greenheck, ILG – CRD, ACME PX, PennBarry DX, Carnes, Twin City DCRU, Jenco.

2.3 ROOFTOP EXHAUST FAN - VERTICAL DISCHARGE - BELT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backwards inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. V-belt drive with adjustable pitch drive sheave and adjustable motor mountings for belt tensioning.

E. Motor mounted outside of air stream and ventilated with outside air. Motor not less than 1/3 HP.

F. Aluminum or brass bird screen. Plastic mesh will not be allowed.

G. Disconnect provided by Electrical Contractor.

H. Furnish permanently lubricated sealed ball type motor and drive shaft bearings sized for 200,000 hours life at specified operating conditions. Drives sized for 150% of rated motor horsepower. Drive assembly and wheel supported by vibration isolators.

I. Include ventilated curb cap and hinged base with restraining means.

J. Furnish normally closed, electric motorized damper. Furnish step down transformer if required. Install and wire damper to open when fan runs.

K. All fans serving range hoods shall have extended shrouds to discharge at least 40" above roof and built-in grease trough with drain.

L. Acceptable Manufacturers: ACME, Cook, Greenheck, PennBarry, Twin City, Jenco.

2.4 ROOFTOP FAN CURBS

A. Furnish and install prefabricated roof curbs for all rooftop fans.

B. Size curb to match the curb cap of fan.

C. Top of all curbs shall be at least 12" above the top of the roof. Increase curb height to allow for roof insulation.

D. Unitized construction, continuous arc welded corner seams. Insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board. Damper support angle. Pressure treated wood nailer.

E. If called for in the drawings, curbs shall be of the sound attenuation type. Sound attenuation curbs shall reduce the fan sone rating by at least 40% and not decrease fan cfm more than 8% (which is accounted for in the scheduled fan cfm). Baffles shall be removable for access to the dampers.

F. 18-gauge galvanized steel construction.

G. Curb without cant.

H. Acceptable Manufacturers: Same manufacturer as the fan, Pate, RPS or Thy.

2.5 WALL EXHAUST FAN - BELT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. All steel parts galvanized or epoxy coated. Non-corrosive fasteners.

E. V-belt drive with adjustable pitch drive sheave and adjustable motor mountings for belt tensioning.

F. Motor mounted outside of air stream and ventilated with outside air. Motor not less than 1/3 HP.

G. Aluminum or brass bird screen. Plastic mesh will not be allowed.

H. Disconnect provided by Electrical Contractor.

I. Furnish normally closed, electric motorized damper. Provide step down transformer if required. Install and wire damper to open when fan runs.

J. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq. ft @1” SP (or shall be AMCA Class 1 certified). Leakage shall not exceed 10 cfm/sq. ft @1” SP (or shall be AMCA Class 1 certified).

K. Acceptable Manufacturers: ACME, Carnes, Cook, Greenheck, PennBarry, Jenco.

2.6 WALL EXHAUST FAN - DIRECT DRIVEN

A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.

B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.

C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

D. All steel parts galvanized or epoxy coated. Non-corrosive fasteners.

E. Direct drive, motor mounted outside of air stream and ventilated with outside air.

F. Aluminum or brass bird screen. Plastic mesh will not be allowed.

G. Disconnect provided by Electrical Contractor.

H. Furnish solid-state dial speed controller. Mount and wire inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.

I. Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs.

J. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq. ft @1" SP (or shall be AMCA Class 1 certified). Leakage shall not exceed 10 cfm/sq .ft @1" SP (or shall be AMCA Class 1 certified).

K. Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.

L. Acceptable Manufacturers: Aerovent "FACX" Cook "ACE-D", Greenheck, ILG – CRD, ACME PX, PennBarry DX, Carnes, Jenco.

2.7 PROPELLER FANS

A. Belt-driven or direct-driven as scheduled propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

B. Galvanized steel sheet, all welded, and integral Venturi orifice ring with baked-enamel finish coat applied after assembly.

C. Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Cast-aluminum blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Provide galvanized steel motor-side back guard complying with OSHA specifications, removable for maintenance.

F. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

G. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

H. Shaft Bearings: Permanently lubricated, L_{10} of 100,000 hours, permanently sealed, self-aligning ball bearings.

I. Motor Sheaves: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select sheave so pitch adjustment is at the middle of adjustment range at fan design conditions.

J. Belts: Oil resistant, non-sparking, and anti-static; matched sets for multiple belt drives.

K. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

L. Provide with the following accessories:

1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.

2. Wall Sleeve: Galvanized steel to match fan and accessory size.

3. Weather Hood: Galvanized steel to match fan and accessory size.

4. Weather Front Guard: Galvanized steel with expanded metal screen.

5. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

M. Acceptable Manufacturers: Aerovent, Cook, Greenheck, ACME, PennBarry, Carnes.

2.8 ROOM EXHAUST FAN

A. Fiberglass lined sheet metal housing.

B. Rubber torsion motor mounts.

C. Plug type disconnect.

D. Built-in backdraft damper.

E. Centrifugal fan.

F. Molded white plastic or aluminum ceiling grille.

G. Provide variable speed controller if called for on the drawings.

H. Acceptable Manufacturers: ACME, Broan, Carnes, Cook, Jenco, PennBarry, Greenheck, Panasonic.

2.9 IN-LINE CABINET FAN

A. Fiberglass lined, sheet metal housing, arranged for in-line installation.

B. Rubber torsion motor mounts.

C. Plug type disconnect.

D. Built-in backdraft damper.

E. Centrifugal fan.

F. Provide variable speed controller if shown on the drawings.

G. Acceptable Manufacturers: ACME, Broan, Carnes, Cook, Jenco, PennBarry, Greenheck.

2.10 CEILING FANS (CF-1)

A. Ceiling mounted fan with enclosed motor, three or four blades and mounting accessories.

B. Housing: Aluminum suspended with hanger bracket and pivot ball. Standard hugger or 5.5” 24” 36” x 1” OD steel pipe extension kit.

C. Motor: Energy efficient fixed-stator with copper windings, steel laminated core, and internal thermal overload protection.

D. Blades: Aerodynamically contoured aluminum, matched in weight.

E. Balance: Components balanced to prevent wobble or vibration.

F. Provide full coverage fan guard to totally enclose blades.

G. Unit shall be vapor tight for installation in damp locations.

H. Acceptable Manufacturer: Leading Edge, Nutone, Hunter, MacroAir Aeratron.

2.11 HVLS (HIGH VOLUME LOW SPEED) - 6 OR 8-BLADE CEILING FANS (CF-2)

A. Ceiling mounted, 8ft 10ft 12ft 14ft diameter fan, with enclosed motor, eight blades, and mounting accessories.

B. Housing: Die cast aluminum with ventilation air space and permanently sealed ball bearings. Suspended with rubber isolated shackle, 3ft steel pipe, and steel yoke connection to housing. Electrostatically applied white epoxy enamel finish.

C. Motor: Energy efficient fixed-stator with copper windings, steel laminated core, and internal thermal overload protection.

D. Blades: Anodized airfoils with winglets, matched in weight.

E. Extension Tube: Minimum 3ft long

F. Color: White motor housing; anodized airfoils with silver trim.

G. Balance: Components balanced to prevent wobble or vibration.

H. Accessories: Wired wall speed controller; internal automatic fire sprinkler relay. If the manufacturer does not provide relay, the supplying contractor shall include relay.

I. Electrical: 120V, 1ø, 60 Hz, 10 amp wired wall controller; connect with 10v CAT5 cable.

J. Sound: <35dBA

K. Acceptable Manufacturer: Big Ass Fan – Essence, MacroAir AVD3 or AVD 370.

2.12 HVLS (HIGH VOLUME LOW SPEED)- 10-BLADE CEILING FANS (CF-3)

A. Ceiling mounted fan, 16ft 18ft 20ft diameter, with enclosed motor, 10 blades, and mounting accessories.

B. Housing: Die cast aluminum with ventilation air space and permanently sealed ball bearings. Suspended with rubber isolated shackle, 3ft steel pipe, and steel yoke connection to housing. Electrostatically applied white epoxy enamel finish.

C. Motor: Energy efficient fixed-stator with copper windings, steel laminated core, and internal thermal overload protection.

D. Blades: Anodized airfoils with winglets, matched in weight.

E. Extension Tube: Minimum 3ft long

F. Color: White motor housing; anodized airfoils with silver trim.

G. Balance: Components balanced to prevent wobble or vibration.

H. Accessories: Wired wall speed controller; internal automatic fire sprinkler relay. If the manufacturer does not provide relay, the supplying contractor shall include relay.

I. Electrical: 120V, 10, 60 Hz, 10 amp wired wall controller; connect with 10v CAT5 cable.

J. Sound: <35dBA

K. Acceptable Manufacturer: Big Ass Fan – Element, MacroAir AVD3 or AVD 550/780.

END OF SECTION

SECTION 23 3514
DUST COLLECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Centrifugal Fans.

B. Ductwork Accessories.

C. Inlet Fittings.

D. Dust Elimination and Collection Devices.

1.2 QUALITY ASSURANCE

A. Fans:

1. Performance Ratings: Bear the AMCA Certified Rating Seal for Air Performance.

[***OR*****]**

2. Sound Ratings: Bear the AMCA Certified Sound Rating Seal for Sound and Air Performance.

3. Fabrication: Conform to AMCA 99.

1.3 REFERENCES

A. ACGIH - Industrial Ventilation, A Manual of Recommended Practice.

B. ASTM A569 - Steel, Carbon (0.15 Maximum Percent), Hot-rolled Sheet and Strip, Commercial Quality.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating purposes.

E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

F. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

G. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Sheet Articles.

H. ASTM A167 - Stainless and Heat-resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

I. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

J. ASTM A527 - Steel Sheet, Zinc Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

K. PS 15 - Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment.

L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

M. SMACNA - Round Industrial Duct Construction Standards.

N. SMACNA - Rectangular Industrial Duct Construction Standards.

O. UL 181 - Factory-Made Air Ducts and Connectors.

P. UL 214 - Tests for Flame-Propagation of Fabrics and Films.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS

A. Performance: Based on sea level _____ conditions.

1. Air Flow: _____ cfmat _____ inch WG external static pressure.

2. Motor: _____ hp, _____ volt, single three phases, 60 Hz.

3. Refer to Fan Schedule. Ratings per AMCA 210. Sound ratings per AMCA 301.

B. Wheel and Inlet:

1. Backward Inclined: Steel construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded to flange and back plate; cast iron hub riveted to back plate and keyed to shaft with set screws.

2. Radial: Steel construction with inlet flange, heavy reinforced back plate, plate blades with reinforcing gussets and wearing strips welded or riveted to back plate and flange; cast iron hub riveted to back plate and keyed to shaft with set screws.

C. Housing: Heavy gauge steel, continuously welded with inlet bell and shaped cut-off, factory finished with enamel or prime coat. Provide bolted construction with horizontal flanged split housing.

D. Motors and Drives:

1. Motors: As specified in Section 23 05 13.

2. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated, ball or roller type.

3. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil.

4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed; variable and adjustable pitch for motors 15 HP and under; fixed sheaves for larger motors; matched belts; and rated minimum 1.5 times nameplate rating of motor.

5. Belt Guard: Fabricate to SMACNA HVAC Standards; of 12 gauge, 3/4 inch diamond mesh wire screen welded to steel angle frame, prime coated.

E. Accessories:

1. Fixed Inlet Vanes: Steel construction with fixed cantilevered inlet guide vanes welded to inlet bell.

2. Adjustable Inlet Vanes: Steel construction with blades supported at both ends cantilevered with two permanently lubricated bearings, variable mechanism out of air steam terminating in single control lever with control shaft for double width fans and locking quadrant.

3. Discharge Dampers: Parallel Opposed blade heavy duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.

4. Inlet/Outlet Screens: Galvanized steel welded grid.

F. Acceptable Manufacturers: _____, _____, or _____.

2.2 DUCTWORK AND ACCESSORIES

A. Materials:

1. Galvanized Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, G90zinc coating, conforming with ASTM A90. G60galvanizing is not acceptable.

2. Steel Ducts: ASTM A569 carbon steel.

3. Stainless Steel Ducts: ASTM A167, Type 304 316.

4. Glass Fiber Reinforced Plastic Ducts: NBS Voluntary Product Standard PS 15, UL 181, _____.

B. Ductwork:

1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible 2 _____ Pressure Class Round Industrial Duct Construction Standard and Rectangular Industrial Duct Construction Standard and ACGIH Industrial Ventilation Manual except as indicated.

2. Interior of all ducts shall be smooth and free from obstructions with all joints sealed airtight.

3. Construct ducts of riveted galvanized steel. Ducts 18 inches and under shall be 22 gauge; larger ducts shall be 18 gauge. Spiral ductwork may be used of equivalent gauge.

4. Elbows, fittings and hoods shall be of continuously welded 18 gauge. Prime coat welded joints.

5. Lapped and riveted longitudinal joints on three inch centers or double locked seams may be used. Solder all longitudinal joints.

6. Make girth joints with 1 inch inner lap in direction of airflow. Use couplings for spiral ducts. Install joints with the Thermo-Fitshrinking Band System by Raychem Corp. Screws are not permitted.

7. Elbows and angles shall have inside radius of two duct diameters. Construct elbows under 6 inches and smaller of five sections and larger elbows of seven sections. Prefabricated elbows of smooth construction may be used.

8. Connect duct to fan with split sleeve drawband. Inlet to fan shall have a minimum of 2 diameters of straight duct.

9. Flexible Connectors: UL 214 listed, fire-retardant chloroprene or chlorosulfonated polyethylene impregnated fabric, minimum density 20 36 oz. per sq. yd., approximately 2 3 6 inches wide, crimped into metal edging strip.

10. Taper all transitions in mains and submains. Taper shall be 5 inches long for each 1 inch change in diameter.

11. All branches shall enter the main at the large end of transitions at an angle not over 30º. Connect branches only to the top or sides of main with no two branches entering diametrically opposite.

12. Provide dead-end cap within 6 inches from last branch of all mains and submains.

13. Provide access openings or cleanouts every 10 feet and near each elbow, angle or duct junction in horizontal sections.

14. Support ducts sufficiently to place no load on connecting equipment and to carry weight of system if plugged with sawdust. Support every 12 feet for 8 inches and smaller ducts; support every 20 feet for larger ducts.

15. Angle Rings: Carbon steel, unpainted, leg out, drilled with bolt holes.

16. Blast Gates: All outlets, unless shown otherwise on the drawings shall have manual sliding cut-off gates. Half Full collar of cast aluminum steel, with galvanized steel slide, set screw.

17. Flat Back Elbows: Long radius rectangular elbow with heavy gauge, removable, stainless steel rubber lined _____ back strip.

18. Ball Joints: Cast iron Spun galvanized steel with tubular studs for connecting ducts, allowing 25º angle off center.

19. Final connections shall be made to all equipment hoods using flexible duct not over 3'-0" long. Design flexible duct for material handling with wire reinforced spiral system capable of withstanding a negative pressure of 10 inches WC.

2.3 INLET FITTINGS

A. Provide a hood for each machine to which an exhaust connection is made, custom built for the machine on the job. Floor sweeps shall be air-tight when the damper is closed.

B. Fabricate of minimum 16 gauge _____ galvanized carbon stainless steel.

C. Fabricate inlet for _____ to detail indicated on the drawings ACGIH ACGIH Industrial Ventilation Manual detail print number _____ indicated in the Schedule.

D. Fabricate with hemmed edges, closed corners, and reinforced for span and attachment; with duct connection; prime coated enameled finish.

E. Hoods shall be free of sharp edges or burrs and reinforced for necessary stiffness.

2.4 FILTER SEPARATOR

A. Indoor dust collector consisting of frame, casing, filters, fan and accessories.

B. Frame and Casing: Steel frame with enamel finish, 16 18 gauge galvanized steel panels, ___ x ___ inch floor area, ___ cubic feet dust storage capacity bin bags.

C. Filter: Polyester _____ fabric filters, 12_____ ounces/sq. yd. density, _____ square feet filter area, 99.9 _____ percent dust spot efficiency.

D. Fan: Welded construction centrifugal fan with material handling wheel, direct drive.

1. Capacity: _____ cfmat _____ inch WG static pressure.
2. Motor: _____ hp, _____ volt, single three phase, 60 Hz.

E. Accessories: Manual shaker Powered shaker Differential static pressure gauge Discharge silencer Push Button control panel with motor starter.

F. Acceptable Manufacturers: _____ , _____ , or _____ .

2.5 CENTRIFUGAL SEPARATOR

A. Cyclone dust collector consisting of cyclone with integral fan and structural stand incorporating dust storage.

B. Frame and Casing: Steel frame with enameled finish, 16 gauge _____ structure with 18 gauge _____ panels and 20 gauge _____ cyclone, _____ cubic feet dust storage capacity.

C. Cyclone Efficiency: 99 84 _____ percent of steel grindings sawdust baking flour cornstarch _____.

D. Fan: Welded construction centrifugal fan with material handling wheel, direct drive.

1. Capacity: _____ cfmat _____ inch WG static pressure.
2. Motor: _____, _____ volt, single three phase, 60 Hz.

E. Accessories: Discharge silencer Push Button control panel with motor starter.

F. Acceptable Manufacturers: Aget Manufacturing, Donaldson Torit, American Air Filter.

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Duct Variable Air Volume Terminal Box.

B. Double Wall Single Duct Variable Air Volume Terminal Box.

C. Dual Duct Variable Air Volume Terminal Box.

D. Fan Powered Variable Air Volume Terminal Box.

1.2 REFERENCES

A. NFPA 70 - National Electric Code.

B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

C. UL 181 - Factory-Made Air Ducts and Connectors.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)

A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8" 20-lb. density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined. Acoustical considerations shall take priority over sizes noted in schedule. Noise in classrooms shall not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002.

2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. 16 gauge aluminum housing with internal components of aluminum and stainless steel.

B. Nylon bushings at moving parts.

C. Venturi configuration for smooth variations in airflow.

D. Pressure independent operation without means of external monitoring devices. Box shall maintain constant volume at all flow rates regardless of changes in upstream or downstream static pressure.

E. Factory calibrate all boxes for the maximum and minimum cfm scheduled on the drawings. Settings shall be field adjustable by means of an external calibrated dial.

F. Damper operators and relays shall be pneumatic, factory mounted, suitable for use with two pipe controls, furnished by the box manufacturer.

G. Box manufacturer shall factory mount all controls and relays to provide "V-Cycle" controls.

H. Boxes shall be gasketed for 100% shutoff capabilities, unless noted otherwise on the drawings.

I. Box shall be fully wrapped with 1-1/2”, 1.0 lb./cu. ft. density fiberglass insulation, with foil scrim Kraft facing, in the factory.

J. Box shall be capable of controlling with a 1.0” to 6.0” WG pressure drop.

K. Spring ranges and/or failure positions shall be as listed on the drawings or in the Controls section of these specifications.

L. Refer to control diagrams and notes on control drawings for complete sequence of control.

M. Acceptable Manufacturers: Air Precision Device, VAV Venturi Corporation, M & I Air System, Enviro-Tec, Johnson Controls Inc.

2.3 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. Casing: Minimum 22 gauge galvanized steel. Fully lined with minimum 1”, minimum 1-1/2 pound density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements.

B. All insulation in contact with the air stream shall be foil faced, UL listed and NFPA 90A approved.

C. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.

D. Damper Operators: Pneumatic, furnished by box manufacturer and factory mounted. Furnish all mounting brackets, relays, and linkages.

E. Box manufacturer shall factory mount all controls and relays to provide “V-Cycle” controls.

F. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings.

G. DDC Volume Controller: Electronic, furnished and installed by TCC. Boxes to be pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at inlet to box for use by unit controller. Boxes shall be set for maximum and minimum settings shown on the drawings. Refer to Section 23 09 00 for additional information.

H. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016" wall thickness, leak tested at 300 psig. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.

I. Electric Heating Coil: Open nichrome type electric resistance coils, automatic reset thermal cutout primary safety device, manual reset thermal cutout secondary safety device, airflow switch interlock, disconnect switch on face of integral control panel, magnetic contactors, 24-volt control, control voltage transformer and fusing, pressure-electric switch for two-stage step control. Capacity and voltage shall be as scheduled on the drawings.

J. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.

K. Refer to control diagrams and notes on control drawings for complete sequence of control.

L. Acceptable Manufacturers: Carrier, Titus, Trane, Krueger, Carnes, E.H. Price, Tuttle & Bailey, Nailor, Enviro-Tec, Johnson Controls Inc., Metalaire.

2.4 DOUBLE WALL SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. Casing: Double wall construction with Minimum 22 gauge galvanized steel interior and exterior walls. Foil or plastic lined insulation in lieu of sheet metal interior is not acceptable. Provide with one inch, 1-1/2 pound density fiberglass insulation in between the interior and exterior walls. Insulation shall be UL listed and meet NFPA 90A requirements.

B. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.

C. Damper Operators: Pneumatic, furnished by box manufacturer and factory mounted. Furnish all mounting brackets, relays, and linkages.

D. Box manufacturer shall factory mount all controls and relays to provide “V-Cycle” controls.

E. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings.

[***OR*****]**

F. Damper Operators: Electronic, furnished and installed by TCC. Refer to Section 23 09 00 for additional information.

G. DDC Volume Controller: Electronic, furnished and installed by TCC. Boxes to be pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at inlet to box for use by unit controller. Boxes shall be set for maximum and minimum settings shown on the drawings. Refer to Section 23 09 00 for additional information.

H. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016" wall thickness, leak tested at 300 psig. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.

I. Electric Heating Coil: Open nichrome type electric resistance coils, automatic reset thermal cutout primary safety device, manual reset thermal cutout secondary safety device, airflow switch interlock, disconnect switch on face of integral control panel, magnetic mercury contactors, 24-volt control, control voltage transformer and fusing, pressure-electric switch for two-stage step control. Capacity and voltage shall be as scheduled on the drawings.

J. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.

K. Refer to control diagrams and notes on control drawings for complete sequence of control.

L. Acceptable Manufacturers: Carrier, Trane, Krueger, Carnes, E.H. Price, Tuttle & Bailey, Nailor, Titus, Enviro-Tec, Johnson Controls Inc., Metalaire.

2.5 DUAL DUCT VARIABLE AIR VOLUME TERMINAL BOX

A. Casing: Minimum 22 gauge galvanized steel. Fully lined with minimum 1", minimum 1-1/2 pound density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements.

B. All insulation in contact with the air stream shall be foil faced. UL listed and NFPA 90A approved.

C. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.

D. Damper Operators: Pneumatic, furnished by box manufacturer and factory mounted. Furnish all mounting brackets and linkages. Hot and cold deck dampers shall have separate operators. Cold deck shall be normally closed, direct acting, 8-13 psi. Hot deck shall be normally open, direct acting 3-7 psi.

E. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings. Hot and cold deck shall have separate volume regulators.

[***OR*****]**

F. Damper Operators: Electronic, furnished and installed by TCC. Refer to Section 23 09 00 for additional information.

G. DDC Volume Controller: Electronic, furnished and installed by TCC. Boxes to be pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at inlet to box for use by unit controller. Boxes shall be set for maximum and minimum settings shown on the drawings. Refer to Section 23 09 00 for additional information.

H. Box shall provide for complete mixing of the hot and cold air streams at all flow settings.

I. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.

J. Refer to control diagrams and notes on control drawings for complete sequence of control.

K. Acceptable Manufacturers: Carrier, Titus, Trane, Krueger, Carnes, E.H. Price, Tuttle & Bailey, Nailor, Enviro-Tec.

2.6 FAN POWERED VARIABLE AIR VOLUME TERMINAL BOX

A. Casing: Minimum 22 gauge galvanized steel. Filter rack provided on plenum inlet. Factory mounted access panel to provide access to air valve and fan.

B. Insulation: Fully lined with 1" 1-1/2", 1-1/2 pound density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A and UL 181 requirements.

C. All insulation in contact with the air stream shall be foil faced, UL listed and NFPA 90 approved.

D. Fan: FC style, galvanized steel fan wheel. Fan housing shall be 22 gauge steel and fan board shall be 18 gauge steel. Motors shall be permanently lubricated, single speed, direct drive, permanent split capacitor type motor ECM motor with factory mounted SCR speed controller. Maximum motor temperature rise on all speeds of 50°F. Fan motor voltage shall be as scheduled on the drawings.

E. Fan Controls: Factory mounted and wired manual adjustment of SCR fan speed controller.

F. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.

G. Damper Operators: Pneumatic, furnished by box manufacturer and factory mounted. Furnish all mounting brackets and linkages.

H. Volume Regulator: Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches WG. Regulator shall have field adjustable maximum and minimum settings. Furnish calibration charts mounted on each box. Boxes shall be factory set for the maximum and minimum settings shown on the drawings.

I. Boxes shall be normally closed, direct acting with an 8-13 psi operating range.

[***OR*****]**

J. Damper Operators: Electronic, furnished and installed by TCC. Refer to Section 23 09 00 for additional information.

K. DDC Volume Controller: Electronic, furnished and installed by TCC. Boxes to be pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at inlet to box for use by unit controller. Boxes shall be set for maximum and minimum setting shown on the drawings. Refer to Section 23 09 00 for additional information.

L. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016" wall thickness, leak tested at 300 psig. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.

M. Electric Heating Coil: Open nichrome type electric resistance coils, automatic reset thermal cut-out primary safety device, manual reset thermal cut-out secondary safety device, airflow switch interlock, disconnect switch on face of integral control panel, magnetic mercury contactors, 24-volt control, control voltage transformer and fusing, pressure-electric switch for two-stage step control. Capacity and voltage shall be as scheduled on the drawings.

N. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.

O. Refer to control diagrams and notes on control drawings for complete sequence of control.

P. Acceptable Manufacturers: Carrier, Titus, Trane, Krueger, Carnes, E.H. Price, Nailor, Enviro-Tec, Johnson Controls Inc.

END OF SECTION

SECTION 23 3700
AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial Compensating Range Hood.

B. Commercial Exhaust Range Hood.

C. Heat Only Exhaust Hood.

D. Variable Volume Exhaust Hood Controller.

E. Condensate Exhaust Hood.

F. Grilles And Registers.

G. Architectural Square Panel Diffusers.

H. Square Stepdown Cone Diffusers.

I. Laminar Flow Diffusers.

J. Radial Flow Diffusers.

K. Linear Diffusers.

L. Linear Diffuser Supply Plenum.

M. Fan Filter Units.

N. Air Supply Baseboard Cabinet.

O. Louvers.

P. Louvered Penthouses.

Q. Roof Hoods.

R. Roof Curbs.

S. Goosenecks.

1.2 QUALITY ASSURANCE

A. Test and rate performance of air inlets and outlets per ASHRAE 70.

B. Test and rate performance of louvers per AMCA 500L-99.

C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 500L-07 - Test Method for Louvers, Dampers and Shutters.

B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.

E. SMACNA - Duct Construction Standards.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 COMMERCIAL COMPENSATING RANGE HOOD

A. Energy saving, short cycle kitchen hood with adjustable air nozzles to introduce untempered outside air into interior of hood.

B. Hood shall be 18 gauge Type 304 stainless steel construction with #3 polished finish. All exterior seams shall be continuously welded, ground, and polished to match hood finish.

C. The supply air plenum shall be completely insulated with 1" thick, 3 lb. density insulation with metallic vapor barrier. Junction boxes or conduits inside plenum shall also be insulated.

D. Hood shall be furnished with UL classified baffle type stainless steel grease filters.

E. Provide UL listed 100-watt incandescent vapor-proof lights, pre-wired to junction box mounted on top of hood. Fixture shall have plastic coated glass.

F. Unit shall have NSF label and UL label in accordance with NFPA-96.

G. Provide slide gate exhaust balance damper in the hood construction. If the hood manufacturer does not offer the slide gate style damper as an option, the Contractor shall provide and install duct mounted balancing dampers as specified in Ductwork Accessories.

H. Provide full NFPA wet chemical fire suppression system including storage tank control panel, piping, detectors, nozzles, manual pull station and electric gas shutoff valve. Size system to meet the hood dimensions. System controls shall be integrated with controls for fans and lights. Acceptable Manufacturer: Ansul R-102 System.

I. Provide variable exhaust system controller as specified below.

J. Provide fan switch pre-wired to junction box mounted on top of hood.

K. Provide temperature sensor in exhaust collar wired to temperature controller and fan switch circuit.

L. Acceptable Manufacturers: Kees Incorporated, Econovent, Captive Aire, Greenheck.

2.2 COMMERCIAL EXHAUST RANGE HOOD

A. Hood shall be 18 gauge Type 304 stainless steel construction with #3 polished finish. All exterior seams shall be continuously welded, ground, and polished to match hood finish.

B. Hood shall be furnished with UL classified baffle type stainless steel grease filters.

C. Provide UL listed 100-watt incandescent vapor-proof lights, pre-wired to junction box mounted on top of hood. Fixture shall have plastic coated glass.

D. Unit shall have NSF label and UL label in accordance with NFPA-96.

E. Provide slide gate exhaust balance damper in the hood construction. If the hood manufacturer does not offer the slide gate style damper as an option, the contractor shall provide and install duct mounted balancing dampers as specified in ductwork accessories.

F. Provide full NFPA wet chemical fire suppression system including storage tank control panel, piping, detectors, nozzles, manual pull station and electric gas shutoff valve. Size system to meet the hood dimensions. System controls shall be integrated with controls for fans and lights. Acceptable Manufacturer: Ansul R-102 System.

G. Provide variable exhaust system controller as specified below.

H. Acceptable Manufacturers: Kees Incorporated, Econovent, Captive Aire, Greenheck.

2.3 HEAT ONLY EXHAUST HOOD

A. Hood shall be 18 gauge Type 304 stainless steel construction with #3 polished finish. All exterior seams shall be continuously welded, ground, and polished to match hood finish.

B. Provide UL listed 100-watt incandescent vapor-proof lights, pre-wired to junction box mounted on top of hood. Fixture shall have plastic coated glass.

C. Unit shall have NSF label and UL label in accordance with NFPA-96.

D. Provide variable exhaust system controller as specified below.

E. Acceptable Manufacturers: Kees Incorporated, Econovent, Captive Aire, Greenheck.

2.4 VARIABLE VOLUME EXHAUST HOOD CONTROLLER (NOT FOR FUME HOODS)

A. Operator shall automatically control speed of exhaust fan, and make-up air if applicable, to ensure optimal hood performance.

B. Control system shall include I/O processor, keypad, temperature sensors, optic sensors, cables, and variable frequency drive for each fan.

C. Keypad shall control exhaust fans and lights associated with hood.

D. Install I/O processor, keypad and electronic motor starters in a cabinet.

E. Install one temperature sensor in each exhaust collar.

F. Install optic sensors to monitor smoke inside the ends of each Type 1 hood with air purge units mounted on top.

G. Factory install controller in hood.

H. Controller shall be warranted for three years from time of purchase.

I. Controller shall be UL and CSA listed.

J. Acceptable Manufacturers: Melink Intelli-Hood Control System

2.5 CONDENSATE EXHAUST HOOD

A. Complete ceiling hung vapor hood.

B. Hood shall be 18 gauge galvanized steel construction with baked off-white enamel finish on exterior.

[***OR*****]**

C. Hood shall be 16 gauge aluminum construction with continuously welded (heliarc) exterior seams.

[***OR*****]**

D. Hood shall be 18 gauge, Type 304 stainless steel construction, #3 polish finish, with continuously welded exterior seams ground and polished to match hood.

E. Provide removable interior baffles to allow condensation to drain to perimeter drain trough.

F. Unit shall have NSF label and UL label in accordance with NFPA-96.

G. Provide 1" drain connection.

H. Acceptable Manufacturers: Kees Incorporated, Econovent, Captive Aire, Greenheck.

2.6 GRILLES AND REGISTERS

A. Reference to a grille means an air supply, exhaust or transfer device without a damper.

B. Reference to a register means an air supply, exhaust or transfer device with a damper.

C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.

D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

E. The capacity and size of the unit shall be as shown on the drawings.

F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.

G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.

H. Provide with 3/4” blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.

J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.

K. Where specified to have filters, provide with filter rack suitable for 1” 2” thick MERV-8 pleated media filters. Grille border shall be fabricated from minimum 22 gauge steel or minimum 0.040-inch thick for aluminum grilles. Provide removable grille face with metal knurled knob or quarter turn fastener to allow for filter media replacement.

L. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.

M. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger, Anemostat, Raymon Donco.

2.7 ARCHITECTURAL SQUARE PANEL DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.

F. Diffusers shall be architectural solid square panel and flush with ceiling.

G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge steel with a rolled edge or shall be 18 gauge with a smooth ground, uniform edge.

H. The back pan shall be one piece 22 gauge stamped and shall include an integral inlet. (Welded inlets and corner joints are not acceptable).

I. Diffusers with a 24x24 back pan shall have a minimum 18x18 face panel size. Diffusers with a 12x12 back pan shall have a minimum 9x9 face panel size.

J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners are not acceptable.)

K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger, Anemostat, Raymon Donco.

2.8 SQUARE STEPDOWN CONE DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.

F. Diffusers shall be drop face construction.

G. Diffuser shall be entirely constructed of stamped panel and a minimum of three stepdown diffusion cones.

H. Stepdown cones shall be mechanically fastened to panel with metal fasteners. Diffuser stepdown cones glued, fastened with plastic clips, or otherwise attached to face panel will not be acceptable.

I. Each stepdown cone shall be one-piece stamped construction. The cones shall be removable for cleaning.

J. Diffusers shall be constructed of minimum 24 gauge steel.

K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger, Anemostat, Raymon Donco.

2.9 LAMINAR FLOW DIFFUSERS

A. Perforated panel diffuser to be laminar flow type, aluminum construction with manufacturer’s standard white baked enamel or acrylic finish. Diffuser shall deliver air to the space with zero aspiration at the face of the perforated plate. Velocities in the plane of the perforated plate shall vary no more than 10%.

B. Air shall be admitted to the initial plenum through an inlet collar without a balancing mechanism. Plenum shall have a V- or U-shaped, perforated diffusion basket constructed of 0.032” aluminum.

C. With a design temperature difference of 10°F, average velocity at four feet below the diffuser face shall not exceed 54 fpm. Static pressure at 20 cfm per square foot face velocity shall not exceed 0.05” water column. NC level shall not exceed 27.

D. Plate shall be retained to the module frame through the use of quarter-turn fasteners. Safety retainers of stainless steel cable or chain shall be provided to prevent accidental dropping of plate. Distribution plate shall be installed in aluminum mounting frame.

E. Fill-in panels identical in appearance to the active air distribution modules shall be furnished where shown on the plans.

F. Where the diffuser schedule requires the diffuser to accommodate filters, filters shall be furnished with the diffuser of the type and size indicated. Filters shall not be installed until air balancing occurs, and one additional set shall be left with the Owner at completion.

G. Acceptable Manufacturer: Precision Air Products Co. PAT, Titus, Tuttle & Bailey, Krueger.

2.10 CRITICAL ENVIRONMENT - RADIAL FLOW DIFFUSERS - FLUSH FACE

A. Radial flow diffusers shall deliver a high volume of low velocity air in a radial air pattern for minimal entrainment of room air.

B. Provide performance data for air volume, initial pressure drop, sound levels, and throw. All data must be tested in accordance with the most recent publication of ASHRAE Standard 70.

C. Each diffuser shall supply a two-way or one-way radial air pattern as indicated on the drawings.

D. Construction:

1. Diffuser frame, border, and deflector blade material shall be steel.

2. Plenum, and equalization baffle material shall be steel.

3. Perforated face shall be steel.

E. The diffuser face shall be flush with the ceiling.

F. The diffuser face shall open easily and include safety retainer cables for cleaning from the room side without moving the plenum.

G. Where the drawings require diffusers to include filters, the diffuser shall be provided with an airtight filter housing. Filters shall be furnished with the diffuser of the type and size indicated. Filters shall not be installed until air balancing occurs, and one additional set shall be left with the Owner at completion.

H. Refer to drawings for quantities, sizes, capacities, finishes, and any additional information.

I. Acceptable Manufacturer: Price, Titus, Nailor, Carnes, Metalaire.

2.11 LINEAR DIFFUSERS

A. Plenum Slot Diffusers (Lay-In):

1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

2. The capacity and size of the unit shall be as shown on the drawings.

3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.

4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.

5. Linear diffusers and mounting frames shall be furnished as one piece up to 5’ in length.

6. Diffusers shall be furnished with factory installed adjustable.

7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.

8. Number and width of slots shall be as shown on the drawings.

9. Provide integral insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum specification section for details.

10. Acceptable Manufacturers: Tuttle & Bailey ITPS, Carnes DA, Price TBD, Krueger PTBS, Nailor 5800, Titus TBD, Metalaire, Anemostat API, Raymon Donco SAT.

11. Linear diffusers for fire-rated ceiling shall be UL labeled with a non-adjustable air pattern. Airflow direction shall be as shown on the drawings.

12. Acceptable Manufacturers for fire-rated diffusers: Kees FRK-UL, Titus TBD-FR, Krueger PFTBS, Price TBD2-FR, Raymon Donco 2000FR.

B. Linear Slot Diffusers (Continuous):

1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

2. The capacity and size of the unit shall be as shown on the drawings.

3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.

4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.

5. Provide with concealed fasteners for installation in the field.

6. Linear diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.

7. Diffusers shall be furnished with adjustable pattern deflectors capable of providing 180° pattern adjustment.

8. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.

9. Number and width of slots shall be as shown on the drawings.

10. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum specification section for details.

11. Acceptable Manufacturers: Tuttle & Bailey 6000/7000, Carnes CH, Price SDS, Krueger 1900, Nailor 5000, Titus ML, Anemostat SLAD, Raymon Donco HPL.

C. Linear Slot Diffusers (High Performance):

1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

2. The capacity and size of the unit shall be as shown on the drawings.

3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect per ANSI/ASHRAE 70.

4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.

5. Provide with concealed fasteners for installation in the field.

6. Linear slot diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.

7. Diffusers shall be furnished with adjustable pattern deflectors.

8. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.

9. Number and width of slots shall be as shown on the drawings.

10. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum specification section for details.

11. Acceptable Manufacturers: Price JS, Titus FL, Krueger DF, Anemostat FF, Raymon Donco WF2000.

D. Linear Bar Grille Diffusers:

1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

2. The capacity and size of the unit shall be as shown on the drawings.

3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect per ANSI/ASHRAE 70.

4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.

5. Provide with concealed fasteners for installation in the field.

6. Linear bar diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.

7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each bar grille. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.

8. Diffuser length and width, bar width, and spacing between bars shall be as shown on the drawings.

9. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum section for details.

10. Acceptable Manufacturers: Tuttle & Bailey 4000, Carnes CC;CT;CW, Krueger 1500/1600, Price LB, Nailor 4900, Titus CT, Metalaire 2000, Anemostat AL/TL, Raymon Donco DGB.

2.12 LINEAR DIFFUSER SUPPLY PLENUM

A. Linear diffusers shall be provided with field fabricated or prefabricated supply plenums. Plenum shall be a minimum of 2-1/2" wider than total slot width, minimum length of slot, and minimum height of 10". Plenums with end fed duct connections shall not exceed 8' in length. The cross sectional area of the plenum shall be designed for a maximum velocity of 500 fpm and the aspect ratio shall be limited to a width-to-height ratio of less than 1.5. Plenums with side outlets shall be designed for a maximum velocity of 600 fpm and inlet ducts to plenum shall be spaced 5' on center maximum. Inlet ducts to plenums shall have a maximum velocity of 900 fpm. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.

B. Plenum shall be constructed with 24 gauge galvanized steel and shall have side inlets unless shown otherwise on the drawings. Refer to Ductwork Application Schedule in Section 23 31 00 for insulation requirements.

C. End caps and required accessories shall be integral with the plenum or furnished and installed by the Mechanical Contractor.

D. A manual volume damper shall be furnished and installed by the Mechanical Contractor in branch ductwork to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings

E. Prefabricated plenums shall be by the same manufacturer as the linear diffuser or Kees Inc.

2.13 FAN FILTER UNITS

A. The FFUs shall be manufactured in the United States, be of aluminum construction, designed for installation in a standard 2'x4' T-bar ceiling grid geometry, and be fully UL and C-UL certified.

B. FFUs connected only to low returns shall dynamically adjust themselves to maintain a set airflow, compensating for changes in static pressure and filter loading. FFUs connected downstream of supply VAV boxes shall be provided with constant speed programming (the VAV box shall control the supply air volume).

C. The FFU shall be provided with an integral universal control (interface) card that supports operation in standalone mode, 0-10V DC remote input mode or Modbus (RTU) network compatible mode.

D. Sound unit discharge sound levels shall be no greater than 47dBA 39NC at 650 CFM and 90FPM as determined by testing in accordance with ANSI S12.51 / ISO 3741, ANSI /ASHRAE 70-06, and ANSI / ASHRAE 130.

E. Construction:

1. The unit lid shall be constructed of 0.080-inch thick aluminum with 0.25" threaded inserts in each corner for suspension. Insert pull strength 225 lbs.

2. The filter housing shall be constructed of 0.063-inch thick aluminum.

3. The fan plenum housing shall be of welded construction.

4. The filter shall be sealed to the filter housing with a gel seal-fluid seal material with knife edge construction. The fluid seal material is resistant to PAO and other harsh cleaning chemicals. UL 900 and UL 586 approved and ASME-AG-1 Section FC5000 for HEPA filters. Provide with white powder coated steel exterior.

5. The interior of the FFU housing shall include an advanced air baffle system that ensures even distribution of air velocity +/- 10% across the filter surface.

6. An optional 10" 12" 14" collar shall be made available.

7. A sound dampening material shall be provided and shall consist of 0.5" internal non-shedding polyurethane foam attached to lid, UL 94 HF-1 rated.

F. Prefilter:

1. The unit shall be furnished with a 20" x 20" x 0.5" Merv 8, snap-in style, polyurethane foam, washable prefilter for use when the optional A/C collar is not in place.

G. Fan/Motor:

1. The fan will be backward curve centrifugal type with 16 inch all aluminum blower wheel.

2. The motor shall be removable from room side.

3. The motor shall be electrically commutative brushless DC, shall be rated for continuous duty and furnished be with thermal overload protection rated by manufacturer for 100,000 hours.

4. Motor shall be provided with electronic sensing for forward rotation.

5. Fan motor and controls shall be built into the unit to provide proper fan motor operation.

H. Integral Universal Control Interface:

1. The FFU shall be provided with an integral universal control card capable of interfacing with the BACnet FMCS.

2.14 AIR SUPPLY BASEBOARD CABINET

A. Cabinet shall be paint grip furniture grade steel with a baked enamel finish. Final color by Architect/Engineer. All cabinets shall be one standard color.

B. Back and bottom panels of cabinet shall be 20 gauge, galvanized. Front, top and ends shall be 16 gauge steel.

C. Unit shall be constructed with concealed fasteners.

D. Unit shall contain grille and accessories as called for in the Schedule.

E. Cabinet size, grille size shall be as shown on the drawings.

F. Acceptable Manufacturer: Kees, Inc., Price Model LE.

2.15 LOUVERS - FIXED - ALUMINUM

A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

H. Louvers shall be suitable for duct connection.

I. Acceptable Manufacturers: Air Flow - “EA-403”, Arrow - “EA-415-D", American Warming & Ventilating - “LE-21", Construction Specialties - “A4097", Dowco - “DBE-4", Louvers & Dampers, Inc. - “IL-23", Ruskin - “ELF375DX”, Vent Products - “2760", Greenheck - “ESD-403", Pottorff - “EFD”.

2.16 LOUVERS - FIXED - GALVANIZED

A. Louvers shall be minimum 4” deep and constructed of galvanized steel with minimum 18 gauge frames and 16 gauge blades.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with 1/2" mesh 0.041 galvanized wire bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

H. Louvers shall be suitable for duct connection.

I. Acceptable Manufacturers: Air Flow, Arrow, American Warming & Ventilating, Carnes, Dowco, Louver and Dampers, Inc., Ruskin, Vent Products.

2.17 LOUVERS - ADJUSTABLE

A. Louvers shall be minimum 4” deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be adjustable and spaced at a maximum of 5.1” apart.

B. Louvers shall be furnished with nylon bearings, extruded aluminum blade shafts, non-binding, corrosion resistant hardware with brass pinions. Blades shall have hollow bulb vinyl blade edge seals and be suitable for motor operator. Motor by Temperature Control Contractor.

C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

F. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

G. Louvers shall be suitable for duct connection.

H. Acceptable Manufacturers: Air Flow, Arrow, American Warming & Ventilating, Construction Specialties, Dowco, Louvers and Dampers, Inc., Ruskin, Vent Products, Greenheck.

2.18 LOUVERS - BY GENERAL CONTRACTOR

A. Louvers shall be provided and installed by the General Contractor.

B. Coordinate exact sizes and locations required for ductwork connections.

2.19 LOUVERS - VERTICAL BLADE MOISTURE ELIMINATION

A. Louvers shall be minimum 4" thick and constructed of extruded aluminum. The frame shall be welded from material a minimum of 0.093 inches thick. The blade material shall be a minimum of 0.065 inches thick. Blades shall be spaced at 1 inch on center.

B. Louvers shall be furnished with integral welded extruded aluminum drain pan. Caulked seams are not acceptable. The material shall be minimum 0.093 inches thick. Captured water shall be self-draining to the outside of the building. Drain holes or slots shall not be located on the face of the louver.

C. Multiple louvers shall be joined together with an integral vertical mullion cover; the cover shall not be fastened to the face of the louver with screws or bolts.

D. Louvers shall withstand wind loadings of 93 mph as defined in Article 6.5.2 of the ASCE Standard 7-88. Wind loads shall be calculated using an Importance Factor (I) of 1.11 and velocity pressure exposure coefficient (K), based on exposure C as given in Table 6, ASCE 7-88.

E. Louvers shall have 99.9% water removal efficiency for 1500 fpm free area velocity through the louver and 0.16” w.g. maximum pressure drop at 3 inches per hour rainfall. Louvers shall have 99.0% water removal efficiency at 1.0 inches w.g. maximum pressure drop at 8 inches per hour rainfall.

F. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

G. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.

H. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.

I. Acceptable Manufacturers: Architectural Storm Louver Model ASL

2.20 LOUVERED PENTHOUSES - ALUMINUM

A. Louvers shall be 4” deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be 0.081". Blades shall be spaced approximately 3" apart.

B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.

C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.

E. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall of penthouse.

F. Penthouse structure shall be constructed of an all-welded aluminum.

G. Curb cap shall be of 14 gauge formed aluminum with mitered corners continuously heliarc-welded. Penthouse roof shall be of the same material and cross-broken for added strength. Underside of roof shall be coated with insulating mastic.

H. Corners of penthouse shall be boxed and insulated.

[***OR*****]**

I. Corners of penthouse shall be mitered with internal reinforcement.

J. Penthouse and throat shall be reinforced with extruded aluminum angle and have a minimum snow load of 40 lbs. per square foot.

K. Inlet area shall be minimum 150% of throat area for intake hoods. Outlet area shall be minimum 125% of throat area for exhaust hoods and relief vents.

L. Louvered penthouses shall be furnished with 12" high curb (above top of roof) and be of the size and type as shown on the drawings.

M. Acceptable Manufacturers: Arrow-United, American Warming & Ventilating, Construction Specialties, Dowco, Greenheck, Louvers & Dampers, Inc., Ruskin, Vent Products, Twin City Fan & Blower.

2.21 ROOF HOODS

A. Hoods shall be constructed of all-welded aluminum.

B. Curb cap shall be of 14 gauge formed aluminum with mitered corners continuously heliarc-welded. Hood shall be of the same material and cross-broken for added strength. Underside of hood shall be coated with insulating mastics.

C. Hoods shall be furnished with aluminum bird screen.

D. Hood and throat shall be reinforced with extruded aluminum angle and have a minimum snow load rating of 30 lbs. per square foot.

E. Size, cfm, finish and pressure drop for hoods shall be as scheduled on the drawings.

F. Inlet area shall be minimum 150% of throat area for intake hoods. Outlet area shall be minimum 125% of throat area for exhaust hoods and relief vents.

G. Hoods shall be furnished with 12" high curb (above top of roof) and be of the size and type as shown on the drawings.

H. Hood shall be furnished with motorized damper unless otherwise noted on the drawings.

I. Acceptable Manufacturers: Ammerman, Carnes, Cook, Greenheck, ILG, Jenco Fan, PennBarry, Twin City Fan & Blower.

2.22 ROOF CURBS

A. Furnish and install, where shown on the drawings, prefabricated roof curbs for all rooftop hood openings.

B. Curbs shall be sized to match curb cap of the hood. The top of all curbs shall be 12" above the top of the roof.

C. Curbs shall be unitized construction, 18 gauge galvanized steel, with continuous arc welded corner seams, insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board and damper support angle.

D. Curb without cant – suitable for use with membrane type roof.

[* * * * * OR * * * * *]

E. Curb with built-in cant with step for roof insulation.

F. Acceptable Manufacturers: Same manufacturer as the equipment it serves or Pate, RPS, or Thy.

2.23 GOOSENECKS

A. Fabricate in accordance with SMACNA Duct Construction Standards of minimum 18 gauge galvanized steel.

B. Mount on minimum 12 inch high curb base.

END OF SECTION

SECTION 23 4000
AIR CLEANING (DEVICES)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filters and Filter Media.

B. Side Access Filter Housings.

C. Activated Carbon Filters.

D. Filter Frames.

E. Filter Gauges.

1.2 QUALITY ASSURANCE

A. Filter media shall be tested under ANSI/UL 900 and labeled.

B. Provide all filters and filter banks by one manufacturer.

C. Air filters shall be State Fire Marshal approved and of a listed type. Preformed filters having combustible framing shall be tested as a complete assembly. Air filters in all occupancies shall be Class 2 or better (as shown in the State Fire Marshal listing). Air filters shall be accessible for cleaning or replacement.

1.3 REFERENCES

A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

B. ANSI/UL 900 - Test Performance of Air Filter Units.

C. ASHRAE 26 - Guideline for Field Testing of General Ventilation Devices and Systems for Removal Efficiency In-Situ by Particle Size and Resistance to Flow.

D. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

E. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 FIBERGLASS THROWAWAY - TYPE B

A. 1" thick fiberglass media with rigid frame and grille, minimum 20% efficiency per ASHRAE Standard 52.1 or MERV-4 per ASHRAE 52.2.

2.2 FIBERGLASS THROWAWAY - TYPE C

A. 2" thick fiberglass media with rigid frame and grille, minimum 20% efficiency per ASHRAE Standard 52.1 or MERV 4 per ASHRAE 52.2.

2.3 MEDIUM EFFICIENCY - DISPOSABLE - TYPE D

A. Non-woven cotton fabric, pleated media, disposable type with welded wire grid support bonded to the filter media.

B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.

C. 2" thick media with at least 4.6 square feet of media per square foot of face area. Maximum initial resistance of 0.30" WG at 500 fpm face velocity.

D. 25-30% efficiency and 90-92% arrestance per ASHRAE 52.1 or MERV 8 per ASHRAE 52.2.

2.4 65% EFFICIENT RIGID FILTER - DISPOSABLE - TYPE E

A. Pleated, rigid, disposable type with high density, fine fiberglass laminated to non-woven synthetic backing. Welded wire grid media support bonded to the filter media. Galvanized steel enclosing frame bonded to media periphery to eliminate air bypass.

B. Maximum 12" thick cartridges with at least 14.5 square feet of media per square foot of face area.

C. 60-65% efficiency and 97% arrestance per ASHRAE 52.1 or MERV 11 per ASHRAE 52.2. Maximum 0.45" WG initial resistance at 500 fpm face velocity.

D. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.5 85% EFFICIENT RIGID FILTER - DISPOSABLE - TYPE F

A. Pleated, rigid, disposable type with high density, fine fiberglass laminated to non-woven synthetic backing. Welded wire grid media support bonded to the filter media. Galvanized steel enclosing frame bonded to media periphery to eliminate air bypass.

B. Maximum 12" thick cartridges with at least 14.5 square feet of media per square foot of face area.

C. 80-85% efficiency and 98% arrestance per ASHRAE 52.1 or MERV 13 per ASHRAE 52.2. Maximum 0.60" WG initial resistance at 500 fpm face velocity.

D. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.6 95% EFFICIENT RIGID FILTER - DISPOSABLE - TYPE G

A. Pleated, rigid, disposable type with high density, fine fiberglass laminated to non-woven synthetic backing. Welded wire grid media support bonded to the filter media. Galvanized steel enclosing frame bonded to media periphery to eliminate air bypass.

B. Maximum 12" thick cartridges with at least 14.5 square feet of media per square foot of face area.

C. 90-95% efficiency and 99% arrestance per ASHRAE 52.1 or MERV 14 per ASHRAE 52.2. Maximum 0.65" WG initial resistance at 500 fpm face velocity.

D. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.7 65% EFFICIENT BAG FILTER - TYPE H

A. Disposable type with high density, fine fiber glass media with reinforced backing and galvanized steel face frame.

B. Self-supporting bags without sag under airflow reduced to 25% of the maximum design flow.

C. Individual pleats shall have sealed link stitching to maintain their shape.

D. Maximum depth of 24". At least 17.5 square feet of media per square foot of face area.

E. 50-55% efficiency and 97% arrestance per ASHRAE 52.1 or MERV 11 per ASHRAE 52.2. Maximum 0.32" WG initial resistance at 500 fpm face velocity.

F. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.8 85% EFFICIENT BAG FILTER - TYPE I

A. Disposable type with high density, fine fiber glass media with reinforced backing and galvanized steel face frame.

B. Self-supporting bags without sag under airflow reduced to 25% of the maximum design flow.

C. Individual pleats shall have sealed link stitching to maintain their shape.

D. Maximum depth of 24". At least 17.5 square feet of media per square foot of face area.

E. 80-85% efficiency and 98% arrestance per ASHRAE 52.1 or MERV 13 per ASHRAE 52.2. Maximum 0.53" initial resistance at 500 fpm face velocity.

F. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.9 95% EFFICIENT BAG FILTER - TYPE J

A. Disposable type with high density, fine fiberglass media with reinforced backing and galvanized steel face frame.

B. Self-supporting bags without sag under airflow reduced to 25% of the maximum design flow.

C. Individual pleats shall have sealed link stitching to maintain their shape.

D. Maximum depth of 24". At least 17.5 square feet of media per square foot of face area.

E. 90-95% efficiency average 99% arrestance per ASHRAE 52.1 or MERV 14 per ASHRAE 52.2. Maximum 0.85" WG initial resistance at 500 fpm face velocity.

F. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.10 99.97% EFFICIENT HEPA FILTER - TYPE K

A. Disposable pleated glass fiber paper media with aluminum separators. Galvanized steel frame.

B. Maximum depth of 12". At least 43 square feet of media per square foot of face area.

C. Minimum efficiency of 99.97% on 0.3 micron and larger particles per ANSI/UL 586. Maximum 1.35" WG initial resistance at 250 fpm face velocity.

D. Acceptable Manufacturers: Camfil, Flanders, American Air Filter.

2.11 ACTIVATED CARBON FILTERS - TYPE L

A. Assembly: Galvanized steel unit with extruded aluminum tracks to hold filter servicing trays in deep V arrangement with disposable panel pre-filter.

B. Media: 34lb/ft^3 pelletized or granular activated carbon. Minimum 60% carbon tetrachloride activity; in thin bed trays, nominal size 24" x 24" x 5/8"; 1.42 ft^3 of carbon per 1,000 cfm nominal airflow capacity.

C. Maximum 0.45" WG initial resistance at 500 fpm face velocity.

D. Acceptable Manufacturers: Camfil, Purafil, Flanders.

2.12 SIDE ACCESS FILTER HOUSING

A. 16 gauge welded galvanized steel construction with bracing and prepunched standing flanges on inlet and outlet.

B. Full size, hinged access doors on each end of housing with 16 gauge galvanized steel, reinforced, positive sealing heavy duty latches and resilient gasketing.

C. 16 gauge galvanized steel or extruded aluminum holding tracks. "U" shaped bearing channel. Replaceable woven pile seals for filters.

D. Holds nominal 24" x 24" or 24" x 12" filters without alteration.

E. Filter channel suitable for 1" or 2" thick prefilter and bag or cartridge type final filters.

F. Acceptable Manufacturers: Camfil, American Air Filter, Flanders.

2.13 HEPA FILTER FRAMES

A. Side access filter housing for HEPA filters.

B. All welded supports to withstand 4.0” positive or negative pressure. Seal around all edges of filter bank to prevent air bypass.

C. Positive seal door latches with neoprene gaskets.

D. 2” prefilter track with 30% prefilters.

E. Acceptable Manufacturers: Camfil, American Air Filter, Flanders.

2.14 FILTER GAUGES

A. Inclined Manometer: One-piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, 0-2" WG range, 3% of full scale accuracy.

B. Accessories: Static pressure tips with integral compression fittings, 1/4" plastic tubing, 2- or 3-way vent valves, indicating fluid.

C. Differential Pressure Gauge: Diaphragm actuated, nominal 3" round dial, glass filled nylon housing, polycarbonate lens, zero adjustment, 0-2" W.G. range, 5% of full scale accuracy.

D. Accessories: Static pressure tips with integral compression fittings and 1/8" NPT plastic tubing.

E. Acceptable Manufacturers: Dwyer "Minihelic II" 2-5000, Marshalltown Instrument “Series 85C”.

2.15 HIGH EFFICIENCY FILTER TEST HOLE

A. 1-1/2” gasketed instrument type test hole with heavy screw cap.

B. Acceptable Manufacturers: Ventlok 699 or equivalent.

2.16 FILTER EFFICIENCY TEST APPARATUS (ONLY ON HEPA FILTERS)

A. Provide equipment as required by ASHRAE Standard 26 to perform a filtration system efficiency test. Required equipment shall include, but not be limited to, a particle counter, dilution system (as necessary for achieving measurable particle concentration), sampling pump (as necessary), air velocity meter, relative humidity meter, temperature sensor, and differential pressure sensor. All equipment shall meet requirements of ASHRAE Standard 26 for function, performance, maintenance, and calibration.

END OF SECTION

SECTION 23 5100

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Breechings.

B. Vent Dampers.

C. Gas Vents.

D. Refractory Lined Metal Stacks.

E. Draft Inducers.

F. Draft Control.

1.2 REFERENCES

A. ANSI Z181.1 (UL 959) - Medium Heat Appliance Factory Built Chimneys.

B. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.

C. ANSI Z223.1 (NFPA 54) - The National Fuel Gas Code.

D. ANSI/ASTM C64 - Refractories for Incinerators and Boilers.

E. ANSI/UL 103 - Standard for Factory Built Chimneys for Residential Type and Building Heating Appliances.

F. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

G. UL 378 - Standard for Draft Equipment

H. UL 441 - Standard for Gas Vents.

I. UL 641 - Standard for Type L Low-Temperature Venting Systems.

1.3 DEFINITIONS

A. Breeching or Vent Connector: Conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: Conveys flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

1.4 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

B. Design stacks for wind loading of 110 mph and seismic loads for zone in California.

C. Design stacks over 5 feet above roof under direct supervision of Professional Engineer experienced in design of this Work and licensed at project location in State of California.

PART 2 - PRODUCTS

2.1 BREECHINGS

A. Equipment with Power Burners or Induced Draft Fans:

1. 10 gauge black steel. All welded construction including joints.

2. Insulate with high temperature fiberglass insulation as specified in Section 23 07 16.

3. Provide high temperature gasket at all flanged connections to equipment.

B. Equipment with Atmospheric Burners:

1. 26 gauge galvanized lock seam ductwork.

2. Secure all joints with at least three sheet metal screws or rivets.

3. Make final connections to all equipment, draft hoods and vent stacks.

C. Provide adjustable self-actuating barometric draft dampers where shown, full size of breeching.

D. Provide cleanout doors of same gauge as breeching where shown on drawings.

E. Reinforce rectangular breeching with angle frames and round breeching with flanged girth joints or angle frames. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. Fabricate breeching fittings to match adjoining breechings. Fabricate elbows with centerline radius equal to breeching diameter. Limit angular tapers to 20º maximum.

2.2 CLASS B GAS VENTS

A. Galvanized steel outer pipe. Aluminum liner pipe. 0.25"insulating air space between pipes. Type B listed by UL.

B. Inside diameter of the liner shall be as shown on the drawings.

C. Extend up 2'-0" above the nearest obstruction within 20'-0" and terminate with a rain and bird proof cap.

D. Install tall cone flashing and storm collar at roof.

E. Maintain 1" clearance to all enclosures.

F. Acceptable Manufacturers: AMPCO, DuraVent, Hart & Cooley, Heat Fab, Metal-Fab, Schebler, Selkirk/Metalbestos, Van-Packer.

2.3 POSITIVE PRESSURE GAS VENTS (NON-CONDENSING)

A. The venting system shall be ANSI/UL 103 listed for use in positive pressure applications. For use with equipment burning gas, liquid or solid fuels as described in NFPA 211, Section 2-3-.1 and Appendix A.

B. The vent system shall be double wall metal with a minimum of 1" air space between the walls. Outer wall shall be aluminum coated steel 0.034" thick.

C. The inner pipe shall be Type 316 stainless steel 0.035" thick in all sizes.

D. Seal each inner pipe joint during field installation with RTV silicone sealant for flue gas temperatures up to 600ºF. For gas temperatures over 600ºF, seal the joints with #33 joint cement, rated for 125% of design temperature.

E. The chimney termination must comply with local building codes or Appendix D, NFPA No. 211.

F. Protect all exposed metal parts with at least one base coat and one finish coat of heat and corrosion resistant primer and exterior paint.

G. Install ventilated thimble at roof penetration.

H. Acceptable Manufacturers: AMPCO, DuraVent, Hart & Cooley, Heat Fab, Metal-Fab, Schebler, Selkirk/Metalbestos, Van-Packer.

2.4 POSITIVE PRESSURE GAS VENTS (CONDENSING AND HIGH EFFICIENCY)

A. The venting system shall be ANSI/UL 1738.

B. The venting system shall be double wall metal with a minimum of 1” air space between the walls. Outer wall shall be Type 430 stainless steel.

C. The inner pipe shall be AL29-4C.

D. Vent flue pipe shall be UL listed for Category III and IV appliances with operating temperatures of up to 480°F. The closure system to be rated as gas tight for 5” w.c. positive pressure flue gas service.

E. Fasteners to be same material as piping and shall maintain 1” air space between walls.

F. The joints shall be gas tight to prevent leakage of flue or condensate.

G. Vent system is to be sized in accordance with manufacturer’s recommendations and the current edition of NFPA 54/ANSI Z223.1: National Fuel Gas Code and ASHRAE recommendations.

H. Furnish roof flashing and cap.

I. Acceptable Manufacturers: AMPCO, DuraVent, Hart & Cooley, Heat Fab, Metal-Fab, Schebler, Selkirk/Metalbestos, Van-Packer.

2.5 REFRACTORY LINED METAL STACKS

A. Fabricate jacket for 36" size and smaller of 24-gauge galvanized steel with grooved seam joint, or 26 gauge aluminized steel with riveted seams. Fabricate sizes 39" and larger of 10 gauge galvanized steel with welded seam joint.

B. Weld heavy gauge sections together in factory. Factory apply primer and heat resistant paint to each section and accessory. Touch-up or refinish in field.

C. Refractory lining shall be minimum 2" thick, ANSI/ASTM C64 proprietary material ASTM C401 tested to UL 959 and UL listed to withstand 2000ºF without fusion, have maximum acid extraction of 0.2 %, have minimum 3200 psi cold crush strength, and be positively bonded to steel jacket, jointed with ANSI/ASTM C105 mortar.

D. Design for wind loading of 110 mph.

E. Provide accessories each bearing factory applied UL label.

1. Anchor Lugs: Acid resistant coated cast iron.

2. Cleanout Section: Welded to base of stack, with gasket, and bolted inspection plate.

3. Branching Sections: Construct with welded joints, lined with refractory, finished with smooth transition and no exposed metal on inside.

4. Spark Screen: Type 304 stainless steel, 16 gauge 1/2" x 1/2" mesh, with rolled angle and drawband.

5. Draw bands: 8" wide, same material as jacket, fastened with nuts and bolts.

6. Roof Penetration: Factory fabricated thimble, flashing and storm collar.

2.6 DRAFT INDUCERS

A. Mechanical Draft Induction Fan: Provide stainless steel axial fan or aluminum backward inclined fan, tested to UL 378, with open drip-proof, ball bearing motor. Fan and housing to be corrosion resistant and rated for operation up to 575°F. Motor(s) to be variable speed.

B. Modulating Fan Controller: Controller capable of set point between 0.00” w.c. to 0.60” w.c.. Furnish static pressure probe to be mounted in stack or chimney per manufacturer’s recommendation. Controller to be capable of modulating fan speed from signal received by static pressure probe. Display to indicate actual draft pressure and draft pressure set point.

C. Variable Frequency Drive: Furnish a variable frequency drive by the manufacturer to operate the mechanical draft induction fan.

D. Balancing Baffles: Furnish balancing baffles in flue outlet of each gas-fired piece of equipment per the manufacturer’s recommendation.

E. Fan Plenum: Furnish plenum for multiple fans.

F. Electrical Disconnect: Provide disconnect for each fan. Whips shall be wired for a single point connection.

G. Controls:

1. Interlock with each boiler to prove draft setpoint prior to firing boiler.

2. Post-purge capability.

3. Boiler shut down on insufficient draft or chimney fan failure. Furnish contactors for DDC alarm and manual override of boiler shutdown. Upon boiler shutdown, controller to sequence partial boiler startup for temporary heat. Coordinate boiler priority sequence with Architect/Engineer.

H. Factory Startup: Provide factory representative to supervise installation of fan and controls, startup and adjustment of system. Representative to submit written report confirming that the system has been started up under their direction and that the safety and operating controls have been properly installed and tested.

I. Approved Manufacturers: Tjernlund, Exhausto.

2.7 DRAFT CONTROL

A. Modulating Draft Control:

1. Provide packaged controller and actuator system to provide automatic modulation of boiler outlet damper for constant boiler draft/pressure.

2. Draft Controller:

a. Sequencing type with pre-purge and adjustable “start” positions.

b. Interface with UL listed burner management systems.

c. Adjustable set point range of -2.0” w.c. to +2.0” w.c.

d. Three-way toggle switch for “Automatic Control”, “Closed Damper”, or “Off” control. “Open Damper” switch for manual positioning of the damper.

e. Operator adjustments of Range and Response.

f. Sequencing operation shall close outlet damper when boiler is not in operation.

g. On a call for boiler fire, draft controller shall open damper to an adjustable “start” position and provide a “proven-open” signal to the burner manager for flame operation.

h. Provide 120-volt output signal for operation of damper actuator.

3. Damper Actuator:

a. 120-volt electric linear actuator with end switches and “safe-start” position switches and feedback potentiometer.

b. Capable of 75 pounds of linear force and 0.5% resolution of full range at 30-second stroke speed.

B. Acceptable Manufacturers: Cleveland Controls Series 7710 controller with Series 9140 actuator.

C. Combined units of controller and actuator meeting listed requirements are acceptable. Acceptable Manufacturers: Cleveland Controls Series 9500.

END OF SECTION

SECTION 23 5216

CONDENSING BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Controls and Boiler Trim.

C. Hot Water Connections.

D. Fuel Burning System and Connection.

E. Vent Connection.

F. Boiler Vent Flue.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with at least three years documented experience.

B. Provide factory authorized start-up service by manufacturer's agent.

C. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 for construction of boilers.

D. Boiler Units: AGA certified, UL listed and ASME certified.

E. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.

F. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

G. ANSI/NFPA 70 - National Electrical Code.

H. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

I. NFPA 85 - Boiler and Combustion Systems Hazard Code.

PART 2 - PRODUCTS

2.1 BOILERS

A. Provide factory assembled, factory fire-tested, self-contained unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Hot water, condensing type boiler with integral forced draft or pulse combustion burner, burner controls, boiler trim, insulation and jacket.

C. ASME allowable working pressure of 150 psig water.

D. Provide two lifting eyes on top of boiler.

E. Unit casing shall be a minimum of 16 gauge steel. Factory paint boiler, base, and other components with hard finish enamel.

F. Porcelain enameled or stainless steel exhaust manifold with gravity drain and reservoir for condensate elimination.

G. Acceptable Manufacturer:

1. Aerco International, Inc. (Benchmark)

2. Thermal Solutions (EVCA) (Apex) (Arctic)

3. Riverside Hydronics (EPV)

4. Cleaver Brooks (Clear Fire)

5. Viessmann (Vitocrossal 300)

6. Raypak (Xfrye, Xtherm)

2.2 HEAT EXCHANGER

A. Condensing type, constructed from stainless steel, fire tube design surrounded by water that is suitable for return water temperatures as low as 50ºF.

B. Seven-year prorated Ten-year non-prorated warranty against leakage due to thermal shock or corrosion.

2.3 BOILER FLUE

A. The boiler manufacturer shall furnish review and approve vent size, type, and routing of all vent flue piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use with category III and IV appliances with operating temperatures of up to 480°F.

B. Refer to Section 23 51 00 for materials.

2.4 HOT WATER BOILER TRIM

A. Provide ASME safety relief valve set at 125 psi or boiler maximum allowable working pressure.

B. Provide low water cut-off with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.

C. Provide operating temperature controller to control burner operation to maintain boiler water temperature, as determined by a remote 4-20 mA signal from building DDC system or boiler controller.

D. Limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.

E. Provide all trim required to meet ASME CSD-1 NFPA 85. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.5 FUEL BURNING SYSTEM

A. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14” W.C. inlet pressure. Maintain fuel-air ratios automatically.

B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor.

C. Include on unit complete gas train including gas safety shutoff valve conforming to CSD-1 requirements. Vent all gas valves to outdoors separately.

D. Burner to be modulating with a minimum turndown ratio of 20:1 5:1 3:1.

2.6 CONTROL PANEL

A. The boiler system control panel shall include contacts for a trouble alarm to the DDC system.

B. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.

C. Manual-automatic selector switch to permit automatic firing in accordance with load demand, or manual control of firing rate at fixed temperature.

D. Panel to include indicating lights to show fault conditions of low water level, flame failure, fuel pressure, exhaust temperature, water temperature, or combustion air pressure. Mount indicating lights and switches in hinged drop-panel for access to wiring.

E. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

F. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

G. For multiple boiler systems, furnish a boiler management system consisting of controller(s) capable of stopping, starting, and modulating all boilers to maintain maximum efficiency of the boiler plant. The boiler management system shall include all alarms, control points, and setpoints specified.

2.7 PERFORMANCE

A. Minimum efficiency, verified by factory tests, shall be 86% at 100% output with 150°F return water and 88% at 25% output with 130°F return water.

B. Rated for return temperatures as low as 40°F and supply temperatures as high as 190°F.

END OF SECTION

SECTION 23 5233.13

FINNED WATER TUBE BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Fuel Burning System.

C. Boiler Trim.

D. Controls.

E. Connections.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 Code for construction of boiler.

C. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

D. Boiler Burner Units: AGA certified.

E. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 4 - Boiler and Pressure Vessel Codes, Rules for Construction of Heating Boilers.

F. ANSI/ASME SEC 8D - Boiler and Pressure Vessel Codes, Rules for Construction of Pressure Vessels.

G. ANSI/NFPA 70 - National Electrical Code.

H. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

I. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

K. NFPA 85 - Boiler and Combustion Systems Hazard Code.

PART 2 - PRODUCTS

2.1 BOILERS

A. Hot water, natural draft boiler with horizontal grid, finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim.

B. Assembly of finned copper or steel tube heat exchanger within combustion chamber conforming to ANSI/ASME SEC 4 and SEC 8D requirements, and tested for maximum working pressure of 160 psi.

C. Line combustion chamber with interlocking refractory insulating panels of vermiculite, high temperature cements, and refractory clay.

D. Fabricate exchanger of finned copper tubing with baffles and sealed into bronze or cast iron headers with silicone O-ring gaskets or finned steel tubing with baffles and welded into steel headers.

E. Finish with galvanized steel jacket with factory applied baked enamel, insulated with foil faced fiberglass insulation.

F. Heat exchanger shall be cleanable from either side, and from one side without removal of external piping.

G. Acceptable Manufacturers: Raypak HI Delta_____.

2.2 FUEL BURNING SYSTEM

A. Induced Draft Atmospheric Gas Burner: Stainless steel burners for on-off hi-low modulating firing of natural gas with adjustable combustion air supply, gas pressure regulator, diaphragm gas valves, manual shutoff, intermittent spark or glow coil ignition standing pilot, thermistor flame sensing device, and automatic 100% safety gas shutoff.

B. Provide gas burner safety controls to energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.

C. Provide flue gas collector, built-in induced draft fan, with draft gauge and draft proving switches.

D. Provide wire brush for cleaning fire side surfaces.

E. Natural Gas Burner Piping: Provide on unit complete gas train including pressure regulators, safety and operating valves, high and low-pressure switches, main shutoff valve, gas pressure gauge, and airflow safety switch. Gas train to conform to CSD-1 or NFPA 85 requirements. Vent all gas valves outdoors separately.

F. Gas train and all controls shall conform to IRI requirements, unless noted otherwise.

2.3 BOILER TRIM

A. ASME rated safety relief valve set at 45 ___ psig.

B. Low water cut-off with manual reset and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

C. Operating temperature controller with outdoor reset to control burner to maintain supply water temperature.

D. Electronic operating temperature controller with full cover for wall mounting, ambient temperature range of 30º to 150ºF, adjustable reset ratio of outside air temperature change to discharge control point change of 1:2 to 100:1, integral setpoint adjustment range of 80ºF to 230ºF, electronic primary and outdoor sensors, for on-off switching of pilot duty single throw double relays.

E. High limit temperature controller with automatic reset.

F. Provide all trim required to meet ASME CSD-1 NFPA 85. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.4 CONTROLS

A. Provide pre-wired, factory assembled electric controls enclosed in NEMA 250 cabinet. Controls shall include pilot safety and thermocouple transformer, 24-volt gas valve, manual main and pilot valves, and junction box.

B. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

C. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

END OF SECTION

SECTION 23 5233.14

HIGH EFFICIENCY NON-CONDENSING FINNED WATER TUBE BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Fuel Burning System.

C. Boiler Trim.

D. Boiler Vent Flue.

E. Controls.

F. Connections.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 Code for construction of boiler.

C. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

D. Boiler: AGA certified.

E. Provide with a 3-year standard warranty, a 10-year warranty against thermal shock, and a 10-year burner warranty.

F. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

G. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 4 - Boiler and Pressure Vessel Codes, Rules for Construction of Heating Boilers.

F. ANSI/ASME SEC 8D - Boiler and Pressure Vessel Codes, Rules for Construction of Pressure Vessels.

G. ANSI/NFPA 70 - National Electrical Code.

H. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

I. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

K. NFPA 85 - Boiler and Combustion Systems Hazard Code.

PART 2 - PRODUCTS

2.1 BOILERS

A. Hot water non-condensing, sealed combustion type boiler with a finned tube heat exchanger, gas burning system, refractory combustion chamber, controls, and boiler trim.

B. Assembly of finned copper tube heat exchanger within combustion chamber conforming to ANSI/ASME SEC 4 and SEC 8D requirements, and tested for maximum working pressure of 160 psi.

C. Fabricate exchanger of finned copper tubing sealed into bronze or cast iron headers.

D. Finish with 16 gauge galvanized steel jacket with factory applied baked enamel finish.

E. Heat exchanger shall be cleanable without removal of external piping.

F. Provide self-contained unit ready for automatic operation except for connection of water, fuel, power, combustion air, and vent services.

G. Acceptable Manufacturers: Thermal Solutions EVA, Patterson-Kelley D, Laars Rheos

2.2 FUEL BURNING SYSTEM

A. Induced Draft Gas Burner: Burner shall provide modulating firing of natural gas with adjustable combustion air supply, gas pressure regulator, gas valves, manual shutoff valve, ignition device, flame sensing device, and automatic 100% safety gas shutoff.

B. Provide gas burner safety controls to energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and control gas valve.

C. Provide built-in modulating induced draft fan with draft proving switches or damper control.

D. Gas train to conform to CSD-1 or NFPA 85 requirements. Vent all gas valves outdoors separately.

2.3 BOILER TRIM

A. ASME rated safety relief valve.

B. Low water cut-off with manual reset and inlet flow switch to automatically prevent burner operation when water falls below safe level or on low flow through boiler.

C. Operating temperature controller to control burner to maintain supply water temperature.

D. Provide with hi-limit temperature control with automatic reset, combination pressure/temperature gauge, high temperature switches for vent outlet and cabinet, and single-point electrical connection.

E. Provide all trim required to meet ASME CSD-1 NFPA 85. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.4 BOILER VENT FLUE

A. The boiler manufacturer shall furnish review and approve vent size, type, and routing of all vent flue piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use with category IV appliances with operating temperatures of up to 480°F.

B. Refer to Section 23 51 00 for materials.

2.5 CONTROLS

A. Provide pre-wired factory assembled electric controls enclosed in NEMA 250 cabinet. Controls shall include pilot safety and transformer, gas valve, manual main and pilot valves, and junction box.

B. A boiler system control panel shall be provided by the boiler manufacturer to sequence the firing of the boiler(s) and to start and stop the associated boiler circulation pumps.

C. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

D. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

E. The boiler system control panel shall include contacts for a trouble alarm to the DDC system.

END OF SECTION

SECTION 23 5233.16

STEEL WATER TUBE BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Boiler Trim.

C. Fuel Burning System.

D. Control Panel.

E. Connections.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. Conform to ANSI/ASME SEC 1, SEC 4 and SEC 8D and ANSI/AGA Z21.13 for construction of boilers.

C. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

D. Boiler Units: AGA certified.

E. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 1 - Boiler and Pressure Vessel Codes - Rules for Construction of Power Boilers.

F. ANSI/ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.

G. ANSI/ASME SEC 8D - Boiler and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

H. ANSI/NFPA 70 - National Electrical Code.

I. ANSI/UL 726 - Oil-Fired Boiler Assemblies.

J. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

K. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

L. NFPA 85 - Boiler and Combustion Systems Hazard Code.

PART 2 - PRODUCTS

2.1 BOILERS

A. Provide factory assembled, fire-tested, self-contained, and readily transported unit ready for automatic operation except for connection of water, condensate, fuel, electrical, and vent services.

B. Unit: Steel membrane wall water tube boiler on integral structural steel base with integral forced draft burner, burner controls, boiler trim, refractory, insulation and jacket.

C. Construct per ANSI/ASME Boiler and Pressure Vessel Code for allowable working pressure of 125 psi water.

D. Provide two lifting eyes on top of boiler.

E. Provide adequate tappings, observation ports, removable panels and access doors for entry, cleaning, and inspection.

F. Insulate casing with readily removable glass fiber blanket insulation covered by sectional preformed sheet metal jacket. Boiler casing temperature shall not exceed ambient temperature by over 18ºF with surface air velocity of one foot per second.

G. Factory paint boiler, base, and other components with hard finish silicone enamel.

H. Boiler shall be provided with a minimum of 5 square feet of heating surface area per boiler horsepower.

I. Provide each boiler with spare parts consisting of the following: seven indicating lamps, once control cabinet fuse, one flame detector canner cell, one ignition electrode for pilot assembly, one set of thermal overload elements for burner fan motor starter.

J. Acceptable Manufacturers: Bryan, Cleaver Brooks, and Unilux.

2.2 HOT WATER BOILER TRIM

A. Provide pressure gauge and thermometer and ASME rated safety relief valves.

B. Provide low water cut-off with manual reset.

C. Operating temperature controller shall control burner to maintain boiler water temperature.

D. High limit temperature controller shall override burner.

E. Provide air vent tapping in boiler shell.

F. Provide all trim required to meet ASME CSD-1. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

G. Gas train shall be UL and FM listed and shall be sized for 2 psi inlet gas pressure.

2.3 FUEL BURNING SYSTEM

A. General: Forced draft automatic burner integral with front head of boiler designed to burn natural gas. Burner operation modulating with low fire ignition position. Maintain fuel-air ratios automatically with flue gas temperature minimum 68ºF above dew point temperature of flue gases at boiler outlet.

B. Blower: Statically and dynamically balanced to supply combustion air. Direct connect to motor and equip with inlet silencer and outlet air dampers.

C. Silencer: Burner supplier should provide as an accessory item a standalone sound deadening attenuator. Silencer shall be made of minimum 14 gauge steel sized to match up to the burner inlet. A layer of sound deadening material shall completely line the interior of the silencer, held in place by a honeycomb mesh of aluminum wire. The silencer shall have a safety mesh incorporated to block debris from entering the burner. The silencer shall incorporate one long radius elbow and extend upward at least 24 inches from the top level of the boiler inlet. The silencer shall be a bolt up design that can be easily removed for burner maintenance.

D. Gas Burner: Forced draft, high radiant multi-port power burner with gas-electric ignition and gas pressure regulator.

E. Natural Gas Burner Piping: Include on unit complete gas train including pressure reducing valve or valves.

F. Natural Gas Burner Piping: Provide on unit complete gas train including pressure regulators, safety and operating valves, high and low-pressure switches, main shutoff valve, gas pressure gauge, and airflow safety switch. Gas train to conform to CSD-1 or NFPA 85 requirements. Vent all gas valves outdoors separately.

G. Gas train and all controls shall conform to IRI requirements, unless noted otherwise.

H. Manufacturers: Industrial Combustion, Power Flame, Webster, Weishaupt, Cleaver Brooks.

2.4 CONTROL PANEL

A. Mount on boiler. Hinged metal cabinet to contain programming relay, blower motor starter, and control switches.

B. Program relay to control ignition, starting and stopping of burner, and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, pilot, or main flame failure. Interlock to shutdown burner upon combustion air pressure drop. Acceptable Manufacturers: Fireye Flame Monitor Controller (Bulletin E100) or equal Honeywell.

C. Manual-automatic selector switch and damper motor positioning switch to permit automatic firing in accordance with load demand, or manual control of firing rate at any desired point between low fire and maximum rating.

D. Electronic detector to prevent primary fuel valves from opening until pilot flame is established.

E. Provide oil-gas selector switch.

F. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Temperature Controls Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

G. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

H. Control panel shall be a minimum of NEMA 1 rated.

2.5 PERFORMANCE

A. Efficiency, verified by factory and site tests shall be minimum 80% from 30 to 100% of maximum firing rate.

2.6 SOURCE QUALITY CONTROL

A. Provide factory tests to check construction, controls, and operation of unit.

B. Provide authorized boiler inspection prior to shipment; submit copy of inspection report to Architect/Engineer.

END OF SECTION

SECTION 23 5239

FIRE TUBE BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.

B. Boiler Trim.

C. Fuel Burning System.

D. Controls.

E. Connections.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Provide authorized factory representatives to conduct initial boiler installation review and start-up. Manufacturer is responsible for burner adjustment and testing.

C. Conform to ANSI/ASME SEC 1, SEC 4 and SEC 8D and ANSI/AGA Z21.13 Code ANSI/UL 726 for construction of boilers.

D. Boiler Burner Units: AGA certified and UL labeled.

E. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

F. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

G. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASME SEC 1 - Boiler and Pressure Vessels Code - Rules for Construction of Power Boilers.

F. ANSI/ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.

G. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

H. ANSI/NFPA 70 - National Electrical Code.

I. ANSI/UL 726 - Oil-Fired Boiler Assemblies.

J. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

K. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

L. NFPA 85 - Boiler and Combustion Systems Hazard Code.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cleaver Brooks “CEW-LN”.

B. Burnham.

C. Johnston.

D. Hurst.

2.2 BOILERS

A. Boiler shall be designed for 15 -psig steam. The maximum operating pressure shall be 12 psig.

B. Boiler shall be three pass wetback horizontal firetube updraft boiler with a minimum of 5 square feet of heating surface per rated boiler horsepower. Boiler shall be mounted and shipped on a heavy steel frame with integral forced draft burner, burner controls, boiler trim, refractory, insulation and jacket factory mounted.

C. Unit may be shipped broken down into individual components only if required to install unit in existing building. Contractor is responsible for assembly of all components following manufacturer's installation requirements.

D. Burner, including low NOx package, shall be approved and listed by Underwriters Laboratories Inc. (UL).

E. Boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate setting into place and ready for attachment of steam, feedwater, fuel, electrical, vent, and blowdown connections.

F. Boiler shell shall be constructed in accordance with ASME Boiler Code and must receive authorized boiler inspection prior to shipment. A copy of the inspection report shall accompany the boiler to the site.

G. Provide two lifting eyes on top of boiler, hinged front and rear doors shall be davited, gas tight, and rear door shall be insulated with blanket material and a steel covering.

H. Front and rear tube sheets and flue fully accessible for inspection and cleaning. Boiler tubes shall not include turbulators, swirlers, or other add-on appurtenances.

I. Provide observation ports at each end of boiler.

J. Provide hand holes and manholes for boiler inspection and cleaning.

K. Insulate casing with readily removable, 2" thick glass fiber blanket insulation covered by sectional preformed sheet metal jacket. Boiler casing temperature not to exceed ambient temperature by over 18ºF with surface air velocity of one foot per second.

L. Factory paint boiler, base, and other components with enamel finish.

M. Provide stack thermometer, 3-1/2" diameter, black letters on white background, bi-metal type.

N. Efficiency, verified by factory and site tests shall be minimum 80% from 30 to 100% of maximum firing rate.

O. Provide minimum of 5 sq. ft. of fire side heating surface per rated boiler horsepower.

2.3 HOT WATER BOILER TRIM

A. Water pressure and temperature gauge. With ASME rated safety relief valve(s), sized for full boiler capacity.

B. Low water cut-off with manual reset, integral with water column, with blowdown valves.

C. Operating temperature controller with outdoor reset to maintain boiler water temperature.

D. Electronic operating temperature controller with full cover for wall mounting, ambient temperature range of 0º to 120ºF, adjustable reset ratio of outside air temperature to discharge control point of 1:2 to 100:1, integral setpoint adjustment range of 80º to 230ºF, electronic water and outdoor sensors, for on-off switching of pilot duty single throw double pole relays.

E. High limit temperature controller for burner.

F. Boiler air vent and drain.

G. Provide all trim required to meet ASME CSD-1 NFPA 85. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.4 FUEL BURNING SYSTEM

A. General: Forced draft automatic burner integral with front head of boiler designed to burn No. 2 oil and natural gas. Burner operation modulating with low fire ignition position. Maintain fuel-air ratios automatically with flue gas temperature minimum 68ºF above dew point temperature of flue gases at boiler outlet.

B. Blower: Statically and dynamically balanced to supply combustion air. Direct connect to motor and equip with inlet silencer and outlet air dampers.

C. Combination Gas-Oil Burner: Burner for gas and light oil to be built as single unit. Gas burner and oil burner complete with gas pressure regulator. Oil burner must be able to fire without the use of natural gas.

D. Oil Burner: Low pressure air atomizing forced draft type with electric ignition.

E. Drip Pan: Provide 24" x24" x2" deep, 16 gauge galvanized steel soldered pan on floor under each oil burner.

F. Oil Pump: Capacity approximately twice maximum burning rate.

G. Oil Burner Piping: Include oil pressure regulating devices, oil metering controls, solenoid shutoff valves, oil strainer and instrumentation, integrally mounted on unit and adequate to permit performance adjustment.

H. Natural Gas Burner Piping: Include on unit complete gas train including pressure reducing valve or valves.

I. Gas Burner:

1. Forced draft, high radiant annular entry, premix, power burner with gas-electric ignition and gas pressure regulator.

2. Natural Gas Burner Piping: Provide on unit complete gas train including pressure regulators, safety and operating valves, high and low-pressure switches, main shutoff valve, gas pressure gauge, and airflow safety switch. Gas train to conform to CSD-1 or NFPA 85 requirements. Vent all gas valves outdoors separately.

3. Gas Valves: Provide at least 2 motorized gas valves. Provide additional valves as required by local codes or Owner's Insurance Company. Gas control valves, pressure switches, and regulators shall be UL motorized type.

4. Gas train and all controls shall conform to IRI requirements, unless noted otherwise.

5. Size gas train for pressure available in boiler room. Provide additional regulators if needed and vent outdoors separately.

2.5 CONTROL PANEL

A. Mount on boiler. Hinged metal cabinet with key lock containing electronic flame safeguard and programming control, control circuit fusing, control circuit transformer, control circuit switch, manual potentiometer, indicating lights, numbered terminal strip, engraved name plates, relays, magnetic motor starters with thermal overload protection.

B. Burner motor voltage shall be as scheduled on the drawings. Provide step down transformer for control power.

C. On modulating burners provide manual-automatic selector switch and damper motor positioning switch to permit automatic firing in accordance with load demand, or manual control of firing rate at any desired point between low fire and maximum rating.

D. Provide controls for combustion air damper. On a call for heat, the combustion air damper shall open. When the damper proves open, the burner shall be allowed to fire. Provide numbered terminal blocks for remote wiring.

E. Burner control and safety functions shall be performed by microprocessor based burner management system with self-diagnostics, non-volatile memory, message center, and flame monitor. Program shall control ignition, flame protection, limit controls, burner activation, blower activation, pre-combustion purge and post combustion purge, fuel valve activation, recycling interlocks, and pilot confirmation.

1. Program shall be self-monitoring and indicate any faults on LED message center. Provide all required accessories for a complete and fully operational system.

2. Acceptable Manufacturer: Fireye Flame-Monitor Electronic Controller (Bulletin E100), or equal Honeywell.

F. Panel to include indicating lights to show operating conditions of primary and secondary low water level alarms, flame failure and fuel valve open. Mount indicating lights and switches in hinged drop-panel for access to wiring.

G. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Temperature Controls Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

H. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read “BOILER EMERGENCY SHUTOFF”. Square D XAL K174 or as approved by Architect/Engineer.

I. Provide 24-volt secondary rated relays wired to the burner circuits to provide the following inputs or outputs to the DDC system:

1. Burner Circuit On/Off.

2. High Water.

3. Primary Low Water.

4. Secondary Low Water.

5. Flame Failure.

6. Fuel Valve Open.

J. Temperature Control Contractor will connect to these relays.

END OF SECTION

SECTION 23 5400

FORCED AIR FURNACES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Forced Air Furnaces.

B. Refrigerant Cooling Coil and Condensing Unit.

C. Humidifier.

D. Controls.

1.2 QUALITY ASSURANCE

A. Conform to requirements of UL and applicable codes.

B. Cooling system tested and rated per AHRI Standard 210.

C. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. AHRI 210 - Standard for Unitary Air-Conditioning Equipment.

C. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Bryant

B. Carrier

C. Lennox

2.2 TYPE

A. Provide counterflow type with gas burner elements.

B. Provide self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner or heater, controls, and air filter.

2.3 FABRICATION

A. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.

B. Combustion Chamber: Welded stainless steel.

C. Supply Fan: Centrifugal type, rubber mounted with direct drive, rubber isolated 1750 rpm, 4-speed motor.

D. Air Filters: 1" thick glass fiber, disposable type arranged for easy replacement.

2.4 BURNER

A. Oil Burner: High pressure atomizing type, rubber mounted with adjustable combustion air blower, fuel pump, hinged flame inspection port, cadmium sulfide flame sensor, electrodes, ignition transformer, and oil nozzle.

B. Oil Burner Safety Controls: Thermostat energizes burner motor and electric ignition. Time delay relay limits time to establish main flame. Flame sensor monitors flame continuously during burner operation and stops burner on flame failure with manual reset necessary. Solenoid operated oil delay valve opens after burner motor starts and closes instantly when burner motor stops.

[***OR*****]**

C. Gas Burner: Condensing sealed combustion type, combustion gas valve and pressure regulator incorporating manual shutoff, standing pilot, pilot valve, automatic 100% shutoff, and thermocouple pilot safety device 90% minimum efficiency.

D. Gas Burner Safety Controls: Thermocouple sensor prevents opening solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.

2.5 OPERATING CONTROLS

A. Provide low voltage, adjustable room thermostats to control burner operation.

B. Provide high limit control, with fixed stop at maximum permissible setting, to de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

C. Control supply fan based on bonnet temperature independent of burner controls. Include manual switch for continuous fan operation.

2.6 ELECTRIC HEATER OPERATING CONTROLS

A. Low voltage room thermostat energizes heater stages in sequence with fixed delay between stages.

B. High limit temperature control de-energizes heating elements.

C. Supply fan starts before electric elements are energized and continues operating after thermostat is satisfied until bonnet temperature reaches minimum setting. Include manual switch for continuous fan operation.

2.7 DRAFT CONTROL

A. Provide each furnace with PVC combustion air inlet and CPVC outlet piping.

B. For oil burner, provide barometric draft regulator in flue.

C. Provide induced draft blower. Pressure switch prove blower operation before allowing gas valve to open. Draft blower shall only operate during heating cycle.

2.8 EVAPORATOR COIL

A. Mount in furnace supply plenum, copper tube, aluminum fin, coil assembly, and refrigerant piping connections.

B. Install a drain pan under each cooling coil per ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

C. Provide factory installed thermostatic expansion valve.

2.9 REFRIGERATION PACKAGE

A. Compressor: Hermetically sealed, 3,600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, hard start kit, motor thermal overload protection, service valves, and drier.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, direct drive propeller fan resiliently mounted, galvanized fan guard.

C. Shutter head pressure control for starting and operating down to 30 ºF.

D. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

E. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.10 REFRIGERATION OPERATING CONTROLS

A. Low voltage, room thermostat controls compressor, condenser fan, and supply fan. Refer to Section 23 09 00 for thermostat description.

B. Include thermostat system selector switch (heat-cool-off) and fan control switch (on-auto).

C. Timer shall limit compressor starts to 12 per hour.

END OF SECTION

SECTION 23 5700

HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shell and Tube Type Heat Exchangers.

B. Plate Type Heat Exchangers.

C. Accessories and Trim.

1.2 REFERENCES

A. ANSI/ASME - Boilers and Pressure Vessels Code.

PART 2 - PRODUCTS

2.1 SHELL AND TUBE TYPE HEAT EXCHANGER

A. Tubes: U-tube type with 3/4 inch OD minimum seamless copper tubes suitable for 125 psig working pressure.

B. Shell: Steel with threaded or flanged piping connections and necessary tappings, steel saddle and attaching U-bolts, prime coated.

C. Heads: Cast iron or fabricated steel with steel or bronze tube sheets, threaded or flanged for piping connections.

D. Water Chamber and Tube Bundle: Removable for inspection and cleaning.

E. Design: Heating fluid in shell and heated fluid in tubes.

F. Acceptable Manufacturers: Bell & Gossett, Taco, Amtrol, Armstrong Pumps, Thrush.

2.2 PLATE AND FRAME TYPE HEAT EXCHANGER

A. Furnish and install exchangers as scheduled on the drawings.

B. Units shall be complete, preassembled, pressure tested at the factory and flushed clean.

C. Units shall bear ASME code stamp for 125 psig water service.

D. Unit shall be rated and certified in accordance with AHRI 400.

E. Plate and frame heat exchangers shall be free standing with multiple plates, designed to allow for opening and cleaning in place. Steel baseplates for anchor bolts and lifting holes. Plates shall be 304 or 316 stainless steel with capability to withstand full operating pressure in one channel with zero pressure in the adjoining channel.

F. Gaskets shall be one-piece molded construction, of a material suitable for the fluids, pressures and temperature specified. Arrange gaskets so gasket failure cannot cause fluid mixing.

G. The plate pack shall be completely enclosed in a removable, rust protected shroud.

H. All exterior steel surfaces shall be shot blasted and coated with a two-part epoxy spray enamel baked at 250ºF.

I. Units shall be easily expanded by adding plates to accommodate future requirements. Frame shall have capacity for 50% additional plates.

J. Only one exchanger per frame is permitted. All pipe connections shall be to the fixed plate.

K. Acceptable Manufacturers: Alfa-Laval, Bell & Gossett, Mueller, APV, American Vicarb, Tranter, Armstrong Pumps.

PART 3 - EXECUTION

3.1 WATER-TO-WATER HEAT EXCHANGER TRIM

A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.

B. Heated Water Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, valved drain.

END OF SECTION

SECTION 23 6116

RECIPROCATING REFRIGERANT COMPRESSORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reciprocating Compressor Units.

B. Internal Piping and Accessories.

C. Controls and Control Panel.

D. Motor Starters.

E. Electrical Power Connections.

1.2 REFERENCES

A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/UL 207 - Refrigerant-Containing Components and Accessories, Non-electrical.

D. ANSI/UL 303 - Refrigeration and Air-Conditioning Condensing and Compressor Units.

E. AHRI 520 - Positive Displacement Refrigerant Compressors, Compressor Units, and Condensing Units.

F. ASHRAE 23 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors.

G. ASME B19.3 - Safety Standard for Compressors for Process Industries.

H. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

1.3 WARRANTY

A. Provide five-year parts and labor warranty for compressor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Copeland.

B. Danfoss.

C. Tecumesh.

D. Carlyle

E. Bitzer

2.2 MANUFACTURED UNITS

A. Compressor Units: Hermetic Semi-hermetic (serviceable hermetic) compressor and motor, with cylinder unloaders, crankcase heater, suction and discharge service valves, vibration isolators, and control panel.

B. Construction and Ratings: In accordance with AHRI 520, and ANSI/UL 207 and ANSI/UL 303. Testing shall be in accordance with ASHRAE 23. Conform to ASHRAE 90.1.

C. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

D. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.3 HERMETIC COMPRESSORS

A. Compressors: Statically and dynamically balanced crankshaft, spring loaded discharge valves, internal relief valve, suction service valve, discharge muffler. Install in welded steel shell, with integral suction accumulator, internally mounted on spring vibration isolators.

B. Lubrication System: Oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer, arranged to ensure adequate lubrication during starting, stopping, and normal operation.

C. Capacity Reduction Equipment: Electrically actuated suction valve unloaders with replaceable solenoid valves, starting compressor unloaded.

D. Motor: Two speed 3600/1800 RPM, suction gas cooled with two winding thermostats for overheating protection. Refer to Section 23 05 13. Furnish with across-the--line part winding starter.

E. Crankcase Heater: To evaporate refrigerant in crankcase during shut down, energize when compressor is not operating.

2.4 SEMI-HERMETIC (SERVICEABLE HERMETIC) COMPRESSORS

A. Construction: Statically and dynamically balanced, forged steel or cast iron crankshafts, aluminum or steel connecting rods, automotive type cast iron or aluminum pistons, floating piston rings, ring type suction and discharge valves, removable discharge heads, spring loaded heads and replaceable cylinder liners, mesh suction inlet screen, and discharge service valves.

B. Lubrication System: Reversible, positive displacement, oil pump with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.

C. Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by oil pressure gas discharge pressure solenoid valve. Provide for unloaded compressor start.

D. Motor: 1800 RPM, suction gas cooled with electronic winding over temperature protection. Refer to Section 23 05 13. Furnish across-the-line starter.

E. Crankcase Heater: Evaporates refrigerant in crankcase during shutdown. Energize when compressor is not operating.

2.5 CONTROLS

A. On compressor, mount steel control panel containing power and control wiring, disconnect switch, factory wired with single point power connection.

B. Provide across-the-line starter, non-recycling compressor overload, starter relay, control power transformer or terminal for controls power, terminal strip for connection to interface equipment and manual reset current overload protection.

C. Provide the following devices on control panel face:

1. Compressor run light.

2. Start-stop switch.

3. Control power fuse or circuit breaker.

4. Demand limit switch.

5. Elapsed time meter.

6. Crankcase heater start-stop switch and light.

D. Provide high discharge pressure switch, low suction pressure switch, and oil pressure switch safety controls with pilot lights arranged so that operating any one will shut down machine and require manual reset.

E. Provide the following operating controls:

1. Multi-step suction pressure controller which activates cylinder unloaders.

2. Timer prevents compressor from short cycling.

3. Part winding start timer.

4. Timer to pump down on high suction pressure.

F. Provide pre-piped gauge board with pressure gauges for suction and discharge pressures, and oil pressure.

END OF SECTION

SECTION 23 6213

AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Condensing Unit Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Refrigerant Circuit.

E. Motor Starters.

F. Electrical Power Connections.

1.2 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. ANSI/UL - Safety for Heating and Cooling Equipment.

C. AHRI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

D. ASHRAE 23 - Methods of Testing for Rating Positive Displacement Condensing Units.

E. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.

B. Construction and Ratings: In accordance with AHRI 210/240 and ANSI/UL 207 and 303. Testing shall be in accordance with ASHRAE 14.

C. Performance Ratings: EER and COP meeting ANSI/ASHRAE 90.1.

2.2 CASING

A. House components in welded steel frame with galvanized steel panels with painted finish meeting ASTM B117 salt spray test standard.

B. Mount starters, disconnects, and controls in weatherproof panel with full opening access doors.

C. Provide gasketed removable access doors or panels with quick fasteners.

2.3 CONDENSER COILS

A. Aluminum fins mechanically bonded to seamless copper tubing. Provide 12ºF of refrigerant subcooling at design conditions. Copper fins for Harbor, WLA, SW Campuses.

B. Coil Guard: Painted expanded metal or PVC coated steel wire.

2.4 CONDENSER FANS AND MOTORS

A. Vertical discharge direct drive propeller type condenser fans with fan guards.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in thermal overload protection.

C. Dynamically and statically balanced fans.

D. Separate motors for each fan.

2.5 COMPRESSORS

A. Construction: Semi-hermetic or hermetic scroll type with suction and discharge valves.

B. Mounting: Dynamically balance rotating parts and mount on vibration isolators.

C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.

D. Capacity Reduction Equipment: Multiple compressors, and/or multi-speed or variable-speed compressors.

E. Motor: Suction gas cooled with electronic sensor and winding over temperature protection.

F. Crankcase Heater: Evaporates refrigerant in crankcase during shutdown.

G. Suitable for operating on voltages plus or minus 15% of nameplate ratings.

2.6 REFRIGERANT CIRCUIT

A. Refrigerant may be new or reclaimed, and shall meet ARI-700-2004 Standard for Refrigerant Purity.

B. Provide each unit with the number of refrigerant circuits needed to provide the scheduled unloading and properly transport oil.

C. Provide the following for each refrigerant circuit:

1. Replaceable core type filter dryer.

2. Liquid line sight glass and moisture indicator.

3. Thermal expansion valve.

4. Insulated suction line.

5. Suction and liquid line service valves.

6. Schraeder valve.

7. Condenser pressure relief valve.

8. Suction filter.

9. Liquid line solenoid valve.

D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control using thermistors.

E. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

F. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.7 CONTROLS

A. On unit, mount NEMA 4 steel control panel containing power and control wiring, factory wired with single point power connection.

B. For each compressor, provide across-the-line starter, factory wired non-fused disconnects, non-recycling compressor overload, starter relay, and control power transformer. For each condenser fan, provide across-the-line starter with starter relay.

C. Provide the following safety controls arranged so operating any one will stop unit:

1. Manual reset high discharge pressure switch for each compressor.

2. Automatic reset low suction pressure switch for each compressor.

3. Manual reset oil pressure switch.

D. Provide the following operating controls:

1. Timer(s) that prevents compressor short cycling.

2. Low ambient temperature (as scheduled) thermostat to lock out compressor.

3. If discharge or return air control is provided with the unit, provide adjustable time delay between stages of operation. All units shall be compatible with direct control of staging by DDC systems. Suction pressure control of staging is not acceptable.

4. Pump down control that activates when the lead compressor of each circuit stops.

5. Hot gas bypass sized for minimum compressor loading, or “Frostat” control. If hot gas is used, the pipe with modulating flow (hot gas or suction) must pitch continuously downward in the direction of flow.

6. Thermostat to cycle fan motors in response to head pressure.

7. Head pressure controlled damper condenser fan. Rated for starting at 0°F.

2.8 ACCEPTABLE MANUFACTURERS

A. Trane.

B. York.

C. Daikin.

D. Carrier.

E. Units shall be of the same manufacturer as the evaporator coil.

END OF SECTION

SECTION 23 6313

AIR COOLED REFRIGERANT CONDENSERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Refrigerant Condenser Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Refrigerant Piping and Connections.

E. Motor Starters.

F. Electrical Power Connections.

1.2 REFERENCES

A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/UL 207 - Refrigerant Containing Components and Accessories, Non-electrical.

D. ANSI/UL 303 - Refrigeration and Air-Conditioning Condensing and Compressor Units.

E. AHRI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

F. ASHRAE 20 - Methods of Testing for Rating Remote Mechanical Air-Cooled Refrigerant Condensers.

G. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Minimum).

H. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

1.3 HANDLING AND EQUIPMENT ROOM REQUIREMENTS

A. Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, rigging, and final setting.

B. Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation.

C. Equipment Room Requirements:

1. Follow minimum standards for refrigeration systems as required by ANSI/ASHRAE Standard 15-2001.

2. Install proper outside exhaust of chiller refrigerant relief device(s) discharge header(s) and purge unit(s). Route exhaust to the outside of the building and away from all air intakes in compliance with ANSI/ASHRAE Standard 15-2001.3. Install a refrigerant monitor that can be calibrated for appropriate refrigerant(s), capable of detecting concentrations of minimum ppm for low level leak detection to assure the safety of chiller plant operating personnel.

3. Install suitable audible and visual alarms that activate well below the acceptable exposure level (AEL) of the specific refrigerant(s) to alert persons inside and outside the equipment room that a refrigerant leak condition exists.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane.

B. York.

C. Daikin.

D. Carrier

2.2 MANUFACTURED UNITS

A. Provide packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil, liquid accumulator, screens, and controls.

B. Construction and Ratings: In accordance with AHRI 210/240 and ANSI/UL 207 and ANSI/UL 303. Testing shall be in accordance with ASHRAE 20. Conform to ASHRAE 90.1.

C. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

D. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.3 CASING

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners.

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Air test under water to 425 psig and vacuum dehydrate. Provide 12°F of subcooling at design conditions. Copper fins for Harbor, SW and WLA Campuses.

B. Coil Guard: Expanded metal.

C. Configuration: Two refrigeration circuits each with receiver.

2.5 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guards, equipped with roller or ball bearings with grease fittings extended to outside of casing. 200,000 hours average bearing life.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in current and thermal overload protection.

2.6 CONTROLS

A. Provide factory wired and mounted control panel, NEMA 250, containing fan motor starters, fan cycling thermostats, head pressure controls, compressor interlock and control transformer.

B. Provide controls to permit operation down to 30 ºF ambient temperature.

C. Provide thermostat to cycle fan motors in response to outdoor ambient temperature.

D. Provide electronic low ambient control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

END OF SECTION

SECTION 23 6413

ABSORPTION WATER CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chiller Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Connections.

E. Starters.

F. Electrical Power Connections.

1.2 REFERENCES

A. AHRI 560 - Absorption Water Chilling Packages.

B. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum).

F. ANSI/NEMA MG 1 - Motors and Generators.

1.3 REGULATORY REQUIREMENTS

A. Conform to AHRI 560 and ANSI/ASHRAE 15.

B. Conform to ANSI/UL 465. Provide UL label for individual components.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code.

D. Provide certification of inspection from authority having jurisdiction approval.

E. Conform to ASHRAE 90.1.

1.4 WARRANTY

A. Provide five year warranty. Include coverage for complete package as manufactured and delivered to site including materials and labor only.

1.5 MAINTENANCE SERVICE

A. Furnish service and maintenance of chillers for five years from Date of Substantial Completion.

B. Include labor and materials required for routine servicing and maintenance as recommended in manufacturer's published operating and maintenance data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane.

B. York.

C. Daikin.

D. Carrier

2.2 MANUFACTURED UNITS

A. Description: Factory assembled and tested, packaged, water cooled, liquid chillers, consisting of absorber-evaporator assembly, solution heat exchanger, solution and refrigeration pumps, interconnecting piping, refrigeration accessories, instrument and control panel including gauges and indicating lights, auxiliary components and accessories, motor starters, and construction and ratings per AHRI 560.

2.3 PUMPS

A. Self-contained hermetically sealed centrifugal solution and refrigerant pumps, separate or on common shaft, lubricated and cooled by lithium bromide refrigerant.

2.4 HEAT EXCHANGERS

A. Shell and tube type, seamless or welded steel construction in one or two shells with cast iron or welded steel heads.

B. First stage absorber tubes of cupro-nickel.

C. All other tubes of cupro-nickel or seamless copper, rolled or silver brazed to tube sheets.

D. Water Boxes: Machine welded to heat exchanger with tapped drain and vent connections, flanged or mechanical joint piping connections, flanged and bolted covers arranged to permit inspection and replacement. Water boxes shall be marine type.

E. Provide thermometer wells for temperature controller and low temperature cutout.

F. Construction and Materials: Conform to ANSI B9.1 and ASME Boiler and Pressure Vessel Code.

G. Design steam space of concentrator for 50 psi minimum working pressure. Test at 1.5 times maximum working pressure.

H. Design hot water space of concentrator for 250 psi minimum working pressure. Test at 1.5 times maximum working pressure.

2.5 PURGE SYSTEM

A. Automatically or manually purge unit of non-condensables, storing them external to unit.

2.6 AUTOMATIC DECRYSTALLIZATION

A. Automatic cycle using lithium bromide solution to prevent crystallization while machine is running or at power failure shutdown.

2.7 CONTROLS

A. Electric or Electronic Control Panel: ANSI/NEMA 250, Type 1; factory wired and mounted panel that includes:

1. Terminal block.
2. Control transformer and separately fused control circuit.
3. Motor temperature cutout and low temperate cutout.
4. Time delay for dilution cycle.
5. Motor starters.
6. Purge motor fuse.
7. Indication of operation of unit, pumps, and purge system.
8. Chilled water temperature control.
9. Condenser water temperature control.
10. Chilled water temperature readout.
11. Condenser water temperature readout.
12. Optional start-up demand limiter.

B. Hot Water Control Valve: Normally closed pneumatic with demand limiter to slow rate at which valve opens to minimum of five-minute cycles.

C. Solution Throttling Device: To increase part load economy and assure operation to 30% specified full load capacity, at 68ºF entering condenser water temperature.

END OF SECTION

SECTION 23 6416

ELECTRIC WATER CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chiller Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Piping Connections.

E. Starters.

F. Electrical Power Connections.

G. Variable Frequency Drives.

H. Refrigerant Sensor.

1.2 REFERENCES

A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE 135 - BACnet-2016.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/NFPA 70 - National Electric Code.

G. ANSI/UL 1995 - Heating and Cooling Equipment.

H. AHRI 550/590-2003 - Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.

I. AHRI 700-2006 - Specification for Fluorocarbon Refrigerants.

J. IEEE 519 - Power condition (for use with VFD applications).

K. International Mechanical Code - 2000 - Chapter 11 Refrigeration.

L. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane

B. York

C. Daikin

D. Carrier

2.2 CHILLER PACKAGE

A. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of centrifugal or rotary screw compressor, motor, condenser, evaporator, refrigeration accessories, control panel auxiliary components, interconnecting piping and wiring, accessories, and motor starters.

B. Evaporator and condenser tubes are designed to operate under variable water flow conditions. Chiller manufacturer shall determine the minimum flow rates and maximum rate of water flow rate change and coordinate with the Controls Subcontractor.

C. Fabricate water chiller mounting frame and attachment to the pressure vessel with reinforcement strong enough to resist water chiller movement during a seismic event when the water chiller mounting frame is anchored by vibration isolators to the building structure.

D. Units shall have efficiency meeting ASHRAE 90.1.

E. Refrigerants shall be R134a, or R1233zd(e).

F. Chiller performance shall be as listed on the drawings.

G. Factory insulate all cold surfaces of chiller with 3/4” 1” closed cell flexible elastomeric insulation with maximum 'K' value of 0.26. Provide two coats of protective coating over insulation. Factory insulate marine water boxes to allow removal for cleaning.

H. Paint chiller completely (including insulation). Provide one pint of additional paint for touch-up after installation.

2.3 COMPRESSORS

A. Compressor Casing: Cast iron, horizontally or vertically split with machined passages, leak tested with refrigerant trace gas to 120% rated pressure of refrigerant. Provide view port to monitor compressor rotation.

B. Centrifugal Impellers: Single or multi-stage, in-line design, fully shrouded, statically and dynamically balanced, overspeed tested to 120% of operating speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.

C. Rotary Screws: Statically and dynamically balanced with tight clearance, end bearings, and capacity control.

D. Motor: Hermetically sealed, refrigerant cooled or open drive, air cooled, single speed, low slip induction type.

E. Lubrication: Direct drive, positive displacement oil pump, with oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater, and motor controls. Interlock to start before chiller motor and run after motor stops. Provide sight glass to monitor oil level.

F. Refrigerant: Charge unit with refrigerant at the factory and provide field charging if required after installation.

G. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

H. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.4 EVAPORATOR

A. Provide shell and tube evaporator with seamless or welded steel construction with cast iron or fabricated steel heads, individually replaceable seamless copper tubes with integral fins, mechanically expanded into the tube sheets designed for 150 psig 300 psig working pressure. If tubes are expanded at intermediate supports, they shall be of a “skip-fin” design, double grooved, or continuously enhanced tubes may be held in place with clips.

B. Tubes: Minimum 3/4” diameter internally enhanced tubing. Minimum tube wall thickness of 0.028”.

C. Provide shell design to prevent carryover of refrigerant into the compressor.

D. Factory test refrigerant side of the evaporator, complete with tubes, to refrigerant working pressure, evaporator refrigerant side shall be vacuum leak tested and pressure leak tested. Hydrostatically test water side at 1.5 times the design working pressure but not less than 225 psig with grooved connections. All tests shall be in accordance with ANSI/ASME SEC 8.

E. Water Box: Compact with side nozzle location **OR** marine water boxes with side nozzle locations arranged for inspection of tubes without disturbing water piping. Nozzles shall be mechanical grooved ANSI raised face flanges ANSI 300# flanges. Provide with taps for drain, vent and safety relief connections. Provide water box assembly with factory mounted gantry or hinges to allow for swing-out and suspension of condenser end sheet once unbolted.

F. Provide thermometer wells for temperature controller and low temperature cutout.

G. Provide multiple reseating spring loaded relief valves on shell in accordance with ANSI/ASHRAE 15. If a carbon rupture disc is factory installed on the equipment, external relief valves shall be installed in the factory or in the field by the Contractor.

H. Construction and materials per ANSI B9.1 and ANSI/ASME SEC 8.

2.5 CONDENSER

A. Provide shell and tube condenser with seamless or welded steel construction with cast iron or fabricated steel heads, individually replaceable seamless copper tubing with integral fins, mechanically expanded into the tube sheets designed for 150 psig working pressure. If tubes are expanded at intermediate supports, they shall be of a “skip-fin” design, double grooved, or continuously enhanced tubes may be held in place with clips.

B. Tubes: Minimum 3/4” diameter internally enhanced tubing. Minimum tube wall thickness of 0.028”.

C. Factory test refrigerant side of the evaporator, complete with tubes, to refrigerant working pressure, evaporator refrigerant side shall be vacuum leak tested and pressure leak tested. Hydrostatically test water side at 1.5 times the design working pressure but not less than 225 psig with grooved connections. All tests shall be in accordance with ANSI/ASME SEC 8.

D. Water Box: Compact with side nozzle location **OR** marine water boxes with side nozzle locations arranged for inspection of tubes without disturbing water piping. Nozzles shall be mechanical grooved ANSI raised face flanges ANSI 300# flanges. Provide with taps for drain, vent and safety relief connections. Provide water box with factory mounted gantry or hinges to allow for swing-out and suspension of condenser end sheet once un-bolted.

E. Provide baffle between the tube bundle and the condenser shell to allow for even distribution of hot gas longitudinally throughout the condenser to protect tubes from high velocity compressor gas and to concentrate non-condensable gases.

F. Construction and materials per ANSI/ASME SEC 8.

2.6 FREE COOLING

A. Provide factory installed automated free cooling cycle whenever condenser water is available at temperatures below that of the chilled water discharge setpoint using the unit mounted chiller control panel.

B. Provide all required valves, operators, refrigerant storage vessel, refrigerant gas line, valved liquid return line, and factory wired components. Provide unit with additional refrigerant, if required.

C. Unit control panel shall include manual switching into and out of free-cooling mode either by operator access at panel or from a binary input from the DDC system.

2.7 AUXILIARY HEAT RECOVERY CONDENSER

A. Construction and materials shall match that of condenser section.

B. Provide factory installed auxiliary condenser to allow automatic heat recovery whenever the chiller plant is operating and water source requires heating.

C. Machine load, water flow rate, and temperature determine the amount of heat recovered. All heat that cannot be supplied to the auxiliary condenser shall be rejected through the standard condenser.

2.8 CONTROLS

A. Lockable steel control panel mounted on chiller containing solid state, microprocessor based, fully automatic operating and safety controls. Display shall be multiple-line LCD or lighted display with keypad.

B. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:

1. High refrigerant (condenser) pressure.

2. Low refrigerant (evaporator) temperature for R-134a pressure for R-22 and R-123.

3. Low chilled water temperature.

4. High bearing temperature.

5. High oil temperature.

6. High or low oil pressure (differential pressure switch).

7. Refrigerant cooled motor winding temperature.

8. Electrical overload.

9. Extended compressor surge.

10. Starter fault trip indicator.

11. Starter overload trip indicator.

C. Provide with the unit the following safety controls factory installed, arranged so that operating any one will shut down machine and automatically reset:

1. Chilled water flow (differential pressure or flow sensor type).

2. Condenser water flow (differential pressure or flow sensor type).

D. Provide the following functions from the control panel face:

1. Machine off-auto switch.

2. Selector switch for load, unload, hold or automatic operation.

3. Operating/alarm condition.

4. Temperature and pressure operating setpoints.

5. Entering and leaving temperatures of chilled water and condenser water.

6. Refrigerant pressures in evaporator and condenser.

7. Saturation temperatures in evaporator and condenser.

8. Oil temperature and pressure.

9. Oil pump condition.

10. Evaporator low temperature cutout condition.

11. Condenser high pressure cutout condition.

12. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, and provides motor current signal to chiller capacity control module.

13. Demand limit.

14. Elapsed run time.

15. Percent of maximum motor amperage.

16. Number of compressor starts.

E. Provide the following operating controls:

1. Solid state, chilled water temperature controller controls electronic guide vane operator and/or VFD within throttling range of 0.5ºF and features adjustable load rate. Locate temperature sensor in leaving chilled water.

2. Start-to-start timer to prevent compressor short cycling.

3. Demand limit device to manually set maximum current between 40% and 100% of full load amps.

F. Provide all needed relays, devices, and/or controls to provide interface to DDC for the following:

1. Chilled Water Output Setpoint.

2. Trouble Alarm on Controls.

3. Trouble Alarm on Starter.

4. Chiller Enable/Disable.

5. Chiller Start/Stop.

6. Chiller Demand.

[***OR*****]**

G. Chiller manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135/2016. This may be accomplished through a system integration panel, or “gateway”. Integration shall be through an RS-232 connection. Integration panels shall be provided as part of the chiller package. Wiring between the chiller control panel(s) and the integration panel shall be the responsibility of the chiller manufacturer.

2.9 STARTER

A. Steel NEMA 1 type enclosure mounted on chiller, containing Star Delta starter, manufactured in accordance with chiller manufacturer's specifications and factory tested. Enclosure size shall meet NEC requirements for termination of number and size of wires shown on electrical plans.

B. Enclosure shall have top or bottom cable entry and front access. Door shall accommodate padlock.

C. Mount the following devices in enclosure:

1. Disconnect switch.

2. Pilot relays to start and stop compressor on signal from chiller control panel.

3. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, and provides motor current signal to chiller capacity control module.

4. Control power transformer.

5. Fused control circuits for control circuit, oil pump motor, oil heater, and purge control unit.

6. Contactor interlocks for communication between starter and control panel.

7. Capacitors, one per phase (if required to correct power factor to 0.9 minimum).

8. Fused disconnect and starter for oil pump.

9. Relay for remote mounted emergency shut down switch.

10. Single point power connection and separate control circuit.

D. Provide the following on starter door or control panel:

1. Ammeters, one per phase.

2. Voltmeters, one per phase.

3. Maintenance disconnect.

[***OR*****]**

2.10 VARIABLE FREQUENCY DRIVES

A. Provide factory installed Variable Frequency Drive (VFD) to automatically regulate chiller compressor speed in response to cooling load and compressor pressure lift. Include adaptive capacity control logic to automatically adjust motor speed and compressor pre-rotation vane position independently. The control panel shall provide maximum operating efficiency at all loads and water temperatures.

B. Input Voltage Tolerance: 460 V plus 10% or 506 V maximum.

C. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.

D. Capable of driving full load, under the following conditions, without derating:

1. Ambient Temperature: 32°F to 104°F.

2. Relative Humidity Range: 5% to 90% (non-condensing).

3. Elevation: Up to 3300 feet.

4. Minimum Efficiency at Full Load: 95 percent.

E. A digital regulator shall provide V/Hz control.

F. The VFD shall accept 8.0% continuous overload of continuous amp rating with no time limit, PWM (pulse width modulated) output, IGBT (insulated gate bipolar transistors) power technology, DC bus inductor (choke), and wireless construction.

G. The VFD shall be unit mounted in a shielded NEMA 1 enclosure with all power and control wiring between drive and chiller factory installed. Field power wiring shall be a single point connection. The entire chiller/drive package shall be UL listed and labeled.

H. If the VFD is shipped for field installation, provide all labor and materials to install components at the jobsite and coordinate with E.C.

I. Harmonic Distortion: Provide maximum 5.0% total harmonic distortion (THD) of amps and voltage measured at the input of the VFD. This requirement references IEEE 519-92 and the maximum recommended THD at the point of common coupling (electric utility connection).

J. Provide the following readouts shall be provided in addition to the standard chiller readouts: input kVA, total power factor, 3 phase input voltage, 3 phase input current, and 3 phase input.

K. All heat producing devices shall be contained in a single heatsink with single inlet and out connections for the connection of chilled water. When factory mounted on the chiller package, the water connections shall be piped and leak tested at the factory.

2.11 VIBRATION

A. Chillers shall be statically and dynamically balanced. Vibration velocities measured at the base shall not exceed 0.1 inches per second peak in any plane. If field testing by Owner reveals non-compliance, Contractor shall rebalance until in compliance and pay for initial and subsequent vibration testing.

2.12 REFRIGERANT SENSOR

A. Microprocessor-based refrigerant detection sensor capable of measuring and alarming at the refrigerant TLV. Monitor shall be capable of sampling up to four separate points.

B. Unit shall be wall mounted with NEMA 4 steel enclosure and a minimum of two internal alarm relays with remote display module located outside the Chiller room.

C. Relays shall be SPDT rated for 5 amps at 120 VAC.

D. Unit shall have 2 line X 20 character readout, indicate all levels of alarm, indicate trouble, and have an internal horn with silence switch.

E. Unit shall detect 0-1000 ppm ± 1 ppm reading accuracy.

F. 32°F to 122°F temperature range and 0% to 99% non-condensing relative humidity range.

G. Acceptable Manufacturers: MSA Instruments "Chillgard", GasTech, Sierra Monitor Corp., San Tech Corp., Thermal Gas Systems "Haloguard", Enmet Corp, Vulcain, Toxalert.

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. Demonstrate system operation and verify specified performance.

END OF SECTION

SECTION 23 6419

RECIPROCATING WATER CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chiller Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Piping Connections.

1.2 REFERENCES

A. ANSI/AHRI 590 - Standard for Reciprocating Water-Chilling Packages.

B. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/UL 465 - Central Cooling Air Conditioners.

G. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

1.3 REGULATORY REQUIREMENTS

A. Conform to ANSI/AHRI 590 and ANSI/ASHRAE 15.

B. Conform to ANSI/UL 465 and provide UL label.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code.

D. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 COMPRESSOR CHILLER

A. General:

1. Complete reciprocating chiller package. Size and capacity as scheduled on the drawings.

2. Factory run tested and monitored for capacity, power draw and control operation.

3. Ship with a full operating charge of refrigerant and oil. Refrigerant may be new or reclaimed. Reclaimed refrigerant shall meet ARI-700-88 Standard for Refrigerant Purity.

4. Designed for use with remote refrigerant condenser.

B. Evaporator:

1. Shell and tube design with seamless copper tubes roller expanded into tube sheets.

2. Designed, tested and stamped per ASME Code for refrigerant side working pressure of 225 psig and water side working pressure of 150 psig.

3. One water pass with a series of internal baffles.

4. Each shell to include drain connections, bulb wells for low temperature cutout and temperature controller.

5. Flare connections on chilled water inlet and outlet for pressure drop measurements.

6. 3/4" expanded PVC insulation (K = 0.26).

7. Dual refrigeration circuits, completely independent.

C. Control Panel:

1. Each unit control panel shall have separate starter and refrigeration control sections.

2. Starter section shall contain: single point connection for customer power hookup, power controls for Star Delta starter, non-cycling compressor overload, and control power transformer.

3. Refrigeration section shall contain the reset relay, compressor service switches, motor protector, differential oil pressure control, high and low-pressure controls and central unit microprocessor.

4. The microprocessor shall control the compressor anti-recycle functions, low water temperature cutout, loss of charge protection, leaving chilled water temperature control, load limiting, low ambient start logic, self-diagnostic capability, and periodic pump out.

D. Refrigerant Circuit:

1. Each circuit shall contain: liquid line solenoid valve, filter dryer, liquid line sight glass, thermal expansion valve, 1/4" flare charging port, insulated suction line, compressor discharge and suction shutoff valves, pressure relief device.

2. Unit shall have two independent refrigeration circuits.

3. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

4. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

E. Compressor and Motor:

1. Motor shall be suction gas cooled and suitable for ±10% of nameplate voltage. One sensor embedded in each motor winding shall protect against excessive temperatures.

2. Direct-drive 1750 RPM semi-hermetic reciprocating compressor.

3. Reversible, spring-loaded, positive displacement oil pump, self-relieving to the suction side.

4. Oil filter and magnetic plugs, oil level sight glass, oil charging valve, two-point lubrication for each bearing and connecting rod, crankcase heater and crankcase well, double-mesh suction inlet screen.

5. High strength, ring-type suction and discharge valve.

6. Electric-actuated cylinder head unloading, removable discharge heads, discharge service valve.

7. Spring isolators.

F. Unit Mounted Disconnect Switch: Molded case switch located inside control panel door to disconnect unit power.

G. Each compressor shall have 3 step capacity control in response to supply chilled water temperature. Unloaders shall be solenoid-actuated and gas-operated.

H. Alarm Package:

1. Include electronic-horn with loudness rating of 103 dB - 3500 Hz at 10 feet and pilot lights indicating loss of evaporator flow, low temperature thermostat operation, power on, compressor on, compressor malfunction.

2. Furnish push-to-test button and lock-on feature to note which control operated.

3. Light shall remain on regardless of the position of the control until reset.

I. Sound Attenuator:

1. Furnish acoustically lined, 16 gauge sheet metal compartment with 1" thick, 1-1/2# fiberglass insulation.

2. Cover shall be easily removable for compressor access.

J. Hot Gas Bypass:

1. Furnish all valves, wiring and piping needed for hot gas bypass operation. Control shall allow compressor to operate below the minimum loading step.

2. Hot gas bypass control shall stop the chiller if there is no load and restart the chiller when load returns.

K. Flow Interlock: Furnish a differential pressure switch to indicate water flow through the evaporator. Connect to inlet and outlet piping and wire into the control circuit. Switch shall have adjustable set point and differential.

L. Hot Gas Muffler: Furnish hot gas muffler on each compressor. Field install in hot gas line.

M. Sequence Panel:

1. Provide a microprocessor based control panel to control multiple units.

2. Controls shall allow series or parallel operation.

3. Panel shall allow chilled water temperature reset based on outdoor or zone temperature.

4. Install panel near chillers and wire to each chiller.

N. Acceptable Manufacturers: Trane, York, Daikin.

2.2 WATER COOLED CHILLER

A. General:

1. Complete reciprocating chiller package. Size and capacity as scheduled on the drawings.

2. Factory run tested and monitored for capacity, power draw and control operation.

3. Shipped with full operating charge of refrigerant and oil. Refrigerant may be new or reclaimed. Reclaimed refrigerant shall meet ARI-700-88 Standard for Refrigerant Purity.

4. Designed for water cooled condensing.

B. Evaporator:

1. Shell and tube type with seamless copper tubes roller expanded into tube sheets.

2. Designed, tested and stamped in accordance with ASME Code for Refrigerant side working pressure of 225 psig, and water side working pressure of 150 psig.

3. One water pass with internal baffles.

4. Each shell to include drain connections, bulb well for low temperature cutout and temperature controller.

5. Flare connections on chilled water inlet and outlet for pressure drop measurements.

6. 3/4" expanded PVC insulation (K = 0.26).

7. Dual refrigeration circuits, completely independent.

C. Condenser:

1. Shell and tube type with seamless integral fin copper tubes expanded into tube sheets.

2. Designed, tested and stamped in accordance with ASME Code for refrigerant side working pressure of 300 psig, and water side working pressure 150 psig 300 psig safety relief valve on R-22 units.

3. Each condenser shall include a subcooler circuit.

4. Tubes shall be cleanable and replaceable.

5. Furnish a two-way, self-contained water regulating valve to control the flow of city water through the condenser. Valve shall shut off 100% when the chiller is not operating. Control water flow by head pressure or condenser water outlet temperature.

D. Control Panel:

1. Each unit control panel shall have separate starter and refrigeration control sections.

2. Starter section shall contain the single point connection for power hookup, power controls for Star Delta starter, non-cycling compressor overload, and control power transformer.

3. Refrigeration section shall contain the reset relay, compressor service switches, motor protector, differential oil pressure control, high and low-pressure controls and central unit microprocessor.

4. The microprocessor shall control the compressor anti-recycle functions, low temperature cutout, loss of charge protection, leaving chilled water temperature control, load limiting, low ambient start logic, self-diagnostic capability, and periodic pump out.

E. Refrigerant Circuit:

1. Each circuit shall contain: Liquid line solenoid valve, filter dryer, liquid line sight glass, thermal expansion valve, 1/4" flare charging port, insulated suction line, compressor discharge and suction shutoff valves, pressure relief devices.

2. Unit shall have two independent refrigeration circuits.

3. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

4. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

F. Compressor and Motor:

1. Motor shall be suction gas cooled and suitable for ±10% of nameplate voltage. One sensor embedded in each motor winding shall protect against excessive temperatures.

2. Direct-drive 1750 RPM semi-hermetic reciprocating compressor.

3. Reversible, spring-loaded, positive displacement oil pump, self-relieving to the suction side.

4. Oil filter and magnetic plugs, oil level sight glass, oil charging valve, two-point lubrication for each bearing and connecting rod, crankcase heater and crankcase well, double-mesh suction inlet screen.

5. High strength, ring-type suction and discharge valve.

6. Electric-actuated cylinder head unloading, removable discharge heads, discharge service valve.

7. Spring isolators.

G. Molded case switch shall be located inside control panel door for disconnect of unit power.

H. Each compressor shall have 3 step capacity control in response to supply chilled water temperature. Unloaders shall be solenoid-actuated and gas operated.

I. Alarm Package:

1. Include electronic-horn with loudness rating of 103 dB - 3500 Hz at 10 feet and pilot lights indicating loss of evaporator flow, low temperature thermostat operation, compressor malfunction.

2. Furnish push-to-test button and lock-on feature to note which control operated.

3. Light shall remain on regardless of the position of the control until reset.

J. Sound Attenuator:

1. Furnish acoustically lined 16 gauge sheet metal compartment with 1" thick, 1-1/2# fiberglass insulation.

2. Cover shall be easily removable for compressor access.

K. Hot Gas Bypass:

1. Furnish all valves, wiring and piping needed for hot gas bypass operation. Control shall allow compressor to operate below the minimum loading step.

2. Hot gas bypass control shall stop the chiller if there is no load and restart it when load returns.

L. Flow Interlock: Furnish differential pressure switches with adjustable set point and differential to indicate water flow through the evaporator and condenser. Connect to inlet and outlet piping and wire into the control circuit.

M. Hot Gas Muffler: Furnish hot gas muffler on each compressor. Field install in hot gas line.

N. Sequence Panel:

1. Provide a microprocessor based control panel to control multiple units.

2. Controls shall allow series or parallel operation.

3. Panel shall allow chilled water temperature reset based on outdoor or zone temperature.

4. Install panel near chillers and wire to each chiller.

O. Acceptable Manufacturers: Trane, York, Daikin, Carrier.

END OF SECTION

SECTION 23 6423

MODULAR SCROLL HEAT RECOVERY CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular Scroll Heat Recovery Chillers.

B. Modular Rotary-Screw Heat Recovery Chillers.

C. Modular Reciprocating Heat Recovery Chillers.

D. Modular Magnetic Bearing Centrifugal Chillers.

E. Controls and Control Connections.

1.2 REFERENCES

A. AHRI 550/590-2011 - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.

B. AHRI 700-2012 - Specification for Fluorocarbon Refrigerants.

C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. ANSI/ASHRAE 135 - BACnet-2001.

F. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code.

G. ANSI/NEMA MG 1 - Motors and Generators.

H. ANSI/NFPA 70 - National Electric Code.

I. ANSI/UL 1995 - Heating and Cooling Equipment.

J. International Mechanical Code - 2012 - Chapter 11: Refrigeration.

K. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

1.3 REGULATORY REQUIREMENTS

A. Conform to AHRI 550/590 standard for testing and rating of centrifugal chillers.

B. Conform to ANSI/UL 465 code for construction of centrifugal chillers and provide UL label.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers.

D. Conform to ANSI/ASHRAE 15 refrigeration safety standard.

E. Conform to IMC Chapter 11 for installation of mechanical refrigerating equipment.

F. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Multistack

B. ClimaCool

C. Arctichill

D. Engineered Air

E. Chillit

2.2 MODULAR HEAT RECOVERY CHILLER PACKAGE

A. Provide factory assembled and tested, packaged, modular water-cooled heat recovery chiller consisting of multiple modules of sizes as scheduled. The multi-circuit chiller must be able to produce chilled water and hot water even in the event of a failure of one or more refrigerant circuits OR changeout of one or more modules.

B. The modular chiller shall control to a heating water chilled water heating and chilled water temperature. This occurs by staging the modules to meet the heating water chilled water temperature setpoint and modulating chilled water flow to meet the chilled water temperature setpoint. Leaving chilled water heating water is allowed to float based on heating cooling demand.

C. Each module shall be self-contained including scroll rotary-screw reciprocating compressors, motors, condenser, evaporator, control valves, refrigeration accessories, control panel auxiliary components, interconnecting piping and wiring, accessories, and motor starters.

D. Six-pipe system: Each module shall utilize condenser water to produce both chilled water and heating water simultaneously.

E. Virtual moveable end-cap:

1. Provide automatic control valves in supply and return header piping between each evaporator and condenser module to allow for a VME (virtual moveable end cap).

2. Provide packaged controls to allow flow only through active modules.

F. Each module shall consist of no less than two refrigeration circuits. Each circuit shall be constructed to be able to operate independently. Failure of a single circuit shall not affect other circuits.

G. Each independent refrigerant circuit shall consist of the following:

1. Compressor

2. Thermostatic expansion valve

3. Sight glass

4. Replaceable filter drier with charging connection

5. High and low pressure and/or low temperature safety controls

6. Refrigerant receivers

7. Reversing valve

8. Liquid solenoid valve

H. All modular chiller components, including compressor, motor, condenser, evaporator, refrigeration accessories, control panel auxiliary components, interconnecting piping and wiring, accessories, and motor starters, shall be mounted on a heavy steel frame. All electrical controls shall be contained in the same module.

I. Power connections for the modules shall have individual point of connection. Each set of refrigeration circuit components shall be provided with separate disconnecting means so that a single refrigeration circuit can be serviced while the chiller is operating.

J. Each bank of modules shall be provided with a common control system that shall be capable of staging the operation of the units to simultaneously maintain the leaving evaporator and condenser temperatures as scheduled. Refer to the control drawings for details of the control sequence.

K. Unit shall be designed to be able to operate at condenser leaving water temperatures up to 50°F for single wall heat exchangers and 50 °F for double wall heat exchangers.

L. Units shall have efficiency meeting ASHRAE 90.1.

M. Unit performance shall be as listed on the drawings.

N. Factory insulate all cold surfaces of unit with minimum 1/2” closed cell flexible elastomeric insulation with maximum ‘K’ value of 0.26.

O. Unit shall be factory pressure tested and fully charged and run tested at scheduled evaporator and condenser water flow rates.

P. Provide automatic control valves in evaporator and condenser piping of each module to provide isolation of modules during part load operation.

2.3 SCROLL COMPRESSORS

A. Each module shall contain two scroll type hermetic compressors independently circuited with rubber-in-shear isolators. Each system shall also include high discharge pressure and low suction pressure manual reset safety cutouts.

B. Refrigerant: Charge unit with R-410a R-134a refrigerant at the factory and provide field charging if required after installation.

C. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.4 ROTARY-SCREW COMPRESSORS

A. Each module shall contain one rotary-screw type hermetic compressors, independently circuited and mounted to the module with rubber-in-shear or spring isolators. Each circuit shall also include high discharge pressure and low suction pressure manual reset safety cutouts.

B. Refrigerant: Charge unit with R-134a refrigerant at the factory and provide field charging if required after installation.

C. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.5 MAGNETIC BEARING CENTRIFUGAL COMPRESSORS

A. Direct drive, oil-free, two-stage, semi-hermetic centrifugal compressor complete with an active/passive magnetic bearing system. Casing shall be constructed of aluminum. The electronic soft starters, compressor controls, inverter power electronics, bearing and motor control shall be fully integrated into the compressor and shall be digitally controlled. The magnetic bearing system must be fully protected in the case of a power outage with a built-in power generation system.

B. Centrifugal Impellers: Statically and dynamically balanced, vibration tested and not exceeding a level of 0.14 inches per second.

C. Capacity control shall primarily be achieved by varying compressor operating speed. A movable inlet guide vane shall only be used in the case of a surge or choke condition arising during normal operation. The moveable inlet guide vane shall be of the electromechanical type.

D. Bearing System: The compressor shall use an oil-free bearing system of the digitally controlled homopolar magnetic bearing type. The bearings shall have a fully integrated backup bearing system and shall have a self-generating power system so that the bearings stay levitated in the case of a power failure. No sump heater is to be required. The bearing system shall use no more than 500 watts of energy during its normal operation, and it must also have an automatic balance capability in the case of any external vibration or out of balance event occurrence.

E. Motor: Direct-drive, synchronous permanent magnet brushless, hermetic type DC motor. Liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase.

F. Motor Starter: Soft start, fully integrated into the compressor, with a maximum starting current of 20% of the full load current of the compressor. Fully integrated with the motor’s variable speed control system. Must be factory tested during the run test of the unit.

G. Variable Frequency Drive: The chiller shall be equipped with a fully integrated variable frequency drive (VFD) to automatically regulate compressor speed in response to cooling load and compressor pressure lift. The chiller control shall coordinate compressor speed and guide vane position to optimize chiller efficiency. The following requirements shall apply:

1. Digital regulator shall provide V/Hz control.

2. 110% continuous overload of continuous amp rating with no time limit.

3. Pulse width modulated (PWM) output.

4. Insulated gate bipolar transistors (IGBT) power technology.

5. Full power rating at 2 kHz.

6. DC bus inductor (choke).

7. Wireless construction.

8. Refrigerant cooled and fully integrated into the compressor package.

H. Refrigerant: Charge unit with R-134a refrigerant at the factory and provide field charging if required after installation.

I. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.6 RECIPROCATING COMPRESSORS

A. Each module shall contain two direct-drive, semi-hermetic reciprocating compressors with internal spring isolation. Each system shall also include high discharge pressure and low suction pressure manual reset safety cutouts.

B. Motor shall be suction gas cooled and suitable for ±10% of nameplate voltage. One sensor embedded in each motor winding shall protect against excessive temperatures.

C. Reversible, spring-loaded, positive displacement oil pump, self-relieving to the suction side.

D. Oil filter and magnetic plugs, oil level sight glass, oil charging valve, two-point lubrication for each bearing and connecting rod, crankcase heater and crankcase well, double-mesh suction inlet screen.

E. High strength, ring-type suction and discharge valve.

F. Electric-actuated cylinder head unloading, removable discharge heads, discharge service valve.

G. Refrigerant: Charge unit with R-134a refrigerant at the factory and provide field charging if required after installation.

H. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.7 EVAPORATOR

A. Brazed plate heat exchanger, seamless or welded 316 stainless steel plate construction with copper brazing, designed for 650 psig working pressure.

B. Insulate evaporator and suction side refrigerant tubing with minimum 3/4” closed cell insulation blanket to prevent condensation.

C. Construction and materials per ANSI B9.1 and ANSI/ASME SEC 8.

2.8 CONDENSER

A. Brazed plate heat exchanger, seamless or welded 316 stainless steel plate construction with copper brazing, designed for 650 psig working pressure

B. Construction and materials per ANSI/ASME SEC 8.

C. Condensers serving domestic water shall be double-wall heat exchangers.

D. Provide with taps for refrigerant safety relief valve.

2.9 CONDENSER

A. Shell and tube condenser with seamless construction with cast iron or fabricated steel heads, individually replaceable seamless copper tubing with integral fins, mechanically expanded into the tube sheets designed for 150 psig working pressure.

B. Tubes: Minimum 3/4” diameter internally enhanced tubing. Minimum tube wall thickness of 0.025”.

C. Factory test refrigerant side of the evaporator, complete with tubes, to refrigerant working pressure, evaporator refrigerant side shall be vacuum leak tested and pressure leak tested. Hydrostatically test water side at 1.5 times the design working pressure but not less than 225 psig with grooved connections. All tests shall be in accordance with ANSI/ASME SEC 8.

D. Water Box: Compact with side nozzle location. Nozzles shall be mechanical grooved ANSI raised face flanges or ANSI 300# flanges. Provide with taps for drain, vent and safety relief connections. Provide removable head for service and maintenance.

E. Provide baffle between the tube bundle and the condenser shell to allow for even distribution of hot gas longitudinally throughout the condenser to protect tubes from high velocity compressor gas and to concentrate non-condensable gases.

F. Construction and materials per ANSI/ASME SEC 8.

2.10 EVAPORATOR AND CONDENSER WATER MAINS

A. Each module shall include supply and return mains for both evaporator and condenser water.

2.11 CONTROLS

A. Master Controller: Master controller shall be capable of monitoring and staging all each bank of modular chillers. System shall have a remote master controller.

B. Unit-mounted Slave Controllers: Lockable steel control panel mounted on unit containing solid state, microprocessor based, fully automatic operating and safety controls. Display shall be multiple-line LCD or lighted display with keypad. Upon failure of the master controller, the slave controllers shall continue to run the chillers with no interruption of service to the system.

C. The unit shall have the capability to operate in response to both heating water and cooling water setpoints.

D. A new lead compressor is selected every 24 hours to assure even distribution of compressor run time. LIFO or FIFO shall be selectable based on Owner preference.

E. Individual monitoring of leaving chilled water temperatures from each refrigeration system shall be programmed to protect against freezing up.

F. The unit control system shall monitor entering and leaving chilled water and condenser water hot water temperatures to determine system load and select the number of compressor circuits required to operate to satisfy the building load.

G. Provide all interface hardware and software required for an interface connection to the FMCS. Provide all hardware and software definitions involved with the interface. Provide a chiller service technician to assist with commissioning of the controls. Provide interface for the following points:

1. Analog Inputs to DDC:
    a. Entering chilled and hot water temperature.
    b. Leaving chilled and hot water temperatures.
    c. Entering condenser water temperature.
    d. Leaving condenser water temperature.
    e. Compressor run time.
    f. Suction temperature.
    g. Chilled water flow status.
    h. Hot water flow status.
    i. Chiller load profile.
    j. Capacity.
    k. Demand.
    l. Compressor suction temperature.
    m. Compressor liquid temperature.
    n. Compressor winding temperature.
2. Analog Outputs from DDC:
    a. Chilled water setpoint.
    b. Hot water setpoint.
3. Binary Inputs to DDC:
    a. Chiller run status.
    b. Manual reset alarms.
    c. Auto reset alarms.
    d. Low water flow.

e. Low water temperature.

f. Compressor status.

g. Discharge pressure fault.

h. Suction pressure fault.

4. Binary Outputs from DDC:

a. Chiller Enable/Disable.

H. Provide the following safety controls arranged so that operating any one will shut down the affected module and require manual reset:

1. High refrigerant (condenser) pressure.

2. Low refrigerant (evaporator) temperature for R-134a pressure for R-410a.

3. Low leaving evaporator temperature.

4. High bearing temperature.

5. High oil temperature.

6. High or low oil pressure (differential pressure switch).

7. Refrigerant cooled motor winding temperature.

8. Electrical overload.

9. Extended compressor surge.

10. Starter fault trip indicator.

11. Safety control setpoints must be coordinated for this project, which may require changes from factory programmed defaults. Changes made to factory defaults shall be provided to the Owner in a Microsoft Word document.

I. Provide with the unit the following safety controls factory installed, arranged so that operating any one will shut down machine and automatically reset:

1. Chilled water flow (differential pressure type).

2. Condenser water flow (differential pressure type).

J. Provide the following functions from the control panel face:

1. Machine off-auto switch.

2. Selector switch for load, unload, hold, or automatic operation.

3. Operating/alarm condition.

4. Temperature and pressure operating setpoints.

5. Entering and leaving temperatures of chilled water and condenser water.

6. Refrigerant pressures in evaporator and condenser.

7. Evaporator low temperature pressure cutout condition.

8. Condenser high pressure cutout condition.

9. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, and provides motor current signal to chiller capacity control module.

10. Number of compressor starts.

K. Provide the following operating controls:

1. Solid state condenser water temperature controller modulates electronic throttling valve for condenser water to regulate water flow as required to maintain leaving water temperature within throttling range of 0.5ºF and features adjustable load rate. Locate temperature sensor in leaving condenser water. Valve actuator shall be capable of full close to full open operation in less than 30 seconds. Provide modulating valve for each compressor/condenser water circuit.

2. Solid state chilled water temperature controller modulates electronic throttling valves for chilled water to regulate water flow as required to regulate flow through the evaporator as required to maintain scheduled temperature drop. Locate temperature sensor in leaving chilled water. Valve actuator shall be capable of full close to full open operation in less than 30 seconds. Provide modulating valve for each compressor/chilled water circuit.

3. Both compressors in one module must be activated before compressors in any other module are allowed to be activated. Both compressors in one module must be deactivated before any compressors in other modules are allowed to be deactivated.

4. Control valves shall close when associated modules are inactive.

5. Start-to-start timer to prevent compressor short cycling.

6. Demand limit device to manually set maximum current between 40% and 100% of full load amps.

7. Condenser water head pressure regulating control for entering condenser water less than 60°F.

L. Unit manufacturer shall provide a communication gateway interface card/panel fully compatible with the facility management and control system (FMCS) to enable communication with the unit control panel. Communication between the FMCS and the chiller control panel shall be through a BACnet MSTP BACnet IP LON Modbus connection. Communication gateway shall be provided as part of the unit package. Wiring between the unit control panel(s) and the communication gateway interface shall be the responsibility of the unit manufacturer. The gateway interface shall allow the FMCS to monitor and control the operation of the heat pump system.

M. Equipment manufacturer factory authorized service agent shall be responsible for assisting the Temperature Control Contractor and the temperature control programmer with device addressing and confirming that the unit communicates with the FMCS as specified. Reset the unit specific BACnet and internet protocol addresses to coordinate with the University of Iowa's Controls Engineering Department. Agent shall be on site to provide the assistance; remote assistance is not acceptable.

N. Unit controls shall provide the monitoring and control points available to the FMCS system as described on the control drawings. The FMCS system will provide monitoring, setpoint adjustment, and scheduling of units.

2.12 ELECTRICAL POWER REQUIREMENTS

A. Each chiller module shall have power connections as scheduled.

B. Provide steel NEMA 1 type enclosure mounted on chiller. Enclosure size shall meet NEC requirements for termination of number and size of wires shown on electrical plans.

C. Enclosure shall be designed for top or bottom cable entry with front access. Door shall accommodate padlock.

D. Power Phase Monitor:

1. Provide a power phase monitor on the incoming power supply to the chiller. This device shall prevent the chiller from operating during periods when the incoming power is unsuitable for proper operation, and shall be shipped loose for installation in the main power panel.

2. The power phase monitor shall provide protection against the following conditions:

a. Low voltage (brown-out).

b. Phase rotation.

c. Loss of phase.

d. Phase imbalance.

2.13 SOUND ATTENUATION PANELS

A. Provide panel enclosures made of 18 gauge sheet metal with powder coat paint finish and fiberglass insulation.

END OF SECTION

SECTION 23 6430

AIR COOLED WATER CHILLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Chiller Package.

B. Charge of Refrigerant and Oil.

C. Controls and Control Connections.

D. Connections.

E. Starters.

F. Sound Reduction Package

1.2 REFERENCES

A. ANSI/AHRI 590 - Standard for Water Chilling Packages using the Vapor Compression Cycle.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/ASME SEC 8 - Boiler and Pressure Vessel Code

E. ANSI/NEMA MG 1 - Motors and Generators.

F. ANSI/UL 1995 - Heating and Cooling Equipment.

G. ANSI/UL 984 - Safety Standard for Hermetic Motor Compressors.

H. ANSI/AFBMA 9 - Load ratings and Fatigue Life for Ball Bearings.

I. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.

J. AHRI 550 - Centrifugal or Rotary Water - Chilling Packages.

K. ARI-700-99 - Specification for Fluorocarbon Refrigerants.

L. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

1.3 REGULATORY REQUIREMENTS

A. Conform to ANSI/AHRI 590, ANSI/UL 1995, ANSI/ASME SEC 8 Boiler and Pressure Vessel Code, ANSI/UL 984, and ANSI/ASHRAE 15.

B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane.

B. York.

C. Daikin.

D. Carrier.

2.2 AIR COOLED WATER CHILLERS

A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, fans, evaporator, thermal expansion valve, refrigeration accessories, and control panel.

B. Evaporator tubes are designed to operate under variable water flow conditions. Chiller manufacturer shall determine the minimum flow rates and maximum rate of water flow rate change. Coordinate with the Controls Contractor Subcontractor.

C. Provide chiller with automatic capacity control down to 10% 20% scheduled minimum capacity.

D. Fabricate water chiller mounting frame and attachment to the pressure vessel with reinforcement strong enough to resist water chiller movement during a seismic event when the water chiller mounting frame is anchored by vibration isolators to the building structure.

E. Units shall have efficiency meeting ASHRAE 90.1.

F. Charge unit with refrigerant at the factory and provide field charging if required after installation.

2.3 COMPRESSORS

A. Hermetic direct drive scroll compressor(s) with suction strainer, crankcase oil heater, and suction and discharge valves.

[***OR*****]**

B. Semi-hermetic direct drive rotary screw compressor(s) with oil injection, crankcase oil heater, and capacity control slide valve.

C. Statically and dynamically balance rotating parts. Mount on internal vibration isolators.

D. Provide oil charging valve, oil level sight glass, oil filter, and magnetic plug on strainer, arranged to ensure adequate lubrication during starting, stopping, and normal operation.

E. Provide reciprocating compressors with suction valve unloaders with lifting mechanism operated by solenoid valve. Provide for unloaded compressor start.

F. Provide compressor motor, suction gas cooled with solid state sensor and electronic winding overheating protection.

G. Provide compressor heater to evaporate refrigerant returning to compressor during shut down. Energize heater when compressor is not operating.

2.4 EVAPORATOR

A. Provide shell and tube evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits on multiple compressor units.

B. Design, test, and stamp refrigerant side for the applicable refrigerant working pressure and water side for 150 300 psi working pressure, in accordance with ANSI/ASME SEC 8.

C. Insulate with 0.75" thick flexible plastic or rubber elastomeric cellular foam insulation with maximum K value of 0.28.

D. Provide heat tape to protect evaporator to -20ºF.

E. Provide water drain and vent connection and thermometer wells for temperature controller and low temperature cutout.

F. Evaporator shall have only one entering and one leaving water mechanical groove 150 psi flange connection. If manufacturer provides two separate evaporators, contractor shall provide manifold and balancing valves conforming to the requirements of Section 23 21 00 to ensure equal flow is provided to each evaporator.

G. Evaporator shall be UL listed.

H. Design, test, and stamp refrigerant side for the applicable refrigerant working pressure and water side for 150 psi working pressure in accordance with ANSI/ASME SEC 8.

I. Evaporator shall be insulated with closed cell insulation with a minimum R-value of 3.0.

J. Provide thermostatically controlled heaters to protect to -20°F ambient in off-cycle.

K. Provide drain and vent connections in the chilled water piping to allow proper drainage and venting of the heat exchangers. Provide thermometer wells for temperature controller and low temperature cutout.

L. Install a 40 mesh strainer upstream of each heat exchanger.

M. Evaporator shall have ANSI/AWWA C-606 grooved 150 psi flange water inlet and outlet connections.

N. Provide a water flow differential pressure switch in horizontal piping of the supply water line to avoid evaporator freeze-up under low or no flow conditions.

2.5 CONDENSERS

A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.

B. Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits with liquid accumulators. Air test under water to 450 psig.

C. Provide vertical discharge propeller condenser fans with fan guard on discharge and factory mounted, louvered, galvanized steel coil guard panels to completely protect condenser coils. Wire mesh coil protection is not acceptable.

D. Provide low sound, direct drive, variable frequency drive, high efficiency fan motors with Class F insulation, permanently lubricated ball bearings, and built-in current and overload protection.

E. Entire fan assembly shall be statically and dynamically balanced.

2.6 ENCLOSURES

A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.

2.7 REFRIGERANT CIRCUIT

A. Provide refrigerant circuits, factory supplied and piped.

B. Provide for each refrigerant circuit:

1. Liquid line solenoid and shutoff valves.

2. Filter dryer (replaceable core type).

3. Liquid line sight glass and moisture indicator.

4. Electronic or thermal expansion valve.

5. Charging valve.

6. Insulated suction line.

7. Discharge and oil line check valves.

8. Compressor suction and discharge service valves.

9. Condenser pressure relief valve.

10. Refrigerant and oil.

C. Refrigerant may be new or reclaimed. Reclaimed refrigerant shall meet the ARI-700-99 Specification for Fluorocarbon Refrigerants.

D. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

E. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.8 CONTROLS

A. On chiller, mount lockable weatherproof steel control panel, containing starters, power and control wiring, non-fused disconnect switch, factory wired with single point power connection. Provide mechanical interlock to disconnect power when door is open.

B. For each compressor, provide across-the-line wye-delta solid state starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for control power. Provide manual reset current overload protection.

C. Provide the following safety controls with 40-character English display, arranged so any one will shut down machine and require manual reset:

1. Low chilled water temperature switch.

2. High discharge pressure switch for each compressor.

3. Low suction pressure switch for each compressor.

4. Oil pressure switch.

5. Flow switch in chilled water line.

6. Motor current overload.

7. Phase reversal/unbalance/single-phasing.

8. Over/under voltage.

9. Failure of water temperature sensor used by chiller controller.

10. Relay for remote mounted emergency shut-down switch.

11. Low ambient/high ambient.

D. Provide the following operating controls:

1. Chilled water temperature controller that modulates capacity control device(s).

2. Timer to prevent compressor short cycling.

3. Anti-coincidental timer.

4. Timer to pump down on high evaporator refrigerant pressure.

5. Load limit thermostat to limit compressor loading on high return water temperature.

6. Low ambient control for operation down to 0ºF.

7. High ambient controls for operation over 115°F.

E. Microprocessor control panel with digital readout. Display shall be multiple character LCD or lighted display with keypad.

1. User interface shall display at a minimum the following:

a. Operating/alarm condition.

b. Leaving chilled water temperature set point (with adjustment at the panel and via DDC).

c. Entering and leaving chilled water temperature.

d. Percent rated load amps output for each compressor.

e. Condenser pressure for each circuit.

f. Evaporator pressure for each circuit.

g. Outside air temperature.

h. Voltage.

2. Control panel shall communicate the following points to the DDC system via a Lon, Modbus or BACnet interface:

a. Inputs:

1) Chiller enable.

2) Leaving chilled water temperature set point.

3) Chiller mode.

4) Current limit set point.

b. Outputs:

1) Chiller status.

2) Active chilled water set point.

3) Leaving chilled water temperature.

4) Entering chilled water temperature.

5) Alarm descriptor.

6) Average percent Run Load Amps (actual capacity).

7) Active current limit set point.

F. For multiple units, provide mounted sequence panel for operation in series parallel with lead lag switching.

G. Chiller manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135/2001. This may be accomplished through a system integration panel, or “gateway”. Integration shall be through an RS-232 connection. Integration panels shall be provided as part of the chiller package. Wiring between the chiller control panel(s) and the integration panel shall be the responsibility of the chiller manufacturer.

2.9 BEARINGS

A. All bearings shall have a L10 life of not less than 200,000 hours per ANSI/AFBMA 9.

2.10 SOUND REDUCTION PACKAGE

A. Provide sound reduction package including aerodynamic fan blades and compressor wrap/enclosure to limit unit generated sound power to values scheduled on the drawings. Sound power data shall conform to AHRI 370.

END OF SECTION

SECTION 23 6513.13

INDUCED DRAFT COOLING TOWER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cooling Tower.

B. Controls.

C. Ladder and Handrails.

1.2 REFERENCES

A. ANSI/AFBMA 9 - Load Rating and Fatigue Life for Ball Bearings.

B. ANSI/AFBMA 11 - Load Rating and Fatigue Life for Roller Bearings.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASME PTC-23 - Atmospheric Water-Cooling Equipment.

E. Cooling Tower Institute (CTI) ATC-105 - Acceptance Test Code for Water Cooling Towers.

F. Cooling Tower Institute (CTI) - Certification Standard STD-201.

G. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

H. NFPA 214: Standard on Water-Cooling Towers.

1.3 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance instructions.

B. Include start-up instructions, maintenance data, parts lists, controls, and accessories.

PART 2 - PRODUCTS

2.1 STEEL TOWER

Steel Tower with PVC Fill: Marley NC or BAC Series 3000 Cross-Flow, Gravity Distribution

A. Acceptable Manufacturers:

1. Marley Series NC.
2. Baltimore Air Coil.
3. Evapco.

B. Provide manufacturer's FM-approved and labeled cooling tower that is constructed from FM-approved fill materials and components as required by Owner's building insurance requirements.

C. Fabrication:

1. Type: Suitable for outdoor use, counter-flow, draw-thru type, complete with sump, fan, fill, drift eliminators, and motor.

2. Cooling Technology Institute (CTI) Certified, Standard STD-201.

3. Casing: G210 hot dipped galvanized steel. Galvanized after welding.

4. Fan: Cast aluminum axial type, industrial duty oil lubricated, with geared drive, or one piece, multi-grooved neoprene/polyester belt drive.

5. Motor: Single speed high efficiency totally enclosed fan cooled type with special moisture protection, mounted on welded steel frame in fan deck. Refer to "Motors" section in these specifications for additional requirements, including special motors for VFD service.

6. Vibration Limit Switch: Provide a single-pole, double-throw vibration switch in a NEMA 4 housing. Switch shall be adjustable for sensitivity. Switch shall be manual reset type.

7. Fan Cylinder: One-piece, welded hot-dip galvanized steel assembly with full height, inlet cylinder welded to fan deck.

8. Fan Guard: Welded, one-piece guard, rod and wire, hot-dip galvanized after fabrication.

9. Access: Large doors to air plenum and ladder up to fan deck.

10. Provide safety cage on ladder where fan deck is 15 feet or more above tower base. Provide safety rail around tower perimeter and fan deck walkways between multi-cell towers.

11. Fill, Louvers and Drift Eliminators: Fill shall be film-type, vacu-formed PVC, with louvers and drift eliminators formed as part of each fill sheet. Fill shall be suspended from stainless steel structural tubing supported from the tower structure and shall be elevated above the flow of the cold water basin to facilitate cleaning. Air inlet faces of the tower shall be free of water splash-out. Guaranteed drift losses shall not exceed 0.005% of the design .

12. Collecting Basin: Self-cleaning one-piece 304 stainless steel basin with overflow standpipe, bottom outlet sump with screen, anti-vortex bar and mudsill; and float operated makeup valve with capacity as required. Multiple cell towers shall include 304 stainless steel level equalizing flumes.

13. Hot Water Distribution: Open gravity-type galvanized steel 304 stainless steel distribution basins shall include bolt circle to accept 125 lb. flange. Provide flow control valves for throttling and tight shutoff. Plastic distribution nozzles shall be removable and replaceable.

14. Provide removable opaque basin cover for all towers.

15. Towers shall be statically and dynamically balanced prior to leaving the factory. Vibrational velocities measured at the fan supports shall not exceed 0.1 inches per second peak in any plane.

16. Designed for 30 pounds per $ft.^2$ wind load.

17. De-Icing: Provide reversing fan motor and time delay relay to de-ice tower louvers during winter operation.

2.2 FIBERGLASS TOWER

A. Acceptable Manufacturers:

1. Marley Series QuadraFlow.

2. Ceramic Cooling Tower Ultralite.

B. Performance:

1. Provide in tower sump electric heaters suitable to maintain temperature of water in sump at 40ºF when outside temperature is 0ºF. Control heaters from sump mounted thermostat and interlock with float control so heaters operate only when there is water in sump.

C. Fabrication:

1. Type: Suitable for outdoor use, cross-flow or counter-flow, draw-thru type, complete with sump, fan, fill, drift eliminators, and motor.

2. Cooling Technology Institute (CTI) Certified, Standard STD-201.

3. Casing: Structural components of the tower, including the cold water basin, structural columns, hot water basin, and fan cylinder shall be fabricated of fiberglass reinforced polyester. Mechanical equipment supports and all other steel components shall be stainless steel. Tower assembly hardware shall be stainless steel.

4. Fan: Fan shall be adjustable-pitch propeller type. Fan shall be driven through a right-angle, industrial-duty, oil-lubricated, geared speed reducer, equipped with an oil level sight glass. The motor shall be located outside the moist airstream. A full-floating drive shaft consisting of stainless steel tube and neoprene flex elements shall couple the electric motor to the geared speed reducer. The mechanical equipment shall be structurally supported independent of the casing. A stainless steel wire mesh guard shall prevent entry of airborne objects into the fan itself.

5. Motor: Single speed high efficiency totally enclosed fan cooled type with special moisture protection, mounted on welded steel frame in fan deck. Refer to the “Motors” section of these specifications for additional requirements, including special motors for VFD service.

6. Vibration Limit Switch: Provide a single-pole, double-throw vibration switch in a NEMA 4 housing. Switch shall be adjustable for sensitivity. Switch shall be manual reset type.

7. Fill, Louvers and Drift Eliminators: Fill shall be film-type, vacu-formed PVC, with louvers and drift eliminators formed as part of each fill sheet. Fill shall be suspended from stainless steel structural tubing supported from the tower structure and shall be elevated above the flow of the cold water basin to facilitate cleaning. Air inlet faces of the tower shall be free of water splash-out. Guaranteed drift losses shall not exceed 0.005% of the design .

8. Collecting Basin: The cold water basin shall include flanged suction connection, overflow, and drain. Stainless steel screens shall be included to prevent entry of airborne debris into the cold water basin outboard of the fill.

9. Hot Water Distribution: Open gravity-type distribution basins shall include bolt circle to accept Class 125 flange. Provide flow control valves for throttling and tight shutoff. Plastic distribution nozzles shall be removable and replaceable.

10. Provide removable opaque basin cover for all towers.

11. Towers shall be statically and dynamically balanced prior to leaving the factory. Vibrational velocities measured at the fan supports shall not exceed 0.1 inches per second peak in any plane.

12. Designed for 30 pounds per $ft.^2$ wind load.

13. De-Icing: Provide reversing fan motor and time delay relay to de-ice tower louvers during winter operation.

END OF SECTION

SECTION 23 6513.14

BLOW THROUGH COOLING TOWER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cooling Tower.

B. Controls.

1.2 REFERENCES

A. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/NEMA MG 1 - Motors and Generators.

E. ASME PTC-23 - Atmospheric Water Cooling Equipment.

F. ASME A90 - Standard Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

G. ASME E-84 - Test Method for Surface Burning Characteristics of Building Materials.

H. Cooling Tower Institute (CTI) ATC-105 - Acceptance Test Code for Water Cooling Towers.

I. Cooling Tower Institute (CTI) STD-201 Certification Standard.

1.3 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. BAC.

B. Evapco.

C. Marley.

2.2 COOLING TOWER

A. Provide in tower sump electric heaters suitable to maintain temperature of water in sump at 40ºF when outside ambient temperature is 0ºF. Control heaters from sump mounted thermostat and interlock with float control so heaters operate only when there is water in sump.

B. If fans are cycled for capacity control, provide time delay relay to limit motor starts to maximum of six per hour.

C. Provide capacity control suitable for stable operation down to 10 percent of rated cooling.

2.3 FABRICATION

A. Type: Suitable for outdoor use, sectional, counterflow, blow-through type, complete with sump, fan, surface and spray sections, drift eliminators, and motor.

B. Casing: Hot-dipped galvanized steel.

C. Fan Assembly: Centrifugal fans, V-belt drive, motor shaft, and bearings. Coat inside and outside with prime coat zinc chromate with second coat of zinc pigmented paint. Provide self-aligning sleeve type bronze bearings and extended oil tubes. Protect fan inlets with removable screens.

D. Sump Tank and Base: 304 stainless steel. Provide pump suction, bottom drain, overflow, and make-up water connections. Provide compound lever float valve with float to automatically maintain water level in sump. Provide removable #4 mesh 304 stainless steel strainer and anti-vortex baffle over pump suction inlet.

E. Wetted Surfaces: Galvanized steel minimum 24 gauge, fabricated in wave pattern.

F. Spray Headers and Piping: Standard weight galvanized steel pipe with removable branch pipes and self-cleaning plastic nozzles.

G. Drift Eliminators: Hot-dipped galvanized steel, minimum 24 gauge.

H. Designed for 30 pounds per $ft.^2$ wind load.

I. Motor: Totally enclosed fan cooled.

J. Controls: Cycling two-speed fan motors.

END OF SECTION

SECTION 23 6533

EVAPORATIVE CLOSED CIRCUIT COOLING TOWER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cooling Tower.

B. Controls.

C. Ladder and Handrails.

D. Circulating Pump.

E. Sound Attenuators.

F. Discharge Hood.

1.2 REFERENCES

A. ANSI/AFBMA 9 - Load Ratings and Fatigue Life of Ball Bearings.

B. ANSI/AFBMA 11 - Load Ratings and Fatigue Life of Roller Bearings.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ASME PTC-23 - Atmospheric Water Cooling Equipment.

E. ASTM E84 - Surface Burning Characteristics of Building Materials.

F. CTI (Cooling Tower Institute) ATC-105 - Acceptance Test Code for Water Cooling Towers.

G. CTI (Cooling Tower Institute) ATC-201 - Certification Standard.

1.3 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Evapco.

B. BAC

C. SPX Cooling Technologies

2.2 MANUFACTURED UNITS

A. Provide units for outdoor use, factory assembled, sectional, counterflow, vertical discharge, blow-thru design, with fan assemblies built into pan and casing.

2.3 COMPONENTS

A. Pan and Casing: 304 stainless steel, 12 gauge for casing and 8 gauge for reinforcing angles and channels with access doors at both ends of cooler to air plenum, lift out steel strainer, bleed line (from pump discharge) with valve, inlet and outlet silencers, discharge hood with access doors, duct flanges on inlet and outlet.

B. Cooler Coil: Steel tubing, air tested under water to 350 psig, sloped to ensure drainage, encased in steel framework. Provide cleanable **header tube** unit with removable cover plates on header to access tubular coil. Coils to be hot dip galvanized after assembly and eddy current tested.

C. Fans: Multi-blade, cast aluminum, axial type Forward curved centrifugal type mounted on steel shaft, with belt drive, bearings with ANSI/AFBMA 9 or ANSI/AFBMA 11 L-10 life expectancy at 30,000 hours, with extended grease fittings.

D. Fan Motors: Two speed (1800/900 RPM) mounted on adjustable steel base.

E. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheave for motors 15 HP and under, selected so required RPM is obtained with sheaves set at mid-position. Fixed sheave for 20 HP and over, matched belts. Drive rated minimum 1.5 times nameplate rating of motor. Minimum L10 bearing life of 40,000 hours.

F. Fan Guard: Removable, welded steel rod and wire guard.

G. Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.

H. Wet Deck: Wave formed sheets of polyvinyl chloride plastic, self-extinguishing with flame spread rating of 5 10 to ASTM E-84.

I. Drift Eliminators: Two or three pass formed steel, minimum 24 gauge to limit drift loss to 0.2 percent of total water circulated.

J. Float Valves: Brass or bronze balanced piston type make-up valve with plastic or copper float.

K. Hardware: Galvanized steel nuts, bolts, and washers, stainless steel 0.25-inch nuts, bolts, washers, and nails. Assembled with phenolic epoxy coated, cadmium plated washer head fasteners.

L. Designed for 30 pounds per ft. wind load.

M. Pump: Close coupled, bronze fitted, centrifugal pump with mechanical seal, mounted on piping.

N. Pump Motor: TEFC mounted on pump body.

O. Vibration Cutout Switch: Mounted to fan support framework but unwired. Wiring is the responsibility of the Mechanical Contractor.

2.4 ACCESSORIES

A. Electric Immersion Heaters: In pan suitable to maintain temperature of water in basin at 42ºF when outside temperature is 0ºF and wind velocity is 15 mph; immersion thermostat and float control to operate heaters on low temperature when pan is filled.

B. Positive Closure Dampers: Close to minimize heat loss through an idle unit.

2.5 FACTORY FINISHING

A. Finish of Steel Components: G210 hot dipped galvanized steel with zinc chromatized aluminum paint.

END OF SECTION

SECTION 23 7200

ENERGY RECOVERY DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Energy Recovery Wheels.

B. Fixed Plate Energy Exchange Element.

1.2 QUALITY ASSURANCE

A. Sound Ratings: Tested to AMCA 300.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

C. Enthalpy/Heat Recovery Wheels and Fixed Plate Energy Exchange Element: Effectiveness values shall be tested in accordance with ASHRAE 84, be AHRI certified to Standard 1060, and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.

D. Unit shall bear a UL or ETL label of approval.

1.3 REFERENCES

A. ANSI/AHRI 1060 - Rating Air-to-Air Energy Recovery Ventilation Equipment

B. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

D. ANSI/ASHRAE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. ASHRAE 84 - Method of Testing Air-to-Air Heat Exchangers

G. NFPA 70 - National Electrical Code.

H. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

I. UL 1812 - UL Standard for Safety for Ducted Heat Recovery Ventilators.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY WHEEL

A. Enthalpy Heat Wheel:

1. Wheel shall provide both sensible and latent heat recovery. Sensible and latent effectiveness shall meet or exceed scheduled values.

2. The media shall be constructed of lightweight polymer and shall not degrade or require additional coatings over time. The rotor media shall be continuously wound with one flat and one structured layer that is coated with a non-migrating, permanently bonded molecular sieve or silica gel desiccant, specifically developed for the selective transfer of water vapor. Wheels greater than 25" in diameter shall have multiple segments that can be individually removed. Surfaces sprayed, dip coated, or desiccants that must be reapplied over time are not acceptable. Wheels with desiccant applied after wheel formation are not acceptable.

3. Energy recovery effectiveness values shall be tested in accordance with ASHRAE 84 and be AHRI certified to Standard 1060 and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.

4. Seal: Enthalpy wheel cassette shall be complete with face seal and perimeter seal to prevent cross leakage between the two airstreams. Both seals shall be non-wearable to minimize leakage.

5. Casing: Rotor casing shall limit the deflection of the rotor due to air pressure differential to less than 1/16 inch at design differential pressure. Framing shall be corrosion resistant. Support rotor from bearings that can be maintained or replaced without removal of the rotor from its casing or the media from its spoke system. Wheel bearings shall be selected to provide an L-10 life more than 200,000 hours.

6. Frame: The rotor frame shall be a hub, spoke and rim system that provides the structural integrity required at design pressure differentials.

7. Drive: Rotor shall be driven from belt system and electric motor. Wheel shall be perimeter driven. Provide motor with internal overload protection.

8. Frost Control: Provide variable speed control on rotors for frost control. Provide VFD inverter with manual override speed adjustment and turn down ratio of 20:1. Bypass dampers shall be controlled to bypass outdoor air around the wheel to avoid frosting conditions on the wheel. Outdoor air preheat coil shall be installed to maintain a minimum outdoor air temperature to avoid frosting conditions. Return air preheat coil shall be installed to maintain a minimum exhaust air temperature to avoid frosting conditions.

9. The media shall be fluted, corrugated in design to minimize the leakage of the exhaust air to the supply air through the media. The rotor media shall be coated with a polymer to avoid oxidation and latent energy transfer non-migrating desiccant specifically developed for the selective transfer of water vapor. Silica gel and oxidized aluminum are not acceptable. All media surfaces shall be coated with polymer desiccant prior to being formed into the fluted media structure. Surfaces sprayed, dip coated, or desiccants that must be reapplied over time are not acceptable. Impregnated desiccants in non-metallic substrates, such as paper, synthetic, plastic or glass fiber, will not be acceptable. Wheels with desiccant applied after wheel formation are not acceptable. Wheels shall be treated for corrosion resistance to water moisture.

10. Energy recovery effectiveness values shall be tested in accordance with ASHRAE 84 and be AHRI certified to Standard 1060 and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.

11. Seal: Enthalpy wheel cassette shall be complete with face seal and perimeter seal to prevent cross leakage between the two airstreams. Both seals shall be non-wearable to minimize leakage up to specified differential pressure. Seals shall be adjustable.

12. Casing: Rotor casing shall limit the deflection of the rotor due to air pressure differential to less than 1/16 inch at design differential pressure. Framing shall be galvanized steel, aluminum, or other metal treated to be corrosion resistant to water moisture. Any exposed metal that is not corrosion resistant to water moisture shall be painted with primer and corrosion-resistant paint. Support rotor from bearings selected to support the rotating weight of the wheel. The bearings shall be maintained or replaced without removal of the rotor from its casing or the media from its spoke system.

13. Frame: The rotor frame shall be an industrial spoke system that provides the structural integrity required at design pressure differentials. Wheel construction shall allow for post-fabrication wheel alignment.

14. Drive: Rotor shall be driven from belt system and electric motor. Wheel shall be perimeter driven with pulley sized properly for wheel size and rotation speed. Rotor belt shall have no field adjustments required (0% stretch after initial tension). Provide motor with internal overload protection.

15. Frost Control: Provide variable speed control on rotors for frost control. Provide VFD inverter with manual override speed adjustment and turn down ratio of 20:1. Bypass dampers shall be controlled to bypass outdoor air around the wheel to avoid frosting conditions on the wheel. Outdoor air preheat coil shall be installed to maintain a minimum outdoor air temperature to avoid frosting conditions. Return air preheat coil shall be installed to maintain a minimum exhaust air temperature to avoid frosting conditions.

16. The media shall be fluted, corrugated in design to minimize the leakage of the exhaust air to the supply air through the media. The rotor media shall be coated with a polymer to avoid oxidation and latent energy transfer non-migrating desiccant specifically developed for the selective transfer of water vapor. Silica gel and oxidized aluminum are not acceptable. All media surfaces shall be coated with polymer desiccant prior to being formed into the fluted media structure. Surfaces sprayed, dip coated, or desiccants that must be reapplied over time are not acceptable. Impregnated desiccants in non-metallic substrates, such as paper, synthetic, plastic or glass fiber, will not be acceptable. Wheels with desiccant applied after wheel formation are not acceptable. Wheels shall be treated for corrosion resistance to water moisture.

17. Energy recovery effectiveness values shall be tested in accordance with ASHRAE 84 and be AHRI certified to Standard 1060 and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.

18. Seal: Enthalpy wheel cassette shall be complete with face seal and perimeter seal to prevent cross leakage between the two airstreams. Both seals shall be non-contact, multi-pass seals to minimize leakage up to specified differential pressure. Seals shall be adjustable.

19. Flame and Smoke Test and Rating: Wheel shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as tested in accordance with ASTM E84.

20. Wheel Construction: Wheels of more than 60 inches in diameter shall be of segmented construction, with pie-shaped sections bolted to the hub to form the wheel. Each joint shall be sealed to prevent air from bypassing the element.

    a. For segmented wheels, the wheel manufacturer shall provide field supervision and instruction of the assembly of the first wheel to be assembled at the job site. The installing contractor shall assemble the remaining wheels.

21. Wheel flatness shall be within ± 1/32 inch and wheel runout shall be within ± 1/8 inch measured with wheel rotating and no air pressure applied. Cassette frame shall allow for adjustment of wheel to run true and be centered within the frame.

22. Casing: Rotor casing shall limit the deflection of the rotor due to air pressure differential to less than 1/32 inch more than the runout at design air pressure differential. Framing shall be galvanized steel, aluminum, or other metal treated to be corrosion resistant to water moisture. Any exposed metal that is not corrosion resistant to water moisture shall be painted with primer and corrosion-resistant paint. Support rotor from tapered roller bearings selected to support the rotating weight of the wheel with a minimum safety factor of 4. The bearings shall be maintained or replaced without removal of the rotor from its casing or the media from its spoke system.

23. Frame: The rotor frame shall be industrial spoke system that provides the structural integrity required at design pressure differentials. Wheel construction shall allow for post-fabrication wheel alignment.

24. Shaft: Shaft shall be machined to provide a shoulder against the bearings for a positive locked position to eliminate any lateral movement of the rotor due to set screw failure or shaft wear.

25. Drive: Rotor shall be driven from belt system and electric motor. Wheel shall be perimeter driven with pulley sized properly for wheel size and rotation speed. Rotor belt shall have no field adjustments required (0% stretch after initial tension). Provide motor with internal overload protection.

26. Frost Control: Provide variable speed control on rotors for frost control. Provide VFD inverter with manual override speed adjustment and turn down ratio of 20:1. Bypass dampers shall be controlled to bypass outdoor air around the wheel to avoid frosting conditions on the wheel. Outdoor air preheat coil shall be installed to maintain a minimum outdoor air temperature to avoid frosting conditions. Return air preheat coil shall be installed to maintain a minimum exhaust air temperature to avoid frosting conditions.

B. Media Cleaning:

1. The media shall be cleanable with hot water or light detergent, low pressure steam (less than 5 psi), vacuum, or compressed air (less than 80 psi) without degrading the latent recovery. Dry particles up to 800 microns shall freely pass through the media. Enthalpy wheel shall be self-cleaning by two counter flow airstreams.

C. Purge Section:

1. Unit to be provided with a factory set, field adjustable purge section designed to limit cross contamination to less than 10% 0.04% of the exhaust flow rate. Purge swing arm shall be fully sealed with seals as described above. Rotation of wheel shall be in the direction from the return air through the purge to the supply air side.

D. Dampers:

1. Provide dampers as needed to allow for 100% airflow bypass around the wheel to allow for economizer.

2. Refer to drawings for size and location.

3. Provided by unit manufacturer. Refer to Section 23 09 00 for requirements.

E. Controls:

1. Provide unit with microprocessor controls with remote control panel located as noted on the drawings. Coordinate with Temperature Control Contractor for all wiring of system.

2. Unit shall be equipped with an outdoor air temperature sensor and controller such that the energy recovery wheel can be stopped during moderate temperature periods. The controller shall perform a stop/jog function for the wheel long enough to promote the self-cleaning features of the wheel but not long enough to induce energy recovery.

3. Unit shall be equipped with a rotation sensor and controller such that should the energy recovery wheel not rotate during a signaled run period, the controller shall send a 24-volt AC signal suitable for operating a relay to be used as an alarm contact. The controller shall not initiate an alarm during a stop/jog function.

4. Unit shall be equipped with defrost controls to prevent frost from forming on the enthalpy wheel and to maintain exhaust and outside air ventilation at all times.

F. Acceptable Manufacturers: Airxchange, Greenheck.

*** * * * * OR * * * * ***

G. Acceptable Manufacturers: Innergy Tech, Seibu Giken (SG America), Enventus.

2.2 FIXED PLATE ENERGY EXCHANGE ELEMENT

A. Element shall be of cross-flow type and constructed of embossed aluminum resin-composite media allowing latent heat transfer with performance as scheduled on the drawings. Cross leakage shall be less than 1%.

B. Exchange element to be epoxy air-dried phenolic coated for use in corrosive atmosphere.

C. Provide insulated, stainless steel drain pan under exchange element section. Pitch drain pan to connection on side of unit closest to floor drain. Drain pan shall conform to the latest edition of ASHRAE Standard 62, including addenda.

D. Unit shall be UL 1812 listed for ducted air-to-air heat exchangers.

E. Unit shall be capable of transferring sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust airstream and then to the fresh airstream.

F. Exhaust and fresh air streams shall, at all times, travel in separate passages, and air streams shall not mix.

G. Heat exchanger shall be equipped with face and bypass dampers to modulate effectiveness of the plate exchanger. Bypass area shall be sized for a static pressure more than the pressure drop through the face area. Face and bypass dampers shall be factory installed.

H. Airflow through the energy exchange element shall avoid deposition of particulates on the interior of the energy plate material.

I. Case shall be constructed of galvanized, 20-gauge steel, with lapped corners, and gasketed zinc plated screw fasteners.

J. Acceptable Manufacturers: Innergytech, RenewAire, Heatex

2.3 CONTROLS

A. Unit shall be equipped with an outdoor air temperature sensor and controller such that the bypass dampers can be modulated during moderate temperature periods.

B. Unit shall be equipped with defrost controls to prevent frost from forming on the fixed plate.

C. Refer to Specification Section 23 09 00 for additional control information.

END OF SECTION

SECTION 23 7313

INDOOR MODULAR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular Indoor Air Handling Units.

1.2 QUALITY ASSURANCE

A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section with a minimum of five years' experience.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

D. Sound Ratings: Tested to AMCA 300.

E. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.

F. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.

G. Unit shall contain only UL listed components.

H. Conform to ASHRAE 90.1.

I. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

B. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.

C. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters

D. AMCA 99 - Standards Handbook.

E. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

G. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

H. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

I. AHRI 430 - Standard for Central-Station Air-Handling Units.

J. ASHRAE/ANSI Standard 111 – Practices for Measurements, Testing, Adjusting and Balancing Heating, Ventilating, Air-Conditioning and Refrigeration Systems.

K. NFPA 70 - National Electrical Code.

L. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

M. SMACNA – HVAC Duct Construction Standards – 1995 Edition

N. Standard 62-2004 - Ventilation for Acceptable Indoor Air Quality (ANSI Approved).

PART 2 - PRODUCTS

2.1 MODULAR INDOOR AIR HANDLING UNITS

A. Acceptable Manufacturers

1. Trane – “M” Series.

2. Daikin – Vision.

3. Carrier – 39 Series.

4. York – Solutions.

B. Housing:

1. Minimum 18 gauge G60 galvanized steel exterior panels reinforced and braced with galvanized steel framework.

2. Removable access panels for coil and fan removal.

3. Unit shall be double wall insulated constructed panel. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge perforated plate galvanized steel. Cover all portions of the interior of the unit exposed to the airstream with steel to allow cleaning and prevent fiberglass erosion into the airstream. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. If casing sections are not provided by the unit manufacturer with double wall construction, the Contractor is responsible for covering exposed insulation with galvanized sheet metal. The minimum R-value of the panel assemblies shall be 8.

4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

5. Units shall be draw-thru or blow-thru as noted on the drawings and shall not exceed the overall dimensions.

C. Doors:

1. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.

2. Doors shall contain a continuous neoprene bulb type gasket.

3. Each door shall contain a double pane tempered, reinforced or safety glass window.

4. Each door shall have a minimum of two (2) high compression type latches, operable from both sides.

5. Provide minimum 12" x 18" hinged access doors on both sides of the fan housing.

D. Access Sections:

1. Provide access sections as shown on the drawings between unit sections. Provide access doors as shown on plans. Provide access doors on both sides of section.

E. Air Blender:

1. Shall be of rotary mixing design employing radial blades

2. Shall be completely fixed devices with no moving parts.

3. Shall be provided with proper distances up and downstream such that the mixer is capable of providing a minimum mixing effectiveness of 75% and ±6ºF standard deviation when mixing 50% outside air with 50% return air at 50ºF inlet temperature differential.

4. Shall be sized for maximum velocities between 1,000 and 1,500 FPM.

F. Fan:

1. Double width, double inlet, backward inclined airfoil centrifugal.

2. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type. Substitution of BI or BIA fans for FC is acceptable if efficiency is not lower.

3. Statically and dynamically balanced.

4. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.

5. Provide extended lubrication lines for all bearings to an easily accessible location.

6. Provide approved belt guards with openings for tachometer readings for external drives only.

7. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.

8. Fan(s) shall have internal spring isolators.

G. Motors and Drives:

1. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.

2. Motor mounting bracket shall be adjustable to allow tightening of belts.

3. Motors shall be open drip-proof or TEFC type with grease lubricated bearings.

4. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

5. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

6. No equipment shall be selected or operate above 90% of its motor nameplate rating.

H. Variable Frequency Drives:

1. Provided and installed by unit manufacturer. Refer to Section 26 29 23 for requirements.

I. Multi-Zone Units:

1. Equip with zone dampers as shown on drawings.

2. Maximum 1700 fpm through either hot or cold opening when one damper is closed.

3. Units shall be blow-through design with heating and cooling coils.

4. Unit casing shall have access panels for servicing of all hot and cold zone dampers.

5. The unit manufacturer shall provide zone dampers. Refer to Section 23 09 00 for damper requirements. If the unit manufacturer is unable to meet the requirements listed in Section 23 09 00, the unit manufacturer shall provide dampers from an outside source that meet these specifications.

6. Extend damper rods outside of the casing to allow attachment of damper motors on the top or bottom of the casing.

J. Coils

1. Hot Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW and WLA Campuses.

b. Suitable for continuous operation at 200 psi. Maximum air velocity of 1000 fpm.

c. Galvanized steel casing. Coil headers and U-bends shall not be exposed.

d. AHRI rated with 0.0005 fouling factor.

e. Size coils sized based on EWT, EAT, gpm and cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.

f. Maximum 144 fins per foot.

g. Turbulators are not permitted unless tube velocities are below 2 FPS at design flow or noted otherwise. Turbulators shall be allowed if removable headers are specified.

h. Coils shall have drain and vent connections at supply and return headers with valves. Extend valving outside of the unit casing.

i. Install coils level to allow drainage.

j. Minimum 0.024" tube wall thickness.

k. Acceptable Manufacturers: Trane, York, Carrier, Marlo, Daikin, Heatcraft, or American Air Filter.

2. Chilled Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW and WLA Campuses.

b. Stainless steel casing. Coil headers and U-bends shall not be exposed.

c. Maximum air velocity of 500 fpm.

d. AHRI rated with 0.0005 fouling factor.

e. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. The leaving DB, leaving WB, APD and WPD shall not exceed the scheduled values.

f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

g. Suitable for 200 psig operation.

h. Coils shall have drain and vent connections at supply and return headers. Install coils level for proper drainage. Coils shall be completely drainable. Minimum 1/2" OD tubes. Minimum 0.024" tube wall thickness.

3. Direct Expansion Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW, and WLF Campuses.

b. Galvanized steel casing.

c. Suitable for 250 psig. Maximum air velocity of 500 fpm.

d. AHRI rated for direct expansion use with R-410A.

e. Size coils based on saturated suction temperature, EAT and cfm scheduled. The leaving DB and APD shall not exceed the scheduled values.

f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

g. All coils shall be split row or intertwined configuration.

h. Minimum 0.016" tube wall thickness.

i. Acceptable Manufacturers: Trane, York, Heatcraft, or Daikin.

K. Mixing and Filter Section

1. Provide face and bypass dampers with external bypass duct or internal bypass around the coil. Refer to Section 23 09 00 for damper requirements. If the unit manufacturer is unable to meet the requirements listed in Section 23 09 00, the unit manufacturer shall provide dampers from an outside source that meet these specifications.

2. Provide with a mixing box and a separate angled filter section. Damper arrangement shall be as shown on the drawings. Furnish dampers with the unit. Dampers shall be extruded aluminum with 6” airfoil blades, compressible metal jamb seals, molded synthetic or stainless steel sleeve bearings. The damper shall not leak more than 4 cfm/sq. ft. at 1” W.C. as tested per AMCA Standard 500-D-98. Maximum damper size shall be 48” in length. Provide multiple damper sections for larger lengths. Multiple dampers shall use individual actuators. Jackshafting is not acceptable. Filters shall be as scheduled and have full size hinged access doors.

3. Reference Section 23 40 00 for filter requirements.

L. Electrical Power:

1. Provide factory-mounted, vapor-tight light fixtures in each accessible section of the unit. The fixture shall be complete with junction box, globe, aluminum globe guard, switch, and bulb. Lighting shall be wired to a single 120-volt point, terminating at a designated junction box mounted on the air-handling unit. The Mechanical Contractor is responsible to complete all wiring connection between shipping splits after assembly.

END OF SECTION

SECTION 23 7323

CUSTOM AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Custom Air Handling Units

1.2 QUALITY ASSURANCE

A. Manufacturer specializing in design and manufacturing of custom air handling equipment for industrial and commercial applications. Manufacturer shall have been producing custom air handling equipment for a minimum of ten years.

B. Fabrication of units shall conform to AHRI 430, ASHRAE/ANSI Standard 111 and SMACNA – HVAC Duct Construction Standards.

C. Unit shall be factory assembled and verified. Shipping splits shall be joined at the factory to confirm proper alignment of all components between each section.

D. Unit components shall have a flame spread index of not over 25 and a smoke developed index of not over 50 per ASTM-E84; NFPA-255 and UL-723.

E. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

F. Adhesives, sealants, tapes, insulations, vapor retarders, films, and other supplementary materials added to ducts and AHUs shall have flame spread/smoke developed ratings not over 25/50 per ASTM E84, NFPA 255, or UL 723.

G. A unit manufacturer’s representative, along with the Mechanical Contractor, Testing, Adjusting, and Balancing Contractor, and Temperature Control Contractor shall all be present for the unit start up.

H. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. AHRI 430 - Standard for Central-Station Air-Handling Units.

D. ASHRAE/ANSI Standard 111 – Practices for Measurements, Testing, Adjusting and Balancing Heating, Ventilating, Air-Conditioning and Refrigeration Systems.

E. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

F. ASTM A167 - Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

G. ASTM A500-03a Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

H. ASTM A568 - Standard Specification for Steel Sheet, Carbon, and High Strength Low-Alloy, Hot-Rolled and Cold-Rolled.

I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

J. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

K. ASTM B429A – Standard Specification for Aluminum Alloy Extruded Structural Pipe and Tubing.

L. ASTM D-3359-B – Standard Test Methods for Measuring Adhesion [of Coatings] by Tape Test.

M. ASTM E-84 - Surface Burning Characteristics of Building Materials.

N. ETL – Electrical Testing Lab (Intertek Testing Service).

O. NEMA – National Electrical Manufacturers Association

P. NFPA 70 – National Electrical Code.

Q. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

R. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.

S. SMACNA – HVAC Air Duct Leakage Test Manual.

T. SMACNA - HVAC Duct Construction Standards - 1995 Edition.

U. UL 1995 - Heating and Cooling Equipment.

V. UL 723 - Surface Burning Characteristics of Building Materials.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Energy Labs.

B. Governair.

C. Haakon.

D. Carrier.

E. Temtrol.

2.2 GENERAL UNIT ENVELOPE

A. Thermal Resistance:

1. Walls and Roof:

a. Walls and Roof shall be a minimum of 4” thick with a minimum thermal resistance of R = _____ 16.5 at the center of a panel. Insulation material shall be Polyurethane Foam. Insulation density shall be no less than 3.0 lb/ft^3.

b. Exterior panels of conditioned sections shall not condense given the following air conditions: 52°F; exterior unit conditions: 95°F db/78°F wb. Manufacturer shall submit documentation demonstrating ability to prohibit condensation.

c. Panel joints and seams shall be thermally broken. Manufacturers shall submit details showing the thermal break at panel joints and corners. Thermal break shall consist of a rigid EPDM or neoprene separation between the interior and exterior wall panels. Only screws will be permitted as a thermal bridge through the panels. Caulk will not be accepted as a barrier for the through-metal path.

d. Panel joints and seams shall be thermally broken. Manufacturers shall submit details showing the thermal break at panel joints and corners. Thermal break shall consist of a rigid EPDM or neoprene separation between the interior and exterior wall panels. Direct metal to metal bridging between the interior and exterior wall panels will not be allowed. Screws will also not be permitted to penetrate the thermal break. Caulk will not be accepted as a barrier for the thru metal path.

2. Floors:

a. Floors shall be a minimum of “4” thick with a minimum thermal resistance of R = 16.5 at the center of a panel. Insulation material shall be polyurethane foam. Insulation density shall be no less than 3.0 lb/ft^3.

B. Deflection:

1. Structural reinforcement shall be designed so no member exceeds a deflection of 1/200 of span based on equipment loading and differential static of 8” W.C..

C. Leakage Rate/Pressure Rating:

1. Leakage Rate:

a. The entire exterior unit casing shall be a constructed with an absolute leakage of 1% of design cfm when tested at 8” W.C.

b. Manufacturer shall submit documentation stating their construction standards are within these leakage requirements. Housing construction shall utilize EPDM or neoprene foam gaskets at joints, seams, and split points as the pressure seal. Caulk shall not be used as the primary pressure sealant. All units shall be factory tested or [and] field tested (by the manufacturer). The test shall be performed at the specified test pressure with the leakage rate not exceeding the % leakage specified. Extrapolated data using lower pressures will not be accepted.

D. Acoustics:

1. Maximum Sound Power Levels at Unit Discharge and Return/Exhaust Inlet:

2. Manufacturer shall submit calculated sound power levels. Manufacturer shall factory test acoustical performance of the unit per AMCA 300 and provide written documentation of factory test results to the engineer prior to unit shipment. Manufacturer shall guarantee installed acoustical performance.

2.3 UNIT STRUCTURE

A. Floor Structure:

1. Perimeter floor frame members shall be ASTM B429 welded aluminum using standard shapes and sizes. ASTM A500-03a welded cold formed carbon steel using standard shapes and sizes.

2. Intermediate flooring cross members shall be commercial quality, ASTM B209 sheet steel. ASTM B209 aluminum.

3. Finish base frame after fabrication with minimum of 1.5 mils of corrosion resistant epoxy primer with pencil hardness B, 60-degree gloss of less than or equal to 40 for proper finish adhesion, and adhesion shall comply with ASTM D-3359-B with no lifting.

B. Internal Support Structure Members:

1. Construct internal horizontal and vertical cross members of commercial quality. ASTM A500-03a cold formed carbon steel using standard shapes and sizes.

C. Internal supports shall not interfere with mechanical equipment operation or maintenance.

D. Perimeter base frame shall have integral welded lifting lugs fabricated from same material as the perimeter floor frame. Lifting lugs shall be removable.

2.4 FLOOR CONSTRUCTION

A. Floor Plates/Sheets:

1. Floor sheets shall be ASTM A568 carbon steel.

2. Floor plates/sheets shall be a minimum of 10 gauge with checker plate standard material finish checker plate a rust resistive epoxy finish smooth plate standard material finish.

B. Floor to Adjacent Wall Connection:

1. The floor shall have continuously welded upturned. All joints/corners shall also be continuously welded. Floor shall be continuously sealed with closed cell EPDM (or equal) foam gasket to the wall panels.

C. Floor Plate/Sheet to Floor Plate/Sheet Connection:

1. All floor to floor connections shall be continuously welded to adjacent floor sheets. Floor-to-floor connections may be turned up and bolted with gaskets. Caulk will not be permitted between splits.

D. Floor Plate/Sheet to Unit Base Connection:

1. Floor shall be tack welded to unit base. Floors screwed or bolted to base will not be permitted. Floor may be screwed or tack welded to unit base.

E. Floors shall be constructed to prevent “oil canning”.

2.5 EXTERIOR WALL CONSTRUCTION

A. Interior Liner:

1. Interior liner shall be bright and A653 G60 galvanized steel and shall remain unpainted.

2. Interior liner shall be a minimum of 22 gauge perforated and solid sheets. Only should fan sections use perforated lines

3. All perforated panels shall have a Tedlar liner meeting 25/50 flame spread/smoke developed index between the insulation and the perforated interior liner to prevent air contact with the insulation.

B. Exterior Shell:

1. Exterior shell shall be ASTM A90 and A653 G90 galvanized steel.

2. Exterior shell shall be a minimum of 16 gauge.

3. Exterior shell shall have a finish suitable for field painting (pickelized, etched, etc.). Bright galvannealed finish is not acceptable. [be fitted with hat channels on 16” centers ready to receive field installed exterior building façade.]

2.6 ROOF CONSTRUCTION

A. Interior Liner:

1. Interior liner shall be bright ASTM A90 and A653 G60 galvanized steel and shall remain unpainted.

2. Interior liner shall be a minimum of 22 gauge perforated and solid sheets.

3. All perforated panels shall have a Tedlar liner between the insulation and the perforated interior liner to prevent air contact with the insulation.

B. Exterior Shell:

1. Exterior shell shall be ASTM A90 and A653 G90 galvanized steel.

2. Exterior shell shall be a minimum of 16 gauge.

2.7 ROOFING

A. Standing Seam Roof Panel:

1. Exterior Standing Seam panel shall be ASTM A90 and A653 G90 galvanized steel. The standing seam panels of the unit shall be sloped in one or two directions to drain water. Minimum slope shall be 1/4” per foot.

2. The roof shall be factory primed and painted to match the color of the exterior walls of the unit.

3. Provide gutters and downspouts for the roof of the unit. The gutters shall be factory painted to match the exterior walls of the unit. Refer to drawings for gutter locations.

4. Install rib caps at each shipping split and continuously caulk both sides prior to installation.

5. Where roof panels slope in two directions, install rib cap and roof peak cap at peak. Install per manufacturer’s recommendations.

6. Unit manufacturer shall provide verification a Structural Engineer has reviewed roofs for snow loads, wind loads, and rain.

2.8 MULTI-SECTION UNITS:

A. Structure shall be designed and fabricated to prevent sagging when lifting individual sections.

B. Design and manufacture units to facilitate field assembly.

C. Provide gaskets at all split joints. Caulking is not permitted at shipping splits.

D. Provide internal lifting eyes such that mating sections can be set together without sliding.

E. Flanged perimeter shall be drilled with assembly holes with continuous gasketing.

F. Gaskets shall be high quality weather resistant closed cell neoprene sponge rubber.

G. The shipping split sections shall not have any standing seams or ridges at the floor. Shipping splits may have standing seams or ridges at the floor within the air path. Standing seams or ridges at the floor are not permitted in vestibules.

2.9 CURB

A. Standard Roof Curb:

1. Rooftop unit manufacturer shall provide curbs with unit.

2. Provide prefabricated curbs as follows:

   a. 12" high above the top surface of the roofing (not the roof structure).

   b. Minimum of 14 or 18 gauge galvanized sheet metal, as required for the equipment weight. Corners and seams shall be continuously welded.

   c. Internal reinforcing.

   d. 2" x 4" pressure treated wood nailer fastened from inside the curb.

   e. 18 gauge counter flashing completely covering nailer.

   f. Factory insulated with 1-1/2” thick 3#/ft^3 density rigid fiberglass insulation.

3. Match units to the building roof with either a raised cant to match roof insulation (for built-up roofs), or with no cant (for single-ply roofs).

4. Provide internal continuous curb supports under every shipping split to reduce deflection at the splits and evenly distribute unit weight to building structure.

5. Acceptable Manufacturers: Thy, Pate, United, Roof Products Systems or Portals Plus.

B. Spring Isolated:

1. Provide factory fabricated vibration isolated curb consisting of an upper floating section resting on a rigid rectangular steel tube structure containing adjustable steel vibration isolation springs.

2. Vibration Isolation:

   a. Isolators shall consist of free standing, unhoused laterally stable steel springs.

   b. Springs shall be cadmium or zinc electroplated.

   c. Springs shall rest on a minimum of 1/4” neoprene pad.

   d. Springs shall provide a minimum of 1-1/2 deflection calculated based on final assembled loads.

3. Provide continuous wood nailing strip and counter flashing along entire perimeter of the curb.

4. Provide continuous air and water seal, such as an EPDM bellows, around the entire curb.

5. Curb assembly shall withstand 125#/sf lateral wind loading against the supported equipment.

6. The curb shall be designed with lateral restraint to meet seismic requirements specified in Section 23 05 50.

7. Coordinate internal structural cross framing with ductwork and piping routed in the curb.

8. Acceptable Manufacturers: Mason Industries, Inc. – Type RSC; Vibration Elimination Company – BERC; ThyCurb – Vibro Curb II; and Kinetics – SSR.

2.10 DOORS

A. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.

B. Doors shall be the same material and thickness as the surrounding walls.

C. Exterior layer shall be a minimum of 16 gauge. Interior layer shall be a minimum of 22 gauge.

D. Door frames shall be continuously welded and formed of the same materials as the surrounding wall.

E. Doors shall contain a continuous neoprene bulb type gasket.

F. Each door shall have 6” butt hinges eccentrically pivoted hinges.

G. Each door shall have a minimum of two (2) high compression type latches, operable from both sides. All exterior doors shall have a secured padlock fitting.

H. Each door shall contain a double pane tempered, reinforced or safety glass window.

I. Doors shall be a minimum of 24” wide and 60” high, unless noted otherwise.

2.11 INTERIOR WALL PANEL CONSTRUCTION – DOUBLE WALL

A. Where there is a temperature difference across an interior partition, where large differential pressures exist (such as across fan sections) and where shown on the drawings, panels shall be double wall.

B. Liners shall be bright ASTM A90 and A653 G60 galvanized steel and shall remain unpainted.

C. Liners shall be a minimum of 22 gauge perforated only at fan section and solid sheets.

D. Interior wall panels shall be the same thickness and insulated with the same insulation as specified for exterior wall panels.

E. Internal walls shall be completely sealed with EPDM foam gasket to the exterior wall or air tunnel pressure barrier surface.

F. All perforated panels shall have a Tedlar liner meeting 25/50 flame spread/smoke developed index between the insulation and the perforated interior liner to prevent air contact with the insulation.

G. Usage: Fan section, damper sections, cooling coils, etc.

2.12 INTERNAL COMPONENTS

A. Pumps:

1. Provided and installed by unit manufacturer. Refer to Section 23 21 23 for requirements.

B. Motors:

1. Provided and installed by unit manufacturer. Refer to Section 23 05 13 for requirements.

C. Internal Vibration Isolation:

1. Provided and installed by unit manufacturer. Refer to Section 23 05 48 for requirements.

D. Plumbing Piping And Valves:

1. Provided and installed by unit manufacturer where designated on drawings. Refer to drawings for division of work between contractor and manufacturer. Refer to Section 22 10 00 for requirements.

E. Hydronic Piping And Valves:

1. Provided and installed by unit manufacturer where designated on drawings. Refer to drawings for division of work between contractor and manufacturer. Refer to Section 23 21 00 for requirements.

F. Steam And Condensate Piping and Accessories:

1. Provided and installed by unit manufacturer where designated on drawings. Refer to drawings for division of work between contractor and manufacturer. Refer to Section 23 22 00 and Section 23 22 18 for requirements.

G. Humidifiers:

1. Provided and installed by unit manufacturer. Refer to Section 23 22 18 for requirements.

H. Air Coils:

1. Provided and installed by unit manufacturer. Refer to Section 23 82 16 for requirements.

2. Provide drain pan and drain connection for all cooling coils. Fabricate drain pan from 20 gauge stainless steel. Install a drain pan under each cooling coil per ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot. Pipe drain pans individually to floor drain.

3. Unit manufacturer shall design and provide 304 stainless steel structure to support all cooling coils. Structure shall be arranged such that any individual coil may be removed through the face of the structure without affecting the other coils or cutting/removal of housing panels.

4. Manufacturer shall insulate the underside of all drain pans, except those integral with the floor, with a minimum of 3/4” cellular flexible elastomeric foam sheet (Type E).

I. Fans:

1. Provided and installed by unit manufacturer. Refer to Section 23 34 16 for requirements.

J. Filters:

1. Provided and installed by unit manufacturer. Refer to Section 23 40 00 for requirements.

K. Air Blenders:

1. Provided and installed by unit manufacturer. Refer to Section 23 33 00 for requirements.

L. Louvers:

1. Provided and installed by unit manufacturer. Refer to Section 23 37 00 for requirements.

M. Control Dampers and Actuators:

1. Provided and installed by unit manufacturer. Refer to Section 23 09 00 for requirements.

2. Dampers shall be installed to allow the mounting and future maintenance of damper actuators. One direct coupled actuator shall be used per damper section. Jack shafting is not acceptable.

N. Control Valves with Actuators:

1. Provided and installed by unit manufacturer. Refer to Section 23 09 00 for requirements.

O. Variable Frequency Drives:

1. Provided and installed by unit manufacturer with external bypass panel. Refer to Section 26 29 23 for requirements.

P. Electrical Power:

1. Internal wiring and devices provided and installed by unit manufacturer. Refer to Division 26 for requirements.

2. All electrical wiring and devices, lighting, and electric unit heaters shown as being provided by the manufacturer shall be furnished and pre-wired back to an electrical distribution panel located in the service vestibule of each unit. The Electrical Contractor, after installation and assembly of the unit, will connect main power to the unit.

3. Provide shop drawings of the unit, including wiring schematics, to both the Electrical and Temperature Control Contractors to coordinate their work.

4. All wiring shall conform to NFPA 70. All starters and disconnects shall be NEMA (not IEC) rated.

Q. Controls:

1. Provided and installed by the Temperature Control Contractor in the Field.

2. Provide cut sheets of sensors in submittals.

2.13 ACCESSORIES

A. Motor Removal I-Beam:

1. Motor removal I-beam shall be provided to facilitate removal of motors 5 HP and larger. Structural steel frame shall be provided to support motor removal I-beam.

END OF SECTION

SECTION 23 7411

PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Rooftop Unit.

B. Unit Controls.

C. Roof Mounting Frame and Base.

D. Economizers.

E. Power Exhaust.

1.2 QUALITY ASSURANCE

A. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).

B. All units must be UL or ETL listed and must contain UL labeled components.

C. Fans shall be tested and rated in cabinet in accordance with AMCA Standard 210. All fan assemblies shall be dynamically balanced in cabinet at final assembly.

D. Conform to ASHRAE 90.1.

E. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AHRI 210 - Unitary Air Conditioning Equipment.

B. AHRI 240 - Air Source Unitary Heat Pump Equipment.

C. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

D. ASHRAE 37 - Methods of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment.

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Installation of Air Conditioning and Ventilating System.

H. UL - Underwriters' Laboratory.

I. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane.

B. York.

C. Daikin.

D. Carrier.

2.2 MANUFACTURED UNITS

A. Provide roof-mounted units having gas burner, and electric refrigeration.

B. Unit shall be self-contained, packaged, factory assembled, pre-wired and tested, consisting of cabinet and frame, supply fan, return fan or exhaust fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil, condenser fan, and a full refrigerant charge.

C. Unit shall be furnished with non-fused disconnect switch, short fuse protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

2.3 FABRICATION

A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fasteners locking door handle type with piano hinges. Access doors shall be provided at each section (e.g., filter section, supply fan section, etc.). All exterior access panels must be permanently labeled on the outside indicating what is behind the panel. Structural members shall be minimum 18 gauge, with access doors or removable panels of minimum 20 gauge.

B. Outside Air Intakes: The outside air intakes shall be located a minimum of 15 inches above the roof mounting curb to minimize the effect of heat pickup from the roof during the natural cooling cycle and the effects of snow on the roof during winter operation. Each air intake shall be furnished with rain eliminators.

C. Insulation: Minimum of 1/2” thick, 1.5 lb./cu. ft. density coated glass fiber insulation on surfaces where conditioned air is handled. Protect edges from erosion.

D. Heat Exchangers: Aluminized steel, of welded construction.

E. Air Filters: Two inch thick glass fiber disposable media in metal frames.

F. Roof Mounting Curb: Minimum 12 inches 24 inches high, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.

2.4 FANS/MOTORS

A. Supply and Return and Exhaust Fan: Forward curved airfoil centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor sheave, and rubber isolated hinge mounted motor or direct drive as indicated. Isolate complete fan assembly. All fan bearings must be capable of being lubricated by easily accessible grease fittings.

B. Belt drive fans must be within $\pm$ 10% of scheduled RPM.

C. All fans must be statically and dynamically balanced.

D. Belt drive fans shall have slide rails, adjusting screws, anchor bolts, and bedplates.

E. Motors shall be open drip-proof with grease lubricated bearings.

F. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

G. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

H. Units used with variable speed drives shall have fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

I. No equipment shall be selected or operate above 90% of its motor nameplate rating.

J. Motor shall have 1.15 service factor.

2.5 BURNER

A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shutoff pilot. Fully modulating gas valve with minimum 4:1 turndown.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, or adjustable time delay relays with switch for continuous fan operation.

2.6 EVAPORATOR COIL

A. Provide copper tube with aluminum fin coil assembly. Copper fin should be used at coastal campuses, Harbor, SW and West Los Angeles.

B. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

D. Provide insulation on liquid refrigerant and suction piping between compressor and evaporator coil where not protected by drain pans. Insulation shall be elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

2.7 HOT GAS REHEAT COIL

A. Provide copper tube with aluminum fin coil assembly. Only coastal campuses should copper fin coil be used (Harbor, WLA).

B. Valves to reroute hot refrigerant gas from the discharge line of the compressor through the reheat coil.

2.8 COMPRESSOR

A. Provide hermetic or semi-hermetic compressors (quantity as scheduled on drawings), 3600 rev/min maximum, resiliently mounted with positive lubrication, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

B. Five minute timed off circuit shall delay compressor start.

C. Outdoor thermostat shall energize compressor above 50ºF ambient.

D. Provide step capacity control cylinder unloading cycling multi-speed compressors.

E. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

F. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

G. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.9 CONDENSER

A. Provide copper tube aluminum fin coil assembly with sub-cooling rows. Harbor and WLA campuses should be equipped with copper fin coil.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

C. Provide refrigerant pressure switches to cycle condenser fans.

D. Provide hail guards on all condenser.

2.10 MIXING SECTION

A. Dampers: Provide manual outside air dampers for fixed outside air quantity.

2.11 ECONOMIZERS

A. Factory installed by approved rooftop unit manufacturer with fully modulating motorized outside air and return air dampers.

B. To be controlled by differential dry bulb controller with minimum position setting.

C. Shall be equipped with 100% capable relief barometric damper relieving up to 100% return air and sealed to meet ASHRAE 90.1 requirements.

D. Shall be capable of introducing up to 100% outside air.

E. Shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.

F. Dampers shall be capable of completely closing when unit is in unoccupied mode.

G. Outside air damper normally closed and return air damper normally open.

H. Provide economizer components and controls in accordance with ICC IECC.

2.12 POWER EXHAUST

A. Factory installed by economizer supplier or compatible equivalent.

B. Controlled by economizer controls.

C. Power exhaust shall be factory wired to electrical section complete with conduit, feeders, disconnect, and overcurrent protection. Power exhaust shall be energized when dampers open past the adjustable setpoint of the economizer control.

D. Must comply with ASHRAE 90.1 Fan Power Limitation formula.

2.13 ELECTRICAL

A. Provide with single point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet. All units must be so constructed that when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120 volt duplex convenience outlet) is disconnected by means of a single disconnect.

B. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

C. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.

D. All units shall include a transformer for controls and convenience outlet.

E. Only one power cable connection to the unit shall be necessary.

2.14 OPERATING CONTROLS - SINGLE ZONE UNITS

A. Electric solid state microcomputer based room thermostat, located as indicated in service area with remote sensor located as indicated.

B. Room thermostat shall incorporate:

1. Automatic switching from heating to cooling.

2. Preferential rate control to minimize overshoot and deviation from set point.

3. Set-up for four separate temperatures per day.

4. Instant override of setpoint for continuous or timed period from one hour to 31 days.

5. Short cycle protection.

6. Programming based on weekdays, Saturday and Sunday.

7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

C. Room thermostat display shall include:

1. Time of day.

2. Actual room temperature.

3. Programmed temperature.

4. Programmed time.

5. Duration of timed override.

6. Day of week.

7. System model indication: heating, cooling, auto, off, fan auto, fan on.

8. Stage (heating or cooling) operation.

D. Provide low limit thermostat in supply air to close outside air dampers and stop supply fan.

E. Mixed Air Controls: Maintain selected supply air temperature and revert dampers to minimum outside air position on a call for heating and above 75ºF ambient

2.15 OPERATING CONTROLS - VARIABLE VOLUME UNITS

A. Temperature transmitter located in supply air shall signal electronic logic panel to control mixing dampers and cooling in sequence to maintain 55°F(adj.). Mixing section shall operate as first stage of cooling and revert to minimum outside air above approximately 65ºF as determined by dry bulb temperature of return and outdoor air.

B. Control cooling by cycling compressors and cylinder unloading.

C. Control logic shall allow adjustable supply air reset under low load or airflow conditions.

D. Seven-day timeclock with spring carry over (or electronic clock with battery backup) shall control unit on occupied/unoccupied schedule. At night, unit shall be off. Locate clock in remote control panel with status lights.

E. Provide two stage morning warm-up thermostat to hold outdoor dampers closed and energize heat until return air temperature reaches set point.

F. Provide bypass dampers, bypassing air from supply fan discharge to return fan inlet to control duct static pressures. Control operation by sensing current to supply fan motor. Dampers shall equal performance of those shown on drawings.

G. Bypass Damper Control Outputs: These outputs are for driving the bypass dampers open and closed. The outputs are powered with a 24 VAC damper power source and can drive multiple dampers in parallel. Each damper requires 2 VA of 24 VAC power.

H. Program Options: Each central control panel is individually configurable as an air conditioner controller for a variable volume system.

I. Supply Air Temperature Sensor Input: The supply air temperature sensor monitors the air handling unit discharge air temperature. It is used by the central control panel to control the stages of heating and cooling, and to protect the air handling unit from excessively high or low discharge air temperatures. The leaving air temperature sensor requires twisted, shielded pair wire. Terminations are screw terminals.

J. System Control: The central control panel scans the unit control modules to determine the deviations from temperature setpoint, time of deviation, time from last changeover, and number of UCMs requiring heating or cooling. Based upon this information, the system heat/cool mode and stage of capacity is selected. The central control panel also monitors the system air temperature to ensure that high and low temperature limits are maintained.

K. Operators Panel: An operator's panel may be used to control up to two central control panels. The 16-button keypad and 2 line/40-character display shall give the operator individual zone status and control from one location.

1. Zone control functions include:

   a. Occupied heat/cool setpoints.

   b. Unoccupied heat/cool setpoints.

2. Zone status includes:

   a. Current zone temperature.

   b. Current occupancy mode.

   c. Current heat/cool mode.

3. Time-of-day scheduling shall be available by group, individually for each of the four groups. Scheduling shall be two on/off periods per day for each of the seven weekdays. A holiday schedule shall also be available for each group. Up to 24 holiday dates can also be scheduled. Groups timed override can be enabled from the keypad for a two-hour period. Operator's panel shall have a 365 day clock with daylight savings time and leap year functions.

[* * * * * OR * * * * *]

2.16 DDC TEMPERATURE CONTROLS

A. Install standalone control module providing communication between unit controls and DDC temperature control system. Control module shall be compatible with temperature control system specified in Section 23 09 00.

END OF SECTION

SECTION 23 7413

ROOFTOP MODULAR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular Outdoor Air Handling Units.

1.2 QUALITY ASSURANCE

A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section with a minimum of five years' experience.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

D. Sound Ratings: Tested to AMCA 300.

E. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.

F. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.

G. Unit shall contain only UL listed components.

H. Conform to ASHRAE 90.1.

I. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

B. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.

C. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters

D. AMCA 99 - Standards Handbook.

E. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

G. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

H. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

I. AHRI 430 - Standard for Central-Station Air-Handling Units.

J. ASHRAE/ANSI Standard 111 – Practices for Measurements, Testing, Adjusting and Balancing Heating, Ventilating, Air-Conditioning and Refrigeration Systems.

K. NFPA 70 - National Electrical Code.

L. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

M. SMACNA – HVAC Duct Construction Standards – 1995 Edition

N. Standard 62-2004 - Ventilation for Acceptable Indoor Air Quality (ANSI Approved).

PART 2 - PRODUCTS

2.1 MODULAR OUTDOOR AIR HANDLING UNITS

A. Acceptable Manufacturers:

1. Trane – “T” Series

2. Daikin - Skyline

3. Carrier – 39 Series

4. York – Solutions

B. Housing:

1. Minimum 18 gauge G90 galvanized steel exterior panels reinforced and braced with galvanized steel framework.

2. Removable access panels for coil and fan removal.

3. Unit shall be double wall constructed and insulated in all sections. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge solid perforated plate galvanized steel. Cover all portions of the interior of the unit exposed to the airstream with steel to allow cleaning and prevent fiberglass erosion into the airstream. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. If casing sections are not provided by the unit manufacturer with double wall construction, the Contractor is responsible for covering exposed insulation with galvanized sheet metal. The minimum R-value of the panel assemblies shall be 8. Perforated liner can be used only as fan section.

4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

5. Units shall be draw-thru or blow-thru as noted on the drawings and shall not exceed the overall dimensions.

6. Provide unit base to allow unit to set on top of rooftop curb. Seal entire length and width under base to create a weather tight seal between the curb and the unit.

7. The external surface of the unit shall be factory painted to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours. Unit casing shall be prepared and coated with a minimum of 1.5 mil enamel finish. Color selected by Architect.

8. The unit's roof shall be double wall constructed. The inner roof shall be installed in such a manner to prevent air bypass between internal components. The outer roof shall be sloped a minimum of 0.25" per foot either from one side of the unit to the other, or from the center to the sides of the unit. All seams shall be gasketed and capped to prevent water infiltration. The roof assembly shall have a drip seal that overhangs all the walls of the unit.

9. Provide unit with a full length, continuous, base rail channel. Base rail channels shall be formed of a minimum 12 gauge galvanized steel. Support all major components from base rail.

C. Doors:

1. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.

2. Door shall have a protective flange to shield gasket from exposure. Door frame shall be mounted on raised door frame and shall channel water away from gasket.

3. Doors shall contain a continuous neoprene bulb type gasket.

4. Each door shall contain a double pane tempered, reinforced or safety glass window.

5. Each door shall have a minimum of two (2) high compression type latches, operable from both sides.

6. Provide minimum 12" x 18" hinged access doors on both sides of the fan housing.

D. Access Sections:

1. Provide access sections as shown on the drawings between unit sections. Provide access doors on both sides of section.

E. Air Blender:

1. Shall be of rotary mixing design employing radial blades

2. Shall be completely fixed devices with no moving parts.

3. Shall be provided with proper distances up and downstream such that the mixer is capable of providing a minimum mixing effectiveness of 75% and ±6ºF standard deviation when mixing 50% outside air with 50% return air at 50ºF inlet temperature differential.

4. Shall be sized for maximum velocities between 1,000 and 1,500 FPM.

F. Fan:

1. Double width, double inlet, airfoil/backward inclined centrifugal.

2. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type. Substitution of BI or BIA fans for FC is acceptable if efficiency is not lower.

3. Statically and dynamically balanced.

4. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.

5. Provide extended lubrication lines for all bearings to an easily accessible location.

6. Provide approved belt guards with openings for tachometer readings for external drives only.

7. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.

8. Fan(s) shall have internal spring isolators.

G. Motors and Drives:

1. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.

2. Motor mounting bracket shall be adjustable to allow tightening of belts.

3. Motors shall be open drip-proof or TEFC type with grease lubricated bearings.

4. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

5. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

6. No equipment shall be selected or operate above 90% of its motor nameplate rating.

H. Variable Frequency Drives:

1. Provided and installed by unit manufacturer with bypass panel. Refer to Section 26 29 23 for requirements.

I. Multi-Zone Units:

1. Equip with zone dampers as shown on drawings.

2. Maximum 1700 fpm through either hot or cold opening when one damper is closed.

3. Units shall be blow-through design with heating and cooling coils.

4. Unit casing shall have access panels for servicing of all hot and cold zone dampers.

5. The unit manufacturer shall provide zone dampers. Refer to Section 23 09 00 for damper requirements. If the unit manufacturer is unable to meet the requirements listed in Section 23 09 00, the unit manufacturer shall provide dampers from an outside source that meet these specifications.

6. Extend damper rods outside of the casing to allow attachment of damper motors on the top or bottom of the casing.

J. Coils

1. Hot Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

b. Suitable for continuous operation at 200 psi. Maximum air velocity of 1000 fpm.

c. Galvanized steel casing. Coil headers and U-bends shall not be exposed.

d. AHRI rated with 0.0005 fouling factor.

e. Size coils sized based on EWT, EAT, gpm and cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.

f. Maximum 144 fins per foot.

g. Turbulators are not permitted unless tube velocities are below 2 FPS at design flow or noted otherwise. Turbulators shall be allowed if removable headers are specified.

h. Coils shall have drain and vent connections at supply and return headers with valves. Extend valving outside of the unit casing.

i. Install coils level to allow drainage.

j. Minimum 0.024" tube wall thickness.

k. Acceptable Manufacturers: Trane, York, Daikin, Carrier, Marlo Heatcraft, or American Air Filter.

2. Hot Water/Steam Coils (Vertical Tube, Integral Face & Bypass):

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

b. Vertical tube integral face and bypass type with electric damper motor. Dampers shall completely enclose the heating elements when no heat is required.

c. Casing of minimum 14 gauge galvanized steel. Dampers of minimum 16 gauge steel with galvanized finish.

d. Factory tested for 200 psi steam and 300 psi water pressure. Maximum air velocity of 900 fpm.

e. Coils shall be sized based on entering water temperature, EAT and cfm as scheduled. LAT shall be at least as high as scheduled. APD shall not exceed the scheduled value in any damper position.

f. Maximum 144 fins per foot.

g. Minimum 0.035" tube wall thickness. Coils shall have provisions for tube expansion.

h. Discharge air temperature in a plane 3 feet downstream of the coil shall not vary by more than 5°F from the average discharge temperature. Maximum 5°F air temperature rise with dampers closed at maximum system design airflow.

i. Acceptable Manufacturers: Aerofin, Armstrong, Control Air Inc., Marlo Coil, or Wing

3. Steam Coils (Distributing):

a. Non-freeze steam distributing type.

b. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

c. Suitable for up to 150 psig steam. Maximum air velocity of 1,000 fpm.

d. Galvanized steel casing.

e. AHRI rated with 0.0005 fouling factor.

f. Size coils based on saturated steam pressure, EAT and cfm scheduled. LAT shall be at least as high as scheduled. APD shall not exceed the scheduled value.

g. Maximum 120fins per foot.

h. Manufacture coils with drain tubes pitched to facilitate condensate removal.

i. Minimum 0.024" tube wall thickness.

j. Acceptable Manufacturers: Trane, York, Daikin, Carrier, Marlo Heatcraft, or American Air Filter.

4. Chilled Water Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

b. Stainless steel casing. Coil headers and U-bends shall not be exposed.

c. Maximum air velocity of 500 fpm.

d. AHRI rated with 0.0005 fouling factor.

e. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. The leaving DB, leaving WB, APD and WPD shall not exceed the scheduled values.

f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

g. Suitable for 200 psig operation.

h. Coils shall have drain and vent connections at supply and return headers. Install coils level for proper drainage. Coils shall be completely drainable. Minimum 1/2" OD tubes. Minimum 0.024" tube wall thickness.

5. Direct Expansion Coils:

a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW and WLA campuses.

b. Galvanized steel casing.

c. Suitable for 250 psig. Maximum air velocity of 500 fpm.

d. AHRI rated for direct expansion use with R-410A.

e. Size coils based on saturated suction temperature, EAT and cfm as scheduled. The leaving DB and APD shall not exceed the scheduled values.

f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

g. All coils shall be split row or intertwined configuration.

h. Minimum 0.016" tube wall thickness.

i. Acceptable Manufacturers: Trane, York, Heatcraft, or Daikin.

K. Mixing and Filter Section

1. Provide face and bypass dampers with external bypass duct or internal bypass around the coil. Refer to Section 23 09 00 for damper requirements. If the unit manufacturer is unable to meet the requirements listed in Section 23 09 00, the unit manufacturer shall provide dampers from an outside source that meet these specifications.

2. Provide with a mixing box and a separate angled filter section. Damper arrangement shall be as shown on the drawings. Furnish dampers with the unit. Dampers shall be extruded aluminum with 6” airfoil blades, compressible metal jamb seals, molded synthetic or stainless steel sleeve bearings. The damper shall not leak more than 4 cfm/sq. ft. at 1” W.C. as tested per AMCA Standard 500-D-98. Maximum damper size shall be 48” in length. Provide multiple damper sections for larger lengths. Multiple dampers shall use individual actuators. Jackshafting is not acceptable. Filters shall be as scheduled and have full size hinged access doors.

3. Reference Section 23 40 00 for filter requirements.

4. Reference Section 23 05 29 for curb description.

L. Intake/Hood: Provide intake/exhaust hood of same construction as main unit casing. The hood shall be sized for scheduled air flow.

M. External Pipe Cabinet:

1. Provide external pipe cabinet spanning all coil and humidifier sections.

2. Minimum cabinet depth shall be 24”.

3. Pipe cabinet shall be supplied by the manufacturer.

4. Pipe cabinet shall be factory assembled and shall be of the same construction as the main unit casing.

5. The pipe cabinet shall be mounted externally and shipped loose to be field installed.

6. Provide two (2) access door(s). Each door shall be of the same construction as the unit doors and a minimum width of 20 inches.

N. Electrical Power:

1. Provide factory-mounted, weather-resistant (enclosed and gasketed), vapor-tight light fixtures in each accessible section of the unit. The fixture shall be complete with junction box, globe, aluminum globe guard, switch, receptacle, and bulb. Provide with factory-mounted outdoor service receptacles. Lighting and utility receptacles shall be wired to a single 120-volt point, terminating at a designated junction box mounted on the air-handling unit. The Mechanical Contractor is responsible to complete all wiring connection between shipping splits after assembly.

END OF SECTION

SECTION 23 7423.13

GAS FIRED MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Direct Fired Make-Up Air Unit.

B. Indirect Fired Make-Up Air Unit.

1.2 QUALITY ASSURANCE

A. Comply with applicable regulations and have local Gas Company approval.

B. Factory test to check construction, controls, and operation of unit and provide certification.

C. Test operation after installation.

D. Provide with complete one (1) year warranty. Warranty period begins at date of initial startup.

E. Conform to ASHRAE 90.1.

F. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI Z83.18 - Recirculating Direct Gas-Fired Industrial Air Heaters.

C. ANSI Z83.4 - Non-Recirculating Direct Gas-Fired Industrial Air Heaters.

D. ANSI/AGA Z223.1 - National Fuel Gas Code.

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. FM - FM Global.

G. NFPA 70 - National Electrical Code.

H. NFPA 90A - Installation of Air Conditioning and Ventilating System.

I. UL - Underwriters' Laboratory.

PART 2 - PRODUCTS

2.1 DIRECT FIRED MAKE-UP AIR UNIT

A. Acceptable Manufacturers:

1. Engineered Air.
2. Reznor.
3. Modine
4. Sterling/Applied Air.
5. Weather-Rite Heating & Ventilating, Inc.
6. Trane
7. Hastings
8. Cambridge
9. Titan

B. Manufactured Units:

1. Self-contained direct-fired make-up air unit with burner, inlet damper, gas controls, unit controls, and all accessories noted or required for complete installation.
2. Units shall bear a UL, ETL or AGA label indicating that the units have been tested and comply with Standard ANSI Z83.4.
3. Provide volume controls to maintain building pressure control.
4. Unit to consist of outdoor air hood, outdoor air inlet damper, direct-fired gas burner, unit cabinet and frame, supply fan, discharge damper, and all unit and burner safety and control devices.
5. Controls shall be unit mounted with remote panels as indicated.

C. Fabrication:

1. Construct heater casing and components of 18 gauge steel panels, reinforced with angles and channels for rigidity. Provide access panels to burner and blower motor assemblies.
2. Outside Air Intakes: Locate intakes at least 15" above roof curb. Furnish rain eliminators in intakes.
3. Locate port on burner section for observing main and pilot flames.
4. Insulate indoor units up to burner section with 1" thick neoprene faced glass fiber insulation.
5. Finish casing and components with heat resistant baked enamel.

6. For suspended units, provide service platforms with handrails and access ladders.

7. For outdoor installation, provide weatherproofed casing with intake louver or hood.

8. Roof Mounting Frame: Minimum 12" high, minimum 14 gauge (1.99 mm) galvanized steel, one-piece construction, insulated, all welded, wood nailer.

D. Filters:

1. Provide filter section complete with removable 2" thick glass fiber, disposable filters in metal frames.

E. Burner:

1. Provide natural gas burner with modulating turndown ratio of 25:1. Adjustable profile plate, stainless steel baffles, cast iron burner tube.

2. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shutoff pilot.

3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

5. Provide motorized damper with end switch to prove position before burner will fire. Inlet dampers required on indoor units. Discharge dampers required on outdoor units.

F. Fan:

1. Provide statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy duty self-aligning lubricated ball bearings and V-belt drive.

2. All fan bearings shall have easily accessible grease fittings.

G. Electrical:

1. Provide with single-point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet. All units must be so constructed that, when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120-volt duplex convenience outlet) is disconnected by means of a single disconnect.

2. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

3. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.

4. All units shall include a transformer for controls and convenience outlet.

5. Only one power cable connection to the unit shall be necessary.

H. Unit Controls:

1. Pre-wire unit so connection of power supply and field wiring from unit to remote control panel makes unit operative. Wiring and control enclosures shall meet NEC and local codes. Provide control voltage transformers as required. All wiring shall be in conduit or in enclosures. Provide pre-wired, numbered terminal strips for field wiring connections.

2. Provide remote control panel with Summer-Off-Winter switch, indicating lights for blower on, burner on, flame failure, low temperature and clogged filter.

3. All unit controls shall be electronic type.

4. Provide the following safety controls: air flow switch, electronic flame safety relay, high temperature limit switch, starter interlock, high gas pressure switch, low gas pressure switch, low discharge temperature control with bypass timer.

5. Provide outdoor thermostat to lock-out burner when outdoor temperature is above 60ºF (adj.).

6. Interlock unit to start when exhaust fan runs. Interlock burner to operate when flow switch in exhaust duct proves flow. Interlock wiring is by the Mechanical Contractor.

7. Unit dampers shall close whenever unit is off. Dampers shall prove open before the unit operates.

I. Discharge Temperature Controls:

1. Fixed Discharge Temperature:

a. Modulate burner to maintain a fixed discharge temperature at the unit mounted sensor.

b. Provide remote wall mounted panel for resetting discharge air temperature. Wire to unit control panel.

c. Controls shall be electronic.

d. Refer to Section 23 09 00 for additional requirements.

e. Provide relays to signal the following conditions to the DDC system:

J. Gas Manifold:

1. Pilot line shall include: gas shutoff valve, gas regulator, pilot gas valve.

2. Main gas line shall include: gas shutoff valve, gas regulator, main gas valve (2 required), modulating gas valve, leakage test valve, low pressure gas switch, high pressure gas switch, vent valve between the two main gas valves and all required test valves.

3. Gas train shall meet FM, local utility, and Owner's insurance company requirements.

4. Provide piping from vent valve to outside the building.

5. Provide additional regulator if the incoming gas pressure exceeds 2 psig.

6. Locate all valves and components in a unit mounted enclosure.

K. Intake Hood:

1. Provide rain hood for rooftop inlet installation. Hood shall draw air through the bottom of the hood. Provide bird screen on inlet.

2.2 INDIRECT FIRED MAKE-UP AIR UNIT

A. Acceptable Manufacturers:

1. Trane

2. Sterling/Applied Air

3. Modine

4. Hastings

5. Rupp

6. Reznor

B. Manufactured Units:

1. Self-contained indirect-fired make-up air unit with burner, inlet damper, gas controls, unit controls, and all accessories noted or required for complete installation.

2. Units shall bear a UL, ETL or AGA label indicating that the units have been tested and comply with ANSI standards.

3. Floor mounted inside building.

4. Provide volume controls to maintain building pressure control.

5. Unit to consist of outdoor air hood, outdoor air inlet damper, indirect-fired gas burner, unit cabinet and frame, supply fan, discharge damper, and all unit and burner safety and control devices.

6. Controls shall be unit mounted with remote panels as indicated.

C. Fabrication:

1. Construct heater casing and components of 18 gauge steel panels, reinforced with angles and channels for rigidity. Provide access panels to burner and blower motor assemblies.

2. Locate port on burner section for observing main and pilot flames.

3. Insulate indoor units up to burner section with 1" thick neoprene faced glass fiber insulation.

4. Finish casing and components with heat resistant baked enamel.

D. Filters:

1. Provide filter section complete with removable 2" thick glass fiber, disposable filters in metal frames.

E. Burner and Heat Exchanger:

1. Provide electronic modulating natural gas burner capable of modulating the gas input from 100% to 40% rated input. Provide with duct thermostat with remote setpoint adjustment.

2. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shutoff pilot.

3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

5. Provide motorized damper with end switch to prove position before burner will fire. Inlet dampers required on indoor units. Discharge dampers required on outdoor units.

6. Provide with 20 gauge, type 409, stainless steel, burners, flue collector, heat exchanger, and tubes and headers on all furnaces.

F. Fan:

1. Provide statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy duty self-aligning lubricated ball bearings and V-belt drive.

2. All fan bearings shall have easily accessible grease fittings.

G. Electrical:

1. Provide with single-point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet. All units must be so constructed that, when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120-volt duplex convenience outlet) is disconnected by means of a single disconnect.

2. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

3. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.

4. All units shall include a transformer for controls and convenience outlet.

5. Only one power cable connection to the unit shall be necessary.

H. Unit Controls:

1. Pre-wire unit so connection of power supply and field wiring from unit to remote control panel makes unit operative. Wiring and control enclosures shall meet NEC and local codes. Provide control voltage transformers as required. All wiring shall be in conduit or in enclosures. Provide pre-wired, numbered terminal strips for field wiring connections.

2. Provide remote control panel with Summer-Off-Winter switch, indicating lights for blower on, burner on, flame failure, low temperature and clogged filter.

3. All unit controls shall be electronic type.

4. Interlock unit to run when vent damper opens and booster fan runs.

5. Provide booster fan for vent and associated wiring.

6. Provide the following safety controls: air flow switch, electronic flame safety relay, high temperature limit switch, starter interlock, high gas pressure switch, low gas pressure switch, low discharge temperature control with bypass timer.

7. Provide outdoor thermostat to lock-out burner when outdoor temperature is above 60ºF (adj.).

8. Interlock unit to start when exhaust fan runs. Interlock burner to operate when flow switch in exhaust duct proves flow. Interlock wiring is by the Mechanical Contractor.

9. Unit dampers shall close whenever unit is off. Dampers shall prove open before the unit operates.

I. Discharge Temperature Controls:

1. Fixed Discharge Temperature:

a. Modulate burner to maintain a fixed discharge temperature at the unit mounted sensor.

b. Provide remote wall mounted panel for resetting discharge air temperature. Wire to unit control panel.

c. Controls shall be electronic.

d. Refer to Section 23 09 00 for additional requirements.

e. Provide relays to signal the following conditions to the DDC system:

J. Gas Manifold:

1. Pilot line shall include: gas shutoff valve, gas regulator, pilot gas valve.

2. Main gas line shall include: gas shutoff valve, gas regulator, main gas valve (2 required), modulating gas valve, leakage test valve, low pressure gas switch, high pressure gas switch, vent valve between the two main gas valves and all required test valves.

3. Gas train shall meet FIA/IRI, FM, local utility, and Owner's insurance company requirements.

4. Provide piping from vent valve to outside the building.

5. Provide additional regulator if the incoming gas pressure exceeds 2 psig.

6. Locate all valves and components in a unit mounted enclosure.

K. Intake Hood:

1. Provide rain hood for rooftop inlet installation. Hood shall draw air through the bottom of the hood. Provide bird screen on inlet.

END OF SECTION

SECTION 23 8113

PACKAGED TERMINAL AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Terminal Air Conditioning Units.

B. Packaged Terminal Heat Pump Units.

C. Wall Sleeves and Louvers.

D. Controls.

1.2 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. AHRI 210 - Unitary Air Conditioning Equipment.

D. AHRI 240 - Air Source Unitary Heat Pump Equipment.

E. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

F. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

G. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Carrier.

B. Lennox.

C. Trane

D. Friedrich

2.2 MANUFACTURED UNITS

A. Provide packaged, self-contained, through-the-wall air water cooled terminal heat pump units, with wall sleeve, room cabinet, electric refrigeration system, hot water heating, outside air louvers, remote temperature controls.

B. Conform to ASHRAE 90.1.

2.3 CABINET

A. Cabinet: Wall mounted of 18 gauge galvanized steel with baked enamel finish, removable front panel with concealed latches. Color selection by the Architect.

B. Discharge Grille and Access Door: Removable discharge grilles, allowing 4-way discharge air pattern, with hinged door in top of cabinet for access to controls.

2.4 WALL SLEEVES AND LOUVERS

A. Wall Sleeves: 12 inches deep, 16 gauge galvanized steel with protective mastic coating.

B. Louvers: Companion flanged anodized aluminum. Color selected by the Architect.

2.5 CHASSIS

A. Refrigeration System:

1. Direct expansion cooling coil.

2. Hermetically sealed compressor with internal spring isolation, external isolation, permanent split capacitor motor and overload protection.

3. Accumulator.

4. Condenser coil and fan.

5. Coaxial tube in tube condenser with water regulating valve.

6. Capillary restrictor.

7. Reversing valve.

B. Air System: Centrifugal forward curved evaporator fans with two speed permanent split capacitor motor, permanent washable filters, positive pressure ventilation damper with concealed manual operator.

C. Heating Coil: Hot water.

D. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per $ft^2$of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

E. Condenser Fan: Propeller type with separate permanent split capacitor motor.

F. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

G. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.6 CONTROLS

A. Control Module: Remote mounted adjustable thermostat with heat anticipator, off-heat-auto-cool switch, high-low fan switch.

B. Low Ambient Lockout Control: Below 35ºF, outdoor thermostat shall switch to reverse cycle heating on cooling mode and on heat mode.

C. Electric resistance heater shall be locked out when heating load can be met by heat pump alone, with the exception of outdoor defrost cycles.

END OF SECTION

SECTION 23 8121

COMPUTER ROOM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Package Computer Room Air Conditioning Ceiling Mounted Units.

B. Package Computer Room Air Conditioning Floor Mounted Units.

1.2 REFERENCES

A. ANSI NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

D. ANSI/ASME - Boilers and Pressure Vessels Code.

E. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. ASHRAE 52 - Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

G. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.

H. UL - Underwriters' Laboratories.

I. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.

PART 2 - PRODUCTS

2.1 COMPUTER ROOM AIR CONDITIONING CEILING MOUNTED UNITS

A. Acceptable Manufacturers:

1. Liebert, Mini-Mate Series.

2. Stulz Air Technology Systems (SATS)

3. Data-Aire

4. ClimateWorx

B. Manufactured Units:

1. Provide packaged, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, remote condensing unit, and controls.

2. Assemble unit for ceiling installation with service access required.

3. Unit shall be concealed above the ceiling with return and supply air duct flanges.

4. Performance shall be as scheduled on the drawings.

C. Evaporator Cabinet and Frame:

1. Cabinet and Chassis: Heavy gauge galvanized steel or 16 gauge aluminum.

2. Access Panels: Galvanized steel or 16 gauge aluminum with Gaskets.

3. Insulation: Thermally and acoustically line cabinet interior with one inchthick acoustic duct liner or 1/2” thick 6 lbs/cu.ft. density foam insulation.

4. Air Distribution Panel: Heavy molded plastic 4-way discharge plenum with return air grille and unit filter. Designed for installation into T-bar ceiling system, 24"x48" size.

5. Duct Connections: Provide return and supply ductwork flanges.

D. Evaporator Fans and Motors:

1. Fans: Double inlet, forward curved, direct drive centrifugal fans or plenum fan, statically and dynamically balanced, on steel shaft with self-aligning permanently lubricated bearings.

2. Motor: Permanent split capacitor, high efficiency single speed with internal overload protection.

E. Evaporator Coils (Direct Expansion):

1. Direct expansion cooling coil of seamless copper tubes expanded into aluminum fins.

2. Single refrigeration circuit with externally equalized expansion valve with hot gas bypass.

3. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

F. Evaporator Coils (Chilled Water):

1. Hydronic cooling coil of seamless copper tubes expanded into aluminum fins.

2. Maximum face velocity of 450 fpm.

3. Control valve, 2-way type, slow close electronic actuator with 125 psi rating.

4. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

G. Heating Coils:

1. Heating coils: Enclosed fin-tubular electrical elements with SCR control.

2. Circuit Protection: UL listed primary and secondary thermal cutouts, differential air pressure switch, and manual reset overload protection, branch circuit over current protection.

H. Reheat Coil:

1. Hot gas refrigerant coil of seamless copper tubes expanded into aluminum fins with three-way solenoid valve on first stage refrigerant circuit.

I. Filters:

1. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; 2 inch nominal thickness.

2. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; 500 ft/min face velocity.

3. Refer to Section 23 40 00 - Air Cleaning for additional requirements.

J. Humidifier:

1. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.

   a. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap on drain.

   b. Drain Cycle: Field-adjustable drain duration and drain interval.

K. Electrical Panel:

1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code.

2. Disconnect Switch: Non-automatic molded NEMA-3R or NEMA-12 case circuit breaker or non-fused disconnect with lockable handle.

L. Control System:

1. Microprocessor based with wall mounted control enclosure with LCD display and membrane keypad for user interface.

2. Wall mounted control shall display unit status, allow setpoint adjustment, and show alarm conditions.

3. Controls shall allow for:

   a. Restart after power loss.

   b. Maintain room temperature and relative humidity setpoints by activation of refrigeration or heating coils, or both.

   c. Maintain room relative humidity using internal humidifier and by using unit cooling and heating coils for dehumidification.

   d. Provide internal seven-day clock function for setback temperatures.

   e. User LCD shall provide indication of on/off, fan speed, operating mode (cooling, heating, humidifying, dehumidifying), current day/time, and temperature/relative humidity.

   f. System shall monitor and alarm with audible and visual signal high temperature, low temperature, high humidity, and low humidity. Silence switch shall be available to shut off audible alarm.

4. Provide relay or acceptable alternative for connection of key alarm conditions to building DDC system. Refer to Section 23 09 00 for additional information.

M. Air Cooled Condensing Unit (Remote Mounted):

1. Hermetic or scroll refrigerant compressors with resilient suspension system, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.

2. Corrosion resistant cabinet with copper tube aluminum fin coils, direct drive propeller fan with permanently lubricated ball bearings, single phase motors with internal overload protection.

3. Corrosion resistant cabinet with copper tube aluminum fin coils, direct drive propeller fan with permanently lubricated ball bearings, single phase motors with internal overload protection.

4. Provide pre-charged refrigerant line sets and accessories of sizes needed for installation. Verify lengths of piping required for installation.

5. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

6. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

N. Water Cooled Condensing Unit (Remote Interior Mounted):

1. Hermetic refrigerant compressors with resilient suspension system, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.

2. Corrosion resistant cabinet with copper coaxial counter flow condenser. Provide water regulating valve with head pressure control; 150 psi rated.

3. Provide pre-charged refrigerant line sets and accessories of sizes needed for installation between evaporator and condensing unit. Verify lengths of piping required for installation.

4. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

5. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

O. Glycol Pump Package:

1. Packaged pump unit matched to evaporator, condensing unit, and drycooler.

2. Centrifugal pumps with single phase motors with internal overload protection.

3. Provide weatherproof and vented enclosure and integral electric control panel.

4. Refer to drawings for performance and capacity.

P. Drycooler:

1. Low profile packaged unit with low profile design, slow speed, multiple propeller fans.

2. Unit to be constructed of aluminum and contain a copper tube aluminum fin coil with integral electric control panel.

3. Fans to be direct drive propeller type with permanently lubricated ball bearing, single phase motors with internal overload protection.

4. Unit shall be designed for 95°F ambient operation.

Q. Condensate Pump:

1. Packaged unit matched to evaporator unit including float switch, pump, motor assembly, check valve, and reservoir.

2. Provide alarm to indicate high level reservoir.

3. Unit shall be powered from evaporator unit with appropriate field connections available.

2.2 COMPUTER ROOM AIR CONDITIONING FLOOR MOUNTED UNITS

A. Acceptable Manufacturers:

1. Liebert.
2. Stulz Air Technology Systems (SATS)
3. Data-Aire
4. ClimateWorx

B. Manufactured Units:

1. Provide packaged, water on air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, and controls.

2. Assemble unit for up-flow on down-flow air delivery, in draw-through or blow-through configuration.

C. Cabinet and Frame:

1. Structural Frame: Welded steel suitably braced for rigidity, capable of supporting compressors and other mechanical equipment and fittings, welded tubular steel floor stand with adjustable legs and vibration isolation pads.

2. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges to allow removal of panels, and concealed fastening devices.

3. Insulation: Thermally and acoustically line cabinet interior with one inch thick, 1.5 lb. glass fiber insulation.

4. Finish of Exterior Surfaces: powder coated; color by Architect.

D. Evaporator Fans and Motors:

1. Fans: Backward inclined plenum fan with direct drive motors mounted on rubber-in-shear isolators or double inlet, forward curved centrifugal fans, statically and dynamically balanced, on steel shaft with self-aligning permanently lubricated ball bearings, and V-belt drive.

2. Motor: Drip-proof, permanently lubricated ball bearing motor with built-in current and overload protection.

3. Drive: Site tunable electronic inverter drive that enables the adjustment of airflow to site external static pressure or V-belt, cast iron or steel sheaves, dynamically balanced, keyed, variable and adjustable pitch motor sheave, minimum of two matched belts, drive rated minimum 2.0 times nameplate rating of motor.

E. Compressors:

1. Scroll with resilient suspension system, oil strainer, crankcase sight glass, internal motor protection, low pressure switch, manual reset high pressure switch.

a. System shall include cylinder unloaders to provide four steps of cooling as follows:

1) One compressor operating at 50% capacity.

2) Two compressors, each operating at 50% capacity.

3) One compressor operating at 50% capacity, and one compressor operating at 100% capacity.

4) Two compressors operating at 100% capacity.

b. When humidistat calls for dehumidification, the microprocessor control system shall ensure that at least one compressor is operating at 100% capacity.

2. Provide with fan speed control to operate a variable speed motor from 10 to 1050 rpm. System shall be complete with transducers, thermostats, and control circuit to sense the highest head pressure of either operating compressor and control the variable speed fan to maintain head pressure. The fan speed control system shall provide positive start-up an operation to -20°F.

3. Compressors shall be individually serviceable without dismantling other components.

4. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

5. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

F. Evaporator Coils:

1. Split face circuits, direct expansion cooling coils of seamless copper tubes expanded into aluminum fins, in vertical flat face configuration.

2. Two refrigeration circuits, each with hot gas mufflers, thermal expansion valve with external equalizer, liquid line solenoid valve, liquid line filter-drier, refrigerant sight glass with moisture indicator, service shutoff valves and charging valves, hot gas bypass.

3. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

G. Condensers:

1. Water Cooled: Shell and tube type to Section 8D of ANSI/ASME code with liquid line stop valve and head pressure actuated water regulating valve. Terminate cabinet for easy external connections.

*******OR*******

2. Air Cooled: Air cooled refrigerant condenser, refer to Section 23 63 13, consisting of corrosion resistant cabinet, copper tube aluminum fin coils arranged for two circuits, multiple direct drive propeller fans with permanently lubricated ball bearing single phase motors with internal overload protection.

H. Chilled Water Coil:
Hot Water Reheat Coil:
Steam Reheat Coil:
Glycol Cooling Coil:

1. Seamless copper tubes expanded into aluminum fins with two-way modulating control valve, strainer, and float and thermostatic trap.

I. Hot Gas Reheat Coil:

1. Hot gas refrigerant coil of seamless copper tubes expanded into aluminum fins with three-way solenoid valve on first stage refrigerant circuit.

J. Filters:

1. Media: Pleated, lofted, non-woven, reinforced cotton fabric; supported and bonded to welded wire grid; enclosed in cardboard frame; 2 inch nominal thickness.

2. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; 500 ft/min face velocity, 0.30-inch WG initial resistance, 1.0-inch WG recommended final resistance.

K. Heating Coils:

1. Heating Coils: Enclosed fin electrical elements arranged for minimum of three stages.

2. Circuit Protection: Primary and secondary thermal cutouts, differential air pressure switch, and manual reset overload protection, branch circuit over current protection.

L. Humidifier:

1. Infrared Type: High intensity quartz lamps mounted above stainless steel evaporator pan, serviceable without disconnecting water, drain, or electrical connections; pre-piped and utilizing condensate water from cooling coils with stainless steel or brass float valve mechanism; located in bypass air stream; with flush cycle timer and solenoid drain valve.

M. Glycol Pump Package:

1. Cabinet: Weatherproof and vented enclosure of enameled, galvanized steel on structural base frame.

2. Pumps: Two centrifugal pumps with mechanical seal.

3. Controls: Electrical control cabinet with starters, disconnect, lead/lag switch, and automatic switch-over and alarm light.

4. Piping: Interconnecting piping, from suction to discharge with shutoff valves, flow switches, check valves in pump discharge, unions, and pressurized expansion tank with air purge vent and system charging connection.

N. Drycooler:

1. Low profile packaged unit with low profile design, slow speed, multiple propeller fans.

2. Unit shall be constructed of aluminum and contain a copper tube aluminum fin coil with integral electric control panel.

3. Fans shall be direct drive propeller type with permanently lubricated ball bearing, single phase motors with internal overload protection.

4. Unit shall be designed for -20°F to 100°F ambient operation. Provide with low temperature accessories as needed.

5. Controls:

   a. All electrical connections and electrical low ambient control options shall be provided in a weatherproof enclosure. The enclosure shall be integral with the condenser. A door mounted and internally wired electrical disconnect switch shall be included.

   b. Unit shall have the motors factory wired to a three phase power block in the electrical enclosure. Provide magnetic contactor and control voltage for remote starting of the drycooler. Fan cycling shall be used to control leaving fluid temperature by cycling fans in one or two steps. The 24-volt control circuit furnished consists of control transformer, fan contactor(s) and temperature control(s) as specified.

O. Electrical Panel:

1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code.

2. Control Cabinet: NEMA 250; Type 2 enclosure, UL listed, with piano hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer.

3. Disconnect Switch: Non-automatic molded case circuit breaker with handle accessible with panel closed and capable of preventing access until switched to "off" position.

P. Microprocessor Control System:

1. Logic Circuitry: Microprocessor shall continuously monitor operation of process cooling system; continuously digitally display room temperature and room relative humidity, sound alarm on system malfunction and simultaneously display problem. When more than one malfunction occurs, flash fault in sequence with room temperature, remember alarm even when malfunction cleared, and continue to flash fault until reset.

2. Malfunctions: Power Loss, Loss of Air Flow, Clogged Air Filter, High Room Temperature, Low Room Temperature, High Humidity, Low Humidity, Smoke/Fire, Compressor No. 1 - Overload, Compressor No. 1 - Low Pressure, Compressor No. 1 - High Pressure, Compressor No. 2 - Overload, Compressor No. 2 - Low Pressure, Compressor No. 2 - High Pressure.

3. Light Emitting Diodes Display: Control Power On, System On, Humidification, Dehumidification taking place, Compressor No. 1 operating, Compressor No. 2 operating, Heat or Reheat operating, Economy Cooling.

4. Provide push buttons to STOP process cooling system, START process cooling system, SILENCE audible alarm, push-to-test LED indicators, and display room relative humidity.

END OF SECTION

SECTION 23 8126

SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Split system air conditioning, ceiling-mounted, and/or ceiling-concealed units.

1.2 REFERENCES

A. ARI 210 - Unitary Air Conditioning Equipment

B. ARI 240 - Air Source Unitary Heat Pump Equipment

C. ANSI NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

D. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. ASHRAE 52 - Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

H. ASTM B1003 - Standard Specification for Seamless Copper Tube for Linesets.

I. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.

J. UL - Underwriters' Laboratories.

1.3 WARRANTY

A. Provide five (5) year manufacturer's warranty on all compressors.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM WALL AND CEILING-MOUNTED UNITS

A. Acceptable Manufacturers:

1. Carrier/Toshiba
2. Panasonic
3. LG
4. Sanyo
5. Samsung

6. Daikin Applied

7. Mitsubishi

B. Manufactured Units:

1. Provide packaged, air-cooled, factory assembled, pre-wired and pre-piped unit consisting of cabinet, fans, filters, remote condensing unit, and controls. Wall-mounted units shall be furnished with integral wall mounting bracket and mounting hardware.

2. Assemble unit for wall-mounted or ceiling installation with service access required.

3. Performance shall be as scheduled on the drawings.

4. Unit shall be rated per AHRI Standards 210/240 and listed in the AHRI directory as a matched system.

5. Provide unit with factory-supplied cleanable air filters.

6. The units shall be listed by Electrical Laboratories (ETL) in accordance with UL-1995 certification and bear the ETL label.

7. All wiring shall be in accordance with the National Electric Code (NEC).

C. Evaporator Cabinet and Frame:

1. Cabinet:

a. Refer to schedule on drawings for mounting type (ceiling-recessed cassette, or ceiling concealed).

b. Exposed units shall have a finished appearance with concealed refrigerant piping, condensate drain piping, and wiring connections.

2. Air Distribution Panel (for ceiling-mounted units): Heavy molded plastic 4-way discharge plenum with return air grille and unit filter. Designed for installation into T-bar ceiling system, 24” x 24” size.

D. Evaporator Fans and Motors:

1. Fans:

a. The evaporator fan shall be direct drive with a single motor having permanently lubricated bearings.

b. The fan shall be statically and dynamically balanced.

c. The indoor fan shall have at least three speeds.

2. Motor:

a. Direct driven, digitally controlled with multiple speeds. Permanently lubricated with internal overload protection.

E. Evaporator Coils (Direct Expansion):

1. Direct expansion cooling coil of seamless copper tubes expanded into aluminum fins.

2. Single refrigeration circuit with externally equalized expansion valve.

3. Coils shall be pressure tested at the factory.

4. A sloped, corrosion-resistant condensate pan with drain shall be provided under the coil.

F. Electrical Panel:

1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code and local electrical codes.

G. Control:

1. The unit shall have a hard-wired 7-day programmable remote controller to operate the system. Provide wall mounting bracket for controller.

2. Remote controller shall have “automatic”, “dry” (dehumidification), and “fan only” operating modes.

3. The remote controller shall have the following features:

a. On/Off power switch.

b. Mode Selector to operate the system in auto, cool, heat, fan, or dehumidification (dry) operation.

c. Fan Setting to provide multiple fan speeds.

d. Swing Louver for adjusting supply louver discharge.

e. On/Off Timer for automatically switching the unit off or on.

f. Temperature Adjustment allows for the increase or decrease of the desired temperature.

g. Powerful Operation to allow quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time.

4. The remote controller shall perform fault diagnostic functions that may be system related, indoor or outdoor unit related depending on the fault code.

5. Temperature range on the remote controller shall be 64°F to 90°F in cooling mode and 50°F to 86°F in heating mode.

6. The indoor unit microprocessor shall have the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote controller.

H. Outdoor Unit:

1. General:

a. The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be completely factory assembled and pre-wired with all necessary electronic and refrigerant controls.

2. Cabinet:

a. The outdoor unit shall be fabricated of galvanized steel, bonderized and coated with a baked enamel finish for corrosion protection.

3. Fan:

a. The fan shall be direct drive, propeller type fan with fan guard.

b. Fan blades shall be statically and dynamically balanced.

c. The fan shall have permanently lubricated type bearings.

d. Motor shall be protected by internal thermal overload protection.

e. Airflow shall be horizontal discharge.

4. Coil:

a. The outdoor coil shall be nonferrous construction with corrugated fin tube.

b. The coil shall be protected with an internal guard.

c. Refrigerant flow from the condenser shall be controlled via a metering device.

5. Compressor:

a. Hermetic or scroll refrigerant compressors with resilient suspension system, inverter driven, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.

b. The outdoor unit shall have an accumulator and four-way reversing valve.

6. Refrigerant:

a. Unit shall use R-410a.

b. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

I. Integral Condensate Pump:

1. Packaged unit matched to evaporator unit including float switch, pump, motor assembly, check valve, and reservoir.

2. Provide alarm to indicate high level reservoir.

3. Unit shall be powered from evaporator unit with appropriate field connections available.

J. Condensate Pump:

K. Refrigerant Piping:

1. Design Pressure: 450 psig.

2. Maximum Design Temperature: 250 F.

3. Piping - 4" and under.

   a. Tubing: Type ACR seamless copper tube linesets, ASTM B1003. Sizes indicated are nominal designation.

   b. Joints: Brazed with silver solder.

   c. Fittings: Wrought copper solder joint, ANSI B16.22.

   d. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged, and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

4. Refrigerant linesets are permitted.

   a. Provide refrigerant linesets and accessories of sizes needed for installation. Verify lengths of piping required for installation.

5. Insulation:

   a. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). If thickness required in Part 4 - Execution does not meet 25/50 flame spread/smoke developed rating, use multiple layers of a thickness that does meet 25/50 flame spread/smoke developed.

END OF SECTION

SECTION 23 8145

VARIABLE REFRIGERANT FLOW HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable refrigerant flow split system heat pump (heat/cool).

B. Variable refrigerant flow split system heat pump with heat recovery (simultaneous heat/cool).

1.2 REFERENCES

A. ANSI/AHRI 210/240 – Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.

B. ANSI/AHRI 270 - Sound Rating of Outdoor Unitary Equipment.

C. ANSI/ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

E. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

PART 2 - PRODUCTS:

2.1 ACCEPTABLE MANUFACTURERS

A. Mitsubishi

B. Daikin AC

C. Panasonic/Sanyo

D. LG

E. Toshiba Carrier

2.2 SYSTEM DESCRIPTION

A. The variable capacity, heat recovery, heat pump air conditioning system shall be a variable refrigerant flow split system. The system shall consist of multiple evaporators using PID control and inverter driven outdoor unit. The unit shall consist of direct expansion (DX), air-cooled heat pump air conditioning system, and variable speed driven compressor multi zone split system.

B. Outdoor Unit - General: The outdoor unit is designed specifically for use with the manufacturer’s components:

1. Refrigerant: R410A.

2. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant control. The refrigeration circuit of the outdoor unit shall consist of a compressor, motors, fans, condenser coil, electronic expansion valves, oil separators, service ports, liquid receivers, and accumulators.

3. All refrigerant lines shall be individually insulated between the outdoor and indoor units.

4. The connection ratio of the nominal capacity of indoor units to outdoor unit shall be 50-130%.

5. The sound pressure shall be no greater than 63 dBA at 4 feet from the outdoor unit at full load at fan height.

6. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost, thus eliminating the need for re-programming.

7. The following safety devices shall be included on the outdoor unit: high pressure switch, control circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic as required to maintain oil levels at the outdoor unit.

8. The outdoor unit shall be able to operate in heating mode to -4°F dry bulb ambient temperature without additional ambient controls.

    a. Heating capacity at design condition of -5°F shall be no less than 50% of the value scheduled on the drawings

9. The outdoor unit shall have air cooled heat exchange coils constructed from copper tubing with aluminum fins. The coils shall be capable of being divided into sections to enable the outdoor unit to match the capacity required by the indoor units and to allow individual defrosting to take place as required.

10. The outdoor unit shall have at least one inverter controlled compressor and at least one high efficiency constant speed compressor, depending on scheduled capacity. The system shall use a control sequence to ensure that indoor loads are matched to the compressor capacity control.

11. The refrigeration process of the outdoor unit will be maintained by pressure and temperature sensors controlling solenoid valves, check valves, and bypass valves. The heating or cooling mode of the outdoor unit will be controlled using a combination of 2 and 3-way valves that shall reverse the cycle of the refrigerant to change the mode of the outdoor unit.

12. Unit Cabinet: The outdoor unit model shall be completely weatherproof and corrosion resistant. The outdoor unit shall be constructed from steel plate and treated with an anti-corrosive paint.

13. Fan:

    a. The outdoor unit shall consist of propeller type, direct-drive fan motors that have multiple speed operation via a DC inverter.

b. The fans shall be a vertical discharge. The fan motors shall have inherent protection and permanently lubricated bearings.

c. The fans shall be provided with fan guards.

14. Condenser Coil: The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.

15. Compressor:

a. The variable speed compressor shall be capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the outdoor unit.

b. The inverter driven compressor in each outdoor unit shall be DC, hermetically sealed, scroll type.

c. The capacity control range shall be a minimum of 20% to 100% of total capacity.

d. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

e. Oil separators shall be standard with the equipment, together with an oil balancing circuit.

f. The compressor shall be mounted to avoid the transmission of vibration.

C. Branch Circuit Controllers Solenoid Valve Kits Branch Selector Heat Recovery Unit:

1. The unit shall be constructed from galvanized steel plate and be internally insulated with polyurethane foam. The connection to the system shall be either via brazed connection or flare nuts.

2. The unit shall be connected to the indoor units or group of indoor units via its own dedicated connection. This connection shall supply power and control signals to the solenoid valves in the unit.

3. The unit shall have integral controls and be factory assembled, wired, and piped.

4. The unit shall include an integral drain pan and condensate pump as required.

5. The unit electrical power shall be 208-230V/1-phase/60Hz or as noted on the drawings.

6. Provide unit with at least two (2) additional unused connections for future expansion and maintenance. Provide isolation valves and caps on unused connections.

D. Oil Recovery System:

1. System shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.

2. System shall be designed for proper oil return to compressor, along with distribution of oil to individual compressor.

E. Indoor Units:

1. General – Each indoor unit shall have a heat exchanger that shall be constructed from copper tubing with aluminum fins. The flow of refrigerant through the heat exchanger shall be controlled by an electronic modulating expansion valve. This valve shall be controlled by internal temperature sensors and shall be capable of controlling the variable capacity of the indoor unit between at least 25% and 100%. The units shall be shipped from the factory fully charged with dehydrated air.

2. Wall Mounted:

a. The indoor units shall be designed for installation onto a wall within a conditioned space to be connected to a heat pump outdoor unit.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 35 dBA at low speed measured at 3.3 feet from the units.

c. Construction:

1) The indoor units shall be completely factory assembled and tested. Included in each unit is factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. Each unit shall have at least one auto-swing louver for efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge louver angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The condensate drain pipe shall be able to be connected to either left or right sides.

d. The indoor units shall be equipped with a return air thermistor.

e. The indoor unit shall be separately powered.

f. Unit Cabinet:

1) The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.

2) The cabinet shall be constructed of molded plastic cover with sound absorbing foamed polystyrene and polyethylene insulation.

g. Fan:

1) The fan shall be a direct-drive cross-flow type, statically and dynamically balanced with high and low fan speeds available.

2) The fan motor shall be thermally protected.

h. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

i. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

3. Four-way Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette for installation into the ceiling cavity, equipped with an air panel grille to be connected to the indoor unit as scheduled and specified in this section. The indoor unit shall have four-way air distribution and an ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via motorized louvers that can be horizontally and vertically adjusted from 0° to 90° angle.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) The 4-way supply airflow shall be field modifiable to 3-way and 2-way airflow to accommodate various installation configurations, including corner installations.

3) Return air shall be through the concentric panel, which shall include a filter.

4) The indoor units shall be equipped with a return air thermistor.

5) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be recessed into the ceiling.

2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.

3) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by a washable long-life filter with mildew proof resin.

g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

4. One-way Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette indoor unit for installation into the ceiling cavity, equipped with an air panel grille to be connected to the indoor unit. The indoor unit shall have a one-way air distribution type, ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via motorized louvers that can be horizontally and vertically adjusted from 0° to 90° angle.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3--minute fused time delay, and test run switch.

2) Return air shall be through the concentric panel, which shall include a filter.

3) The indoor units shall be equipped with a return air thermistor.

4) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be located into the ceiling.

2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.

3) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 25 inches635 mm lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

5. Ceiling Concealed Ducted (Low Static Pressure):

a. The indoor unit shall be a built-in ceiling concealed indoor unit, low static pressure (LSP), for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for ducted horizontal discharge air, with ducted horizontal return air or bottom return air configuration (as scheduled or shown on the drawings). The external static pressure shall be as scheduled on the drawings.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

6. Ceiling Concealed Ducted (High Static Pressure):

   a. The indoor unit shall be a built-in ceiling concealed indoor unit, high static pressure (HSP), for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for ducted horizontal discharge air, with ducted horizontal return air or bottom return air configuration (as scheduled or shown on the drawings). The external static pressure shall be as scheduled on the drawings.

   b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

   c. Construction:

      1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

      2) The indoor units shall be equipped with a return air thermistor.

      3) The indoor unit shall be separately powered.

      4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

   d. Unit Cabinet:

      1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

      2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

      3) The cabinet shall be factory insulated for use in unconditioned indoor spaces.

   e. Fan:

      1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

      2) The fan motor shall be thermally protected.

   f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

   g. Coils:

      1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

7. Ceiling Suspended:

a. The indoor unit shall be a ceiling suspended indoor unit. The unit shall be constructed of galvanized steel with white impact resistant casing, to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for a horizontal discharge air with bottom return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall range from 22 dB(A) to 31 dB(A) at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

8. Floor Standing Exposed:

a. The indoor unit shall be a floor standing exposed indoor unit. The unit shall be constructed of galvanized steel with painted finish, to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for a vertical discharge air with bottom front return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be located against the wall, with top mounted supply and bottom return.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

9. Floor Standing Concealed:

a. The indoor unit shall be a floor standing concealed indoor unit. The unit shall be constructed of galvanized steel with painted finish, to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for a ducted discharge air with bottom front return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall range from 22 dBA to 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the wall or casework and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

10. Vertical / Horizontal Air Handling Unit: The indoor unit shall be a floor standing vertical / horizontal air handling unit with ducted discharge.

a. Acoustic Performance: Sound pressure shall range from not exceed 41 dBA at low speed measured 3.3 feet from the unit.

b. Construction:

1) Indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

c. Unit Cabinet:

1) Unit cabinet shall be constructed of galvanized steel with painted finish.

2) Cabinet shall be single wall construction with sound absorbing foamed polystyrene and polyethylene insulation.

3) Cabinet shall be factory insulated for use in unconditioned indoor spaces.

d. Fan:

1) Fan shall be direct-drive, forward curved fan, statically and dynamically balanced impeller with high, medium and low fan speeds.

2) Fan shall have static pressure up to 0.5” W.C.

3) Fan motor shall be thermally protected.

e. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

f. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

2.3 PIPING

A. Design Pressure: 450 psig.

1. Maximum Design Temperature: 250 F.

B. Piping - 4" and under.

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Brazed with silver solder.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

C. Insulation:

1. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). If thickness required in Part 4 - Execution does not meet 25/50 flame spread/smoke developed rating, use multiple layers of a thickness that does meet 25/50 flame spread/smoke developed.

PART 3 - CONTROLS

3.1 GENERAL

A. The unit shall have controls provided with the unit by the manufacturer to perform input functions necessary to operate the system.

B. Computerized PID control shall be used to maintain room temperature within 1°F of setpoint.

C. The unit shall be equipped with a programmable drying cycle that dehumidifies while inhibiting changes in room temperature.

D. The indoor circuit board shall be wired to enable auxiliary heating when at least one of the following occurs:

1. Coil thermistor temperature drops below a factory setpoint in heating mode.

2. Outdoor temperature drops below setpoint (adj.).

3. Based on a user adjustable schedule.

3.2 SIMPLE REMOTE CONTROL – TYPE A

A. The wired remote controller shall be able to control one (1) group (maximum of 16 units) and shall be able to function as follows:

1. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions.

2. The controller shall be able to immediately display fault location and condition.

3. An LCD digital display shall allow the temperature to be set in 1°F units.

4. The controller shall be equipped with a thermostat sensor in the remote controller, making possible more comfortable room temperature control.

B. The wired remote controller shall have the following features:

1. Operation: Start/Stop, Temperature Setting, Fan Speed.

2. Monitoring: Status, malfunction flashing, malfunction content, filter sign, operation mode, temperature setting, permit/prohibit selection, fan speed, airflow direction.

3. Control Management: Field Setting Mode, Group Setting, Auto Restart.

4. The controller shall also be able to switch an external dry contact via a 12-volt DC relay (field supplied).

3.3 DELUXE REMOTE CONTROL – TYPE B

A. The wired remote controller shall be able to control one (1) group (maximum of 16 indoor units) and shall be able to function as follows:

1. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions.

2. The controller shall be able to immediately display fault location and condition.

3. An LCD digital display shall allow the temperature to be set in 1°F units.

4. The controller shall be equipped with a thermostat sensor in the remote controller, making possible more comfortable room temperature control.

B. The wired remote controller shall have the following features:

1. Operation: Start/Stop, Operation Mode, Temperature Setting, 60°F - 90°F, Setpoint Range, Fan Speed, Airflow Direction.

2. Monitoring: Status, malfunction flashing, malfunction content, filter sign, operation mode, temperature setting, permit/prohibit selection, fan speed, airflow direction.

3. Scheduling: ON/OFF Timer.

4. Control Management: Field Setting Mode, Group Setting, Auto Restart.

5. The controller shall also be able to switch an external dry contact via a 12-volt DC relay (field supplied).

3.4 SYSTEM CONTROLLER – TYPE C

A. The controller shall control at least 50 units and shall be able to be used in conjunction with all room controller types. Collective and individual group commands are available with permit/prohibit individual remote controller function. At least five system controllers shall be able to reside on any one communication bus.

3.5 CENTRAL CONTROLLER – TYPE D

A. This controller shall be wall mounted and hard wired, either directly to the control system or via gateway. It shall be manufactured in ABS plastic with an LCD display and shall be the manufacturer's standard color. The controller shall be capable of individually controlling the following functions on at least 128 indoor units:

1. On/off

2. Operating mode

3. Setpoint

4. Fan speed

5. Louver position

6. Timer settings

7. Test run

B. The controller shall also be capable of displaying the following information individually for at least 128 indoor units:

1. On/off

2. Operating mode

3. Setpoint

4. Fan speed

5. Louver position

6. Timer settings

7. Test run

8. Fault diagnosis

C. Each central controller unit can be accessed either locally or remotely via standard internet software. The central controller will be able to indicate system alarms via volt free contacts, as well as providing control points for other devices. Additionally, the central controller shall be able to monitor individual usage of heating and cooling demands, report alarm and conditions to nominated email address, and enable remote alteration of systems setpoints to registered users. All required software costs and licensing fees shall be included for the life of the systems.

3.6 MAINTENANCE ACCESS

A. Provide all gateways and connection cabling for performing maintenance functions on system.

B. Provide all software and registration codes as required to allow access into advanced maintenance functions.

3.7 SEQUENCE

A. Install a remote mounted temperature sensor.

B. The thermostat shall stage heating or cooling as required to maintain space setpoint at 72°F (adj.).

C. Thermostat shall automatically change the indoor unit mode based on the space setpoint.

D. If space setpoint continues to drop once indoor unit has been changed to heating mode, the thermostat shall enable the space electric baseboard heat.

E. Control system shall have capability to control electric baseboard heat.

F. Central controller shall enable dedicated outdoor unit based on an adjustable occupancy schedule. Coordinate enable/disable function with AHU manufacturer.

3.8 SYSTEM INTEGRATION

A. The manufacturer’s control system shall be capable of integrating with the building automation system with built in hardware or separate add-on interfaces. All additional devices shall be provided by the manufacturer.

B. The system shall be compatible with LonWorks®, BACnet®, Modbus®, or N2®. Refer to Section 23 09 00.

END OF SECTION

SECTION 23 8200

TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Finned Tube Radiation.

B. Panel Radiation.

C. Convectors.

D. Unit Heaters.

E. Cabinet Heaters.

F. Fan Coil Units.

G. Vertical Stacked Fan Coil Units.

H. Unit Ventilators – Horizontal Type

I. Unit Ventilators – Vertical Upright Type

J. Gas Fired Unit Heaters.

K. Air Curtains - Commercial.

L. Air Curtains - Architectural.

M. Gas Fired Low Intensity Radiant Tube Heaters.

N. Chilled Beams.

1.2 QUALITY ASSURANCE

A. All filters shall be UL listed Class 1 or Class 2.

B. All electrical equipment shall have a UL label.

C. All gas fired units shall be AGA approved or UL listed.

D. All gas trains shall comply with utility company and code requirements.

E. All louvers and dampers shall have AMCA certified ratings.

F. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 FINNED TUBE RADIATION - WALL HUNG

A. Cabinets shall be 14 gauge steel with baked enamel finish.

B. Final color selection shall be by the Architect.

C. Element hangers shall be quiet operating, cradle type.

D. Cabinet top shall be continuously supported on wall mounting strips. Lower front face of cabinet shall be secured to the enclosure brackets.

E. All cabinet and accessories shall be securely connected with no exposed fasteners.

F. Provide end caps, corner pieces, adjustable extensions, etc. as required for proper appearance and service.

G. Provide custom cabinet at corners where, in the Architect/Engineer's opinion, standard fittings will not fit correctly or have acceptable appearance. Custom cabinet shall be 14 gauge sheet metal with finish and shape to match manufacturer's cabinet. Submit drawings of each custom cabinet for approval.

H. Provide removable cabinet sections at all control valves. It shall not be necessary to remove several sections to maintain control valves.

I. Support 1/2" tubes on 36" centers and larger tubes on 48" centers.

J. Elements shall be copper tube with aluminum fins.

K. Cabinet size, element length, and element size shall meet the scheduled capacities, but not be less than the sizes scheduled.

L. Acceptable Products: Vulcan 'Linovector', Sterling 'Versa-Line', Rittling 'Regency', Shaw-Perkins 'Crown-Line'.

[* * * * *OR* * * * *]

M. Acceptable Products: American Air Filter 'Deluxe', Ted Reed Thermal 'Deluxe', Sterling 'LB2', Modine 'Deluxe', Rittling 'Econoline', Sigma ‘Wall Fin’, Vulcan ‘Floorline’.

2.2 PANEL RADIATION - WALL HUNG

A. All components shall be steel.

B. With corrugated fins welded to flat horizontal tubes to connect to vertical headers at each end.

C. Headers with inlet, outlet, vent and drain connections, and baffles for even heat distribution.

D. Provide integral all-welded perforated top grille.

E. Rated for 56 psi working and 74 psi test pressure.

F. Rated per ISO 1503147-3150.

G. Units to have gloss powder-coated finish. Color selection by the Architect. Furnish color charts with shop drawings.

H. Install mounting hardware per manufacturer's recommendations. Conceal all mounting hardware.

I. Acceptable Manufacturer: Runtal, Rittling, Vulcan, Sterling.

2.3 FINNED TUBE RADIATION - PEDESTAL MOUNT

A. Cabinets shall be minimum 16 gauge steel with baked enamel finish.

B. Final color selection shall be by the Architect.

C. Provide end caps, corner pieces, adjustable extensions, and other accessories required for proper appearance and service.

D. Provide supports with matte black finish.

E. Provide access doors at all valves if cabinet is not easily removable.

F. All cabinet and accessories shall be securely connected with no exposed fasteners.

G. Support 1/2" tubes on 36" centers and larger tubes on 48" centers.

H. Elements shall be copper tube with aluminum fins.

I. Cabinet size, element length and element size shall meet the scheduled capacities, but not be less than the sizes scheduled.

J. Acceptable Products: Vulcan 'Lino-Vane', Sterling - 'PM', Rittling 'ETL'.

2.4 CONVECTORS

A. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins, steel side plates and supports, factory air pressure tested at 100 psi under water.

B. Cabinet: 16 gauge steel front and top; 18 gauge steel back and ends; exposed corners rounded; easily secured removable front panels, adequately braced and reinforced for stiffness.

C. Finish: Factory applied baked enamel on exposed surfaces. Color selection by Architect.

D. At otherwise inaccessible valves, provide 6" x 7" minimum size factory-made hinged access doors integral with cabinet.

E. Acceptable Manufacturers: Sterling, Vulcan, Rittling, Modine, Shaw-Perkins, Sigma.

2.5 UNIT HEATERS

A. Casings shall be heavy gauge steel with a baked finish.

B. Coils shall have copper heads and tubes, and aluminum fins.

C. Units shall have threaded pipe connections for hanger rods.

D. Fans shall be direct drive propeller type, factory balanced, with fan guards and totally enclosed motors with integral thermal overload protection.

E. Horizontal units shall have adjustable outlet air louvers.

F. Provide unit mounted and wired disconnects. Contractor shall be responsible for providing and wiring disconnect when using a manufacturer who does not provide factory mounted option.

G. Acceptable Products: Trane - S or P, Daikin - UHH or UDH, Modine - HS or V, Vulcan - HV or VV, Sterling HS or VS, Rittling - H or V, Sigma H or V, Airtherm HA or VA.

2.6 HOT WATER AND STEAM CABINET HEATERS

A. Units shall include cabinet, fan, motor, coil, filter, inlet grille and discharge grille.

B. Cabinets: 16 gauge exposed surfaces and 18 gauge concealed surfaces. Plastic exposed parts are not acceptable.

C. Baked enamel finish. Color selected by Architect.

D. All motors shall be three-speed permanent split capacitor with integral thermal overload protection.

E. Coils shall have finned copper tubes.

F. Provide 1" thick disposable filters or 1/2” thick washable 65% aluminum filters ahead of all coils.

G. Provide a concealed unit mounted fan switch with "Off-High-Medium-Low" positions that doubles as disconnect.

H. Acceptable Manufacturers: Trane - 'Force-Flo', Sterling, Modine, Rittling, Sigma, Vulcan, Airtherm, Beacon Morris.

2.7 ELECTRIC CABINET HEATERS

A. Forced air wall mounted heaters shall include cabinet, fan, motor, coil, inlet grille and discharge grille.

B. Coil: Electric dual element with finned steel sheaths.

C. Blower shall have a two-speed split capacitor motor and a concealed unit mounted "Off-Low-High" fan speed switch.

D. Power connections, circuit breaker, or disconnect shall be provided by the E.C.

E. Units shall have 1" disposable filters ahead of all coils.

F. Cabinets shall have 16 gauge exposed surfaces, 18 gauge concealed surfaces, and no exposed plastic parts.

G. Baked enamel finish. Color selected by Architect.

H. Acceptable Manufacturers: Trane, Berko.

2.8 FAN COIL UNITS

A. Units shall include cabinet, fan, motor, coils, filter and discharge grille.

B. Cabinets shall be 18 gauge steel with baked enamel finish, color selected by the Architect and no plastic exposed parts.

C. Fans: Centrifugal forward-curved, double-width with galvanized steel scrolls.

D. All motors shall be three-speed permanent split capacitor with integral thermal overload protection.

E. Coils shall have copper headers and tubes and aluminum fins.

F. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

G. Provide auxiliary drain pan to collect condensation in the valve compartment.

H. Provide condensate piping and tie into drainage system.

I. Filters: 1" woven glass fiber disposable type.

J. Provide a concealed unit-mounted fan switch with "Off-High- Medium-Low" positions that doubles as a disconnect. Provide a concealed unit-mounted fan switch with "Off-High-Medium-Low" positions that doubles as a disconnect. Provide a factory-installed manual switch disconnect with load side fuse to protect any fan coil units with a maximum overcurrent protection rating of 20 amps or less.

K. Provide oversized left and right end piping compartments.

L. Provide with tamperproof cabinet front.

M. Provide with a motor cord quick disconnect.

N. Units shall have a single coil for heating and cooling.

O. Acceptable Manufacturers: Air-Therm, Trane Daikin, IEC, Enviro-Tech/JCI, Nailor, Williams, First Co.

2.9 FAN COIL UNITS (VERTICAL STACKED)

A. Unit shall include vertical cabinet, fan, motor, coils, filter, controls, return grille, and discharge collar.

B. Cabinets: 18 gauge galvanized steel with no plastic exposed parts.

C. Units shall be lined with 1-1/2# neoprene coated glass fiber insulation.

D. Fans: Centrifugal forward-curved, double-width with galvanized steel scrolls.

E. Motors: Three-speed permanent split capacitor with integral thermal overload protection.

F. Coils shall have copper headers and tubes, and aluminum fins.

G. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

H. Provide auxiliary drain pan to collect condensation in the valve compartment.

I. Drain pan and fan shall slide out of unit as a single assembly for servicing.

J. Unit shall be configured for furred-in application to be completely enclosed in drywall.

K. Provide return air grille. All service components shall be accessible through this grille.

L. Provide full front architectural panel with integral return grille. All components shall be accessible with panel removed.

M. Outlet: Unit mounted double deflection registers provided with unit. Configuration and cfm as shown on the drawings.

N. Filters shall be 1" woven glass fiber disposable type.

O. Provide a unit mounted and wired disconnect switch. Provide a concealed unit-mounted fan switch with "Off-High- Medium-Low" positions that doubles as a disconnect. Provide a factory-installed manual switch disconnect with load side fuse to protect any fan coil units with a maximum overcurrent protection rating of 20 amps or less.

P. Provide the following unit mounted controls:

1. Heating water electric 24 volt two-position normally-open control valve.
2. Chilled water electric 24 volt two-position normally-closed control valve.
3. Off/High/Medium/Low fan control switch.
4. Terminal strip.
5. 24-volt control transformer.
6. Low voltage thermostat.

Q. Units shall have a single coil for heating and cooling.

R. Provide pre-insulated Type M copper risers on unit with Type M copper condensate drains. Size as noted on the drawings. Provide connections for tandem units where applicable.

S. Provide the following piping accessories for each unit:

1. Ball valve shutoff at inlet and outlet for each coil.
2. Copper loop expansion compensators.
3. Separate balancing valves on outlet of each coil.

4. Manual air vent on highest connection to each coil.

T. Acceptable Manufacturers: Air-Therm, Trane Daikin, IEC, Enviro-Tech/JCI, Nailor, Williams.

2.10 UNIT VENTILATORS (TRADITIONAL HORIZONTAL TYPE)

A. Unit shall be in a blow through configuration and shall utilize chilled water and/or heating water coils per the control specifications.

B. Unit shall include cabinet, fan, motor, coil, filter, dampers, inlet grille, discharge grille, and outside air louver.

C. Cabinets shall have 16 gauge front, top, bottom and sides, with exposed edges rounded.

D. Baked enamel finish. Color selected by Architect.

E. Removable front panels secured with camlock fasteners.

F. Discharge Grilles: Heavy steel bars welded in place.

G. Inlet grilles shall be removable for access to filters.

H. Provide 6" false plenum back for all replacement unit ventilators.

I. Outside air louver shall be extruded aluminum with bird screen on the back side.

J. Provide wall sleeve for louver installation.

K. Cabinets shall have space at both ends for coil piping.

L. Unit shall have outside air and return air dampers. All dampers shall be gasketed for tight shutoff.

M. Fans: Forward curved, double width, factory balanced, direct drive.

N. Motors shall be two-speed permanent split capacitor type.

O. Coils: Plate fin type with copper tubes and aluminum fins.

P. Provide a single hot water coil as scheduled on the drawings.

Q. The heating coil is to be in the reheat position.

R. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

S. Provide 1" thick disposable filter upstream of the coil.

T. Unit shall have valve to control discharge temperature. Refer to control section for further detail.

U. Provide unit mounted disconnect/speed switch.

V. Acceptable Manufacturers: Trane, Engineered Air.

2.11 UNIT VENTILATORS (VERTICAL UPRIGHT TYPE)

A. Unit shall be in a blow through configurations and shall utilize chilled water and/or heating water coils per the control specifications.

B. Unit shall include cabinet, fan, motor, coil, filter, dampers, inlet grille, discharge grille, and outside air louver.

C. Cabinets shall have 16 gauge front, top, bottom and sides, with exposed edges rounded. Doors shall be hinged with a spring-loaded pin to allow for easy removal if required.

D. Baked enamel finish. Color selected by Architect.

E. The cabinet shall be insulated with acoustic foam insulation containing no fibrous material.

F. Discharge Grilles: Heavy steel bars welded in place.

G. Inlet grilles shall be removable for access to filters.

H. Unit shall have a sound attenuating return air plenum.

I. Outside air louver shall be extruded aluminum with bird screen on the back side.

J. Provide wall sleeve for louver installation.

K. Unit shall have outside air and a return air damper. All dampers shall be gasketed for tight shutoff.

L. All piping internal to the unit shall be insulated.

M. Fans: Forward curved, double width, factory balanced, direct drive. Fans shall be statically and dynamically balanced to reduce noise levels.

N. Motors shall be a minimum of two-speed and be permanent split capacitor type.

O. Coils: Plate fin type with copper tubes and aluminum fins.

P. Provide a single coil as scheduled on the drawings.

Q. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.

R. Provide 1" thick disposable filter upstream of the coil.

S. Unit shall have valve to control discharge temperature. Refer to control section for further detail.

T. Provide unit mounted disconnect/speed switch.

U. Acceptable Manufacturers: Airedale and Temspec.

2.12 GAS FIRED UNIT HEATERS

A. Units shall be propeller-fan horizontal discharge type.

B. Include the following controls: Electric room thermostat, solenoid gas valve, safety pilot valve, main gas pressure regulator, pilot gas pressure regulator, main manual shutoff, high limit switch, fan control thermostat.

C. Stainless steel combustion chamber and aluminized steel burners.

D. Acceptable Manufacturers: Trane, Modine, Hastings, Rupp, Sterling, Reznor.

2.13 GAS FIRED DUCT HEATERS

A. Designed for horizontal flow.

B. Include the following controls: Solenoid or diaphragm gas valve, 100% safety pilot valve, main gas pressure regulator, pilot gas pressure regulator, main shutoff valve, pilot shutoff valve, high limit switch, lint-free non-clogging pilot burner.

C. Aluminized steel combustion chamber and burners.

D. Stainless steel drain pan with bottom outlet. Pipe to floor drain.

E. Acceptable Manufacturers: Trane, Lennox, Hastings.

2.14 AIR CURTAINS - COMMERCIAL

A. Units shall include cabinet, air intake louver, fan, motor, coils, filter, and discharge nozzle.

B. Cabinets shall be welded 16 gauge steel with baked enamel finish with no plastic exposed parts, color selected by the Architect.

C. Fans: Centrifugal forward-curved, double-width with galvanized steel scrolls.

D. All motors shall be two-speed permanent split capacitor with integral thermal overload protection. Motors shall be high efficiency unless otherwise specified on the drawings.

E. Coils shall have copper headers and tubes and aluminum fins. Coils to be certified to AHRI standards.

[* * * * * O R * * * * *]

F. Provide unit with a factory mounted electric coil complete with automatic reset thermal overload protection.

G. Unit shall be equipped with heating medium and capacities as shown on the drawings.

H. Filters: 1” woven glass fiber disposable type mounted within the air intake louver.

I. Provide factory mounted electrical disconnect switch and motor control panel.

J. Provide unit with an automatic door switch. Manufacturer shall provide overload relays, control transformer, and terminal provisions for field wiring unit controls.

K. Fan discharge to be adjustable for air balancing.

L. Unit shall be capable of being wall mounted or top mounted.

M. Units shall have an 18-month warranty on all parts.

N. Acceptable Manufacturers: Powered Air Model TSD, Marley Model WRS Series, Mars Model BD Windguard.

2.15 AIR CURTAINS - ARCHITECTURAL

A. Units shall include cabinet, air intake, fan, motor, coils, filter, and discharge nozzle.

B. Unit to be mounted recessed above the ceiling. Provide discharge and inlet extensions. Contractor to verify extension lengths.

C. Cabinets shall be welded 16 gauge steel with baked enamel finish with no plastic exposed parts, color selected by the Architect.

D. Fans: Centrifugal forward-curved, double-width with galvanized steel scrolls.

E. All motors shall be two-speed permanent split capacitor with integral thermal overload protection. Motors shall be high efficiency unless otherwise specified on the drawings.

F. Coils shall have copper headers and tubes and aluminum fins. Coils to be certified to AHRI standards.

G. Unit shall be equipped with heating medium and capacities as shown on the drawings.

H. Filters: 1” woven glass fiber disposable type mounted within the air intake.

I. Provide factory mounted electrical disconnect switch and motor control panel.

J. Provide unit with an automatic door switch. Manufacturer shall provide overload relays, control transformer, and terminal provisions for field wiring unit controls.

K. Fan discharge to be adjustable for air balancing.

L. Unit shall be capable of being wall mounted or top mounted.

M. Units shall have an 18-month warranty on all parts.

N. Acceptable Manufacturers: Powered Air Model CED.

2.16 GAS FIRED LOW INTENSITY RADIANT TUBE HEATERS

A. Units shall be ceiling hung, gas fired, low intensity radiant type.

B. System shall include all burner, controls, combustion tube, reflector, venting materials, hanging chains, and accessories.

C. Include the following controls: Electric room thermostat, solenoid gas valve, safety pilot valve, main gas pressure regulator, pilot gas pressure regulator, main manual shutoff, high limit switch.

D. Enameled steel control housing.

E. 4” OD 16 gauge aluminized steel finished combustion tube with high emissivity black coating.

F. Polished aluminum endcaps.

G. Provide all vents and intakes in accordance with manufacturer's recommendations.

H. Provide ceramic insulated reflector system for the entire length of the combustion tube.

I. Acceptable Manufacturers: Schwank, Re-Verber-Ray, Co-Ray-Vac, or Reflecto-Ray.

2.17 CHILLED BEAMS

A. Active Chilled Beam:

1. Furnish and install active chilled beams of capacities as indicated on the drawings and within the mechanical equipment schedules. The primary airflow rate of the beams shall not exceed the value on the drawings, without EXCEPTION. The beams shall be constructed and delivered to the job site as single units.

2. The face of the beam shall consist of a room air induction section of 50% free area perforated steel flanked by two linear supply slots. The entire visible face section shall be finished in white powder _____ coat paint or as specified by the Architect. The face shall be hinged and shall open to allow access to the coil.

3. Beams shall be provided with side and end details that will allow its integration into the applicable (nominal 24 inch wide) acoustical ceiling grid or gypsum ceiling as specified by the Architect. Beams used for exposed mounting applications shall include factory-mounted plates to ensure a horizontal discharge of the supply air.

4. The beams shall consist of a minimum 20 gauge galvanized steel housing encasing the integral sensible cooling coil and a plenum feeding a series of induction nozzles. The inside and outside surfaces of the housing and inlet spigot shall be finished with powder coat paint. A round duct connection shall be installed on the side for connecting the primary air supply to the chilled beam. The overall height of beams shall not exceed 12 inches.

5. Each beam shall be provided with a pressure tap that may be used to measure the pressure differential between the primary air plenum and the room. An airflow calibration label that relates this pressure differential reading with the primary and beam supply airflow rates shall also be affixed to the beam.

6. Beams shall be provided with connections for 2-pipe operation as indicated on plans and schedules. The coils shall be mounted horizontally and shall be manufactured with seamless copper tubing (1/2" outside diameter) with minimum 0.015-inch wall thickness mechanically fixed to aluminum fins. The aluminum fins shall be limited to no more than 10 fins per inch. The beam shall have a working pressure of at least 300 PSI and be factory tested for leakage at a minimum pressure of 360 PSI. Each chilled beam shall be provided with factory integrated drain and vent fittings. Unless otherwise specified, coil connections shall be bare copper for field sweating to the water supply circuit. Connections shall face upwards and be located near the end of the beam.

7. Beams shall be delivered clean, flushed, and capped to prevent ingress of dirt.

8. All performance shall be in compliance with that shown on the equipment schedule. Acoustical testing shall have been performed in accordance with ANSI S12.51.

9. Coils shall be rated in accordance with ARI Standard 410, but their cooling capacities shall be established in accordance to DIN Standard 4715 for the specific application on the inlet side of the submitted chilled beam. Evidence of this testing must be included in the submittal.

10. Chilled water flow rates to the beams shall be limited to that which results in a maximum head loss of ten feet. Water flow velocities through the beam shall not exceed 4 FPS.

11. Acceptable Manufacturers: Titus, Dadanco, Swegon.

B. Passive Chilled Beam:

1. Furnish and install passive chilled beams of capacities as indicated on the drawings and within the mechanical equipment schedules. The beams shall be constructed and delivered to the job site as single units.

2. The face of the beam shall consist of a coil section of minimum of 50% free area perforated steel. The entire visible face section shall be finished in white powder _____ coat paint or as specified by the Architect. The face is hinged and can be opened to allow access to the coil.

3. Beams shall be provided with side and end details that will allow its integration into the applicable (nominal 24-inch wide) acoustical ceiling grid or gypsum ceiling as specified by the Architect.

4. The beams shall consist of a minimum 20 gauge galvanized steel housing encasing the integral sensible cooling coil. The inside and outside surfaces of the housing shall be finished with powder coat paint. The overall height of beams shall not exceed 12 inches.

5. Beams shall be provided with connections for 2-pipe operation as indicated on plans and schedules. The coils shall be mounted horizontally and shall be manufactured with seamless copper tubing (1/2” outside diameter) with minimum 0.015-inch wall thickness mechanically fixed to aluminum fins. The aluminum fins shall be limited to no more than 10 fins per inch. The beam shall have a working pressure of at least 300 PSI and be factory tested for leakage at a minimum pressure of 360 PSI. Each chilled beam shall be provided with factory integrated drain and vent fittings. Unless otherwise specified, coil connections shall be bare copper for field sweating to the water supply circuit. Connections shall face upwards and be located near the end of the beam.

6. Beams shall be delivered clean, flushed, and capped to prevent ingress of dirt.

7. All performance shall be in compliance with that shown on the equipment schedule. Acoustical testing shall have been performed in accordance with ANSI S12.51.

8. Coils shall be rated in accordance with ARI Standard 410, but their cooling capacities shall be established in accordance to DIN Standard 4715 for the specific application on the inlet side of the submitted chilled beam. Evidence of this testing must be included in the submittal.

9. Chilled water flow rates to the beams shall be limited to that which results in a maximum head loss of 10 ft.. Water flow velocities through the beam shall not exceed 4 FPS.

10. Acceptable Manufacturers: Titus, Dadanco, Swegon.

END OF SECTION

SECTION 23 8216

AIR COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Coils.

B. Steam Coils.

C. Refrigerant Coils.

1.2 REFERENCES

A. ANSI/AHRI 410 - Forced-Circulation Air Cooling and Air Heating Coils.

B. ANSI/NFPA 70 - National Electrical Code.

C. ANSI/UL 1096 - Electric Central Air Heating Equipment.

D. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

PART 2 - PRODUCTS

2.1 HOT WATER COILS

A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW, WLA campuses.

B. Suitable for continuous operation at 200 psi. Maximum air velocity of 1,000 fpm.

C. Galvanized steel casing.

D. AHRI rated with 0.0005 fouling factor.

E. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.

F. Maximum 144 fins per foot.

G. Turbulators are not permitted unless tube velocities are below 2 FPS at design flow or noted otherwise. Turbulators shall not be allowed if removable headers are specified.

H. Coils shall have vent connections, with valves, at the supply and return headers.

I. Install coils level to allow drainage.

J. Coils scheduled for over 2,000 cfm shall have valved drain connections at both headers.

K. Headers and pipe connectors shall be copper or brass for use in copper piping systems or cast iron with ferrous pipe connectors for use in steel piping systems. If header material does not match the piping material, use dielectric fittings at the change in material.

L. All duct coils shall have slip and drive connections with clearance sufficient for removal of coils from ducts.

M. Minimum 0.024" tube wall thickness.

[***OR*****]**

N. Minimum 0.035" tube wall thickness.

O. Acceptable Manufacturers: Trane, York, Daikin, Heatcraft, Commercial Coil, American Air Filter.

2.2 STEAM COILS (DISTRIBUTING)

A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, Southwest, WLA campuses.

B. Galvanized steel casing.

C. Suitable for use with 2-150 psig steam. Maximum air velocity of 1,000 fpm.

D. Non-freeze steam distributing type. AHRI rated with a 0.0005 fouling factor.

E. Coils shall be sized based on saturated steam pressure, EAT and cfm as scheduled. LAT shall be at least as high as scheduled. APD shall not exceed the scheduled value.

F. Maximum 144 fins per foot.

G. Coils shall be manufactured with drain tubes pitched to facilitate condensate removal.

H. All duct coils shall have slip and drive connections with clearance sufficient for removal of coils from ducts.

I. Minimum 0.024" tube wall thickness.

J. Acceptable Manufacturers: Trane, York, Daikin, Heatcraft, Commercial Coil, American Air Filter.

2.3 STEAM COILS (VERTICAL TUBE, INTEGRAL FACE & BYPASS)

A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins. Copper fins for Harbor, SW, WLA Campuses.

B. Vertical tube integral face and bypass type with electric damper motor. Dampers shall completely enclose the heating elements when no heat is required.

C. Casing of minimum 14 gauge galvanized steel. Dampers of minimum 16 gauge steel with galvanized finish.

D. Factory tested for 200 psi steam and 300 psi water pressure. Maximum air velocity of 900 fpm.

E. Coils shall be sized based on saturated steam pressure, EAT and cfm as scheduled. LAT shall be at least as high as scheduled. APD shall not exceed the scheduled value in any damper position.

F. Maximum 144 fins per foot.

G. Minimum 0.035" tube wall thickness. Coils shall have provisions for tube expansion.

H. Discharge air temperature in a plane 3 feet downstream of the coil shall not vary by more than 5ºF from the average discharge temperature. Maximum 5ºF air temperature rise with dampers closed at maximum system design airflow.

I. Acceptable Manufacturers: Wing, Aerofin, Armstrong, Control Air, Inc., or Marlo Coil.

2.4 CHILLED WATER COILS

A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.

B. Stainless steel casing.

C. Maximum air velocity of 550 fpm.

D. Minimum water velocity in tubes of 3.2 fps (5/8" tubes), or 2.6 fps (1/2" tubes) at design flow. This is to prevent laminar flow at part load.

E. AHRI rated with 0.0005 fouling factor.

F. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. The leaving DB, leaving WB, APD and WPD shall not exceed the scheduled values.

G. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

H. Headers and pipe connectors shall be copper or brass for use in copper piping systems, or cast iron with ferrous pipe connectors for use in steel piping systems. If header material does not match the piping material, use dielectric fittings at the change in material.

I. All duct coils shall be installed in watertight duct sections with drains per SMACNA Fig. 2-11. Coil sections shall have slip and drive connections, and sufficient clearance for removal from ducts.

J. Coils shall have valved drain and vent connections at supply and return headers. Install coils level for proper drainage. Coils shall be completely drainable at the header. Trane, Daikin.

K. Suitable for 200 psig operation.

L. Turbulators are not permitted unless tube velocities are below 4 FPS at design flow or noted otherwise.

M. Suitable for 200 psig operation.

N. Turbulators are not permitted unless tube velocities are below 4 FPS at design flow or noted otherwise.

O. Suitable for 200 psig operation.

P. Coils shall not have turbulators.

Q. Minimum 0.024" tube wall thickness.

R. Acceptable Manufacturers: Trane, York, Heatcraft, or Daikin.

2.5 DIRECT EXPANSION COILS

A. Extended surface type with seamless copper tubes and continuous plate aluminum fins. Copper ins for Harbor, SW and WLA campuses

B. Galvanized steel casing.

C. Suitable for 250 psig operation. Maximum air velocity of 550 fpm.

D. AHRI rated for direct expansion use with refrigerants specified on drawings and/or in refrigerant compressor section. The use of any chlorofluorocarbon (CFC)-based refrigerants is prohibited.

E. Coils shall be sized based on saturated suction temperature, EAT and cfm as scheduled. The leaving DB, leaving WB and APD shall not exceed the scheduled values.

F. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.

G. All duct coils shall be installed in watertight duct sections with drains per SMACNA Fig. 2-11. Coil sections shall have slip and drive connections, and sufficient clearance for removal from ducts.

H. All coils for variable air volume systems shall be split row configuration.

I. Acceptable Manufacturers: Trane, York, Luvata, or Daikin.

2.6 ELECTRIC COILS

A. Assembly: ANSI/UL 1096 listed and labeled, with terminal control box and hinged cover, splice box, coil, casing, and controls.

B. Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.

C. Casing: Die formed channel frame of 16 gauge galvanized steel with 3/8-inch mounting holes on 6-inch centers. Provide tube supports for coils longer than 36-inches.

D. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, control circuit transformer and fuse, manual reset thermal cut-out, airflow proving device, supplementary fusing for heaters over 48 amps, fused disconnect, multi-stage control with built-in step controller and field installed thermostat solid-state control with built-in zero-cross switching silicone controlled rectifier (SCR) and field installed thermostat.

E. Acceptable Manufacturers: Brasch, Indeeco, or Chromalox.

END OF SECTION

SECTION 26 0000

ELECTRICAL DESIGN CRITERIA

PART 1 - GENERAL

1.1 DESIGN CRITERIA

A. CODES AND STANDARDS

1. National Electrical Code
2. California Building Code
3. California Electrical Code
4. International Building Code
5. California Building Energy Efficiency Standards (Title-24).
6. Americans with Disability Act (ADA)
7. NFPA – National Fire Protection Association
8. International Fire Code with California Amendments
9. IESNA Standards

B. UTILIZATION VOLTAGES

Primary Voltages	4.16KV, 3-Phase, 3-Wire

C. Secondary Voltages

	480Y/277V, 3-Phase, 4-Wire
	208Y/120V, 3-Phase, 4-Wire
Emergency/ Standby	480Y/277V, 3-Phase, 4-Wire
	208Y/120V, 3-Phase, 4-Wire

D. BRANCH CIRCUITS

General Use Receptacles	120V
Special Purpose Receptacles	208V, 1-phase and 208V, 3-Phase
Lighting	277V
Special Purpose Lighting	120V
Motors 1/3HP and smaller	120V
Motors 1/2HP and larger	480V, 3-Phase

E. ELECTRICAL SERVICE

1. Normal Power

   a. Each building shall be served from the campus medium voltage power distribution through a pad-mounted transformer located adjacent to the building. Incoming service shall be rated 480Y/277V, 3-phase, 4-wire, 60 Hz. Main service feeders shall be routed underground. The

   b. A load interrupter switch with current limiting fuse shall be provided at the service entrance to feed the medium voltage transformer.

   c. The medium voltage transformer shall be dry type, step down from current existing primary voltage to 480V, 3-phase, 3-wire or 277/480V, 3-phase, 4-wire.

   d. The unit substation comprising of the load interrupter switch, medium voltage transformer and the secondary disconnect circuit breaker shall be in NEMA 1 enclosure indoor type located inside the main electrical room. If there is no space for the unit substation, the load interrupter switch and the medium voltage transformer shall be in NEMA 3R enclosure located outdoor with a secondary circuit breaker disconnect. Incoming service to the building shall be fed underground in duct banks.

2. Emergency Power

   a. The emergency generator shall be provided to provide power to the egress lighting, life safety equipment (fire alarm system, fire protection equipment), elevators, fire pumps and other selected equipment in case of normal power failure. The emergency power to a building shall be from an outdoor type diesel generator. The emergency generator with a single automatic transfer switch (ATS) will serve a cluster of four (4) buildings, through an outdoor type emergency distribution board.

   b. The generator shall be sized to carry future loads and 20% spare capacity. The emergency generator shall consist of engine generator and controls, sound attenuation enclosure, UL listed fuel tank, exhaust system, radiator, batteries, starting system and generator output circuit breaker.

   c. Fuel storage shall be provided by base-mounted fuel tank located at the bottom of the generator. Tank size shall be enough for 24 hours of emergency operation at full load.

   d. Separate ATS switches will be provided for life safety loads and normal back-up loads

F. METERING

1. Utility meters shall be located on the main service switchboard for standalone buildings. For campus wide power distribution metering shall be at the primary side.

2. All LACCD Buildings including Central Utility Plant in any size structure or configuration shall have sub-meters installed.

3. Building level sub meters shall be configured to interface and exchange data with the District's existing metering software.

4. Building level sub meters shall include an Ethernet communication port or wireless communication capability or other networking capability.

5. Building level sub meters shall be installed to capture the following data at a minimum of 15-minute intervals:

   a. Electricity consumption (kWH)

   b. Power demand (kW)

   c. Power Factor

   d. Natural gas consumption (therms) (if applicable)

6. Building level utility sub meters may be installed to capture the following data at a minimum of 15 minute intervals:

   a. Chilled water (if applicable)

   b. Hot water (if applicable)

   c. Domestic water

   d. Sewer discharge

7. Building level sub meters shall include an Ethernet communication port or wireless communication capability or other networking capability.

8. Building level utility sub meters may be installed to capture the following data at a minimum of 15 minute intervals

9. Individual meters shall retain data for a period of no less than 12 months

10. Photovoltaic installed in or on a building shall have a dedicated meter to track PV productions, in addition to the building sub-meter as outlined in the Standards.

G. SWITCHBOARDS/PANELBOARDS

1. Switchboards and panelboards shall be specified with copper bus bar only. Aluminum bussing is not allowed. Main switchboard and distribution boards shall be provided with power monitoring.

2. The main electrical service switchboard for the building shall be rated 480Y/277V, 3-phase, 4-wire, 60Hz and shall be in the main electrical room on the ground floor. The main switchboard shall have fully rated main circuit breaker with ground fault interrupter for all service rated 1200A and above at 277/480V, 3-phase and shall have power monitoring capabilities.

3. All switchboards and distribution panelboards shall be provided with minimum 20% spare capacity for future use.

4. All lighting and power panelboards shall be sized with minimum 20% spare capacity for future use.

5. The distribution switchboards and panelboards shall have main circuit breakers and utilize copper bussing for phases, neutral and ground. All main circuit

breakers in switchboards, distribution boards and panelboards shall be fully rated for fault current. Series rated equipment is not allowed.

6. Transient Voltage Surge protection (TVSS) devices shall be installed on switchboards and panelboards serving IT equipment rooms for two-stage level protection.

7. All panelboards will shall be in dedicated electrical spaces.

H. TRANSFORMERS

1. Dry type step-down transformers shall utilize copper coils with 115 degree Celsius rise insulation class. Aluminum wires for transformer coils are not allowed.

2. All dry type transformers shall be loaded up to 70% nameplate rating so that a 30% of connected load may be added in the future.

3. Outdoor transformers are not allowed

I. EQUIPMENT WIRING TO MECHANICAL AND PLUMBING EQUIPMENT

1. Provide a fused disconnect switch al all powered HVAC and elevator equipment, including heat pumps and packaged units.

2. Provide control wiring and interlocking for single or simultaneous operation of motor loads per mechanical engineering requirements.

J. FEEDER CONDUCTORS

1. All secondary feeders shall consist of conduit and copper wire. Aluminum wire are not allowed.

2. Power conductors shall be copper single conductors rated 600volts with Type THWN-2, rated 600V, 90 degrees C dry for damp locations. For equipment wiring, conductors shall be THNN (dry locations) or THWN-2 (wet locations).

3. Conductors must be marked with the manufacturer’s name, date of manufacture, voltage and classification letters and shall be inspected and approved before use. Insulated wire conductors, 600V or less, must be copper, with wire gauge, insulation type, temperature rating and manufacturer clearly printed on insulation.

4. Mark each phase or leg in each panelboard with identifying tape. The insulation of all conductors is to be color coded throughout the length of the circuit.

5. Conductor color coding shall adhere to table below:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green
Purple	Switch leg	Pink

6. Wires shall not change colors between the breaker and the final termination. Aluminum conductors are not allowed.

K. WIRING DEVICES

1. The receptacles shall be 20 amperes, 125v volt, 3 pole grounding type NEMA 5-20R with screw-type terminals. Ground-fault circuit interrupter outlets for wet area or sink counter locations shall be “feed-thru” type duplex receptacles with test reset buttons.

2. Switches shall be minimum 20Amp 277V, heavy duty toggle, single pole, with screw-type terminals. When multiple switches are installed, and voltage potential is 150V, approved isolation barriers shall be installed between switches.

3. All device plates shall be labeled with originating panel and circuit numbers.

L. LIGHTING SYSTEMS

1. Electrical lighting system shall be based on the latest version of the Illumination Engineering Society of North America (IESNA) guidelines for application and task-based lux targets. The lighting power density shall exceed California Title 24 as well as ASHRAE standards by at least 20% for energy efficiency and maximum power density.

2. All lighting to be installed at any facilities shall use LED technology, except in case to case basis and only in cases where a new lighting technology is available that is more efficient than LED.

3. LED luminaires shall conform to the following standards:

   a. A minimum efficacy (lumens per watt) of 100

   b. A coloring rendering index (CRI) of 80 or above.

   c. Power factor of 0.9 or above

   d. Total Harmonic Distortion (THD) of 20% or lower

   e. A minimum of five years manufacturer's warranty

   f. Luminaires that are dimmable

   g. Color temperature (CCTC)of 4000Kelvin (exceptions maybe granted on color temperature on a case to case basis in accordance with specific requirements for a given space)

4. Warranty period shall be minimum five years. The project team shall investigate the feasibility and practicality of purchasing longer warranty periods if manufacturer offers that option.

5. Luminaires shall conform to Title 24 lighting and lighting control standards with the current edition of the applicable Code.

6. All luminaires throughout the buildings shall be LED and shall be dimmable. Linear direct indirect pendants shall be provided in classrooms. Recessed volumetric shall be provide in labs. Recessed 2x2s shall be provided in corridors.

7. All classroom lighting shall be dimmable with each row controlled independently and maximum foot candle level to be limited at 80%. Lights can be configured to automatic on to 50% or 70%.

8. The preferred lighting solution for classroom lighting includes the specification of dimmable LED drivers

9. Exterior lighting in the parking lot shall be comprised of area luminaires. Pedestrian scale columns, bollards, illuminated benches, step lights, or other more decorative luminaires in the plaza. Direct, direct indirect, and decorative lighting shall be provided to illuminate the façade. All luminaires on the exterior shall meet the mandatory BUG rating requirements of CalGreen. All exterior light fixtures shall be installed to minimize glare and avoid spillage to adjacent properties.

10. All emergency egress lighting and exit signs shall be served from standby emergency generator. Photometric studies shall be prepared for egress pathway on each floor with minimum design emergency lighting per CBC.

11. Emergency lighting shall be provided in all IDF, MDF and electrical rooms.

12. All LED light fixtures for emergency lighting shall have LED drivers with emergency back-up if emergency generator is not provided.

M. LIGHTING CONTROL SYSTEM

1. The Building lighting control system shall comprise of a network relay control system.

2. Classroom lighting fixtures and controls shall be specified from manufacturer as an integrated system.

    a. Classroom lighting shall be turned on manually and area control to be accessible to occupants to turn on the lighting. Lighting to operate automatically off when room becomes vacant.

    b. Light fixtures within 15’-0” of window shall be separately controlled (dimmed preferred or switched) with integrated daylight photo sensor to automatically reduce or eliminate energy waste.

    c. A manual master on/off and raise/lower shall be provided to control the entire room with an option of a 4-scene control.

    d. The lighting control of classrooms shall be connected to a Central Lighting Control System

    e. Classroom shall have single gang wall mounted manual entrance control and single gang multi push button wall mounted teacher controller preset to achieve proper light levels for classroom functions (i.e. AV presentations). An option is to have a second control at teaching wall.

3. For other spaces a central lighting control system shall be provided.

    a. Central lighting control system should provide on-off inputs from time clock.

b. Provide ceiling or wall mounted occupancy sensor with auto off as well as manual override for private room applications.

4. The control system shall meet all Title 24 requirements including but not limited to dimming daylight harvesting in both primary and secondary daylit zones as well as vacancy, partial on, or partial off occupancy sensors. Dimming control shall be provided for all luminaires where dimming or multi-step is required. Demand response shall be provided as required for delivering a minimum of 15% reduction in lighting load in a uniform method.

5. All exterior lighting shall be controlled by a photo-cell and the programmable network lighting control system. The control system shall meet all Title 24 requirements including part-night based control comprising of dimming and occupancy sensors. The control shall be available to combine set points between building occupation and site occupation. For example, the exterior lighting after dusk may be 100% when both building is open, and the exterior area is occupied, dropping back to 70% when the building is open, but the exterior area is unoccupied. Past building close and until dawn the setting may change such that the when the exterior area is occupied the lighting may be at 70% and reduce back to 50% when unoccupied.

6. Sports lighting shall have independent lighting control and monitoring system that will control, monitor and manage the recreational lighting system.

7. Theatrical lighting control system shall control the auditorium architectural house lighting, lobby lighting and selected work lighting through interface with low voltage relay panels.

8. Theatrical lighting control system shall comprise of control panels, control electronics and data network, dimmers and circuit wiring devices.

N. POWER

1. Classroom shall be provided with a separate branch circuit for general-purpose duplex receptacles, with a minimum of two (2) outlets in each wall maximum 15ft on center. Classroom shall be provided with separate outlets and circuit for other electrical equipment.

2. Computer classrooms shall have recessed floor-mounted outlet boxes with flush steel covers, in a 6ft by 6ft grid pattern for maximum workstation layout flexibility.

3. In corridors, receptacles shall be provided at maximum 50 feet intervals.

4. GFCI receptacles shall be provided on each exterior building wall and each restroom. Receptacles installed outdoors shall be in lockable boxes or cabinets.

5. Receptacles in corridors, restrooms and on exterior walls shall be switched with a locked type switch installed in a Janitor’s closet.

6. Receptacles that automatically shut-off and controlled by occupancy sensors shall be provided in private offices, open offices, lobbies, copy rooms, and conference rooms.

O. SERVER ROOM ELECTRICAL EQUIPMENT

1. A technical power system shall be provided consisting of an isolation transformer and dedicated 120/208V power panel with isolation ground bus, and transient voltage surge suppression (TVSS) for server room equipment loads.

2. Convenience outlets shall be provided at the server room perimeter, spaced 8 feet on center.

3. Server room walls shall be outfitted with ¾" thick fire-retardant treated plywood backboards from floor level to 8 feet above finished floor.

4. Suspended or recessed LED with 50 LUX space illumination shall be provided.

5. The server room wall shall be provided with a supplemental ground system with mounted copper bar for double lug connections.

6. The server room permanent Uninterruptible Power Systems (UPS) integral to the electrical distribution system shall be provided.

P. ELECTRIC VEHICLE CHARGING STATIONS AND CLEAN AIR FUTURE CHARGING STATIONS

1. Electric vehicle (EV) charging stations shall be commercial type and will include the following features:

   a. Software that will allow District staff to program hours of operation, rates, usage rules and the ability for staff to adjust each as needed, from a web-based interface and without having to contact a third party.

   b. Charger or software shall notify customers/users when their cars are charges and/or when charging time for which they pay has expired.

   c. Chargers shall accept payment from common credit cards and mobile devices such as smartphones. Chargers may also use third party pre-paid accounts through vendor's proprietary smart phone application or other vendor-approved payment system.

   d. Metering capability at each charger to allow operators to track times when chargers are in use, revenue produced by each charger, and other metrics.

2. EV chargers shall be pole mounted or wall mounted with proper protection from traffic damage (bollards, curbs, etc.)

3. EV chargers shall be level 2 which shall be installed on a dedicated 40 amp circuit. Provide dedicated Cat 6A cable from the charging stations tot the nearest IDF room. Option: Level 3 chargers which require dedicated power source shall be considered if requested by the College and with adequate funding.

4. EV chargers shall have minimum 25-foot length charging cord with automatic retract capability.

5. Provide at least (1) charging station at the ADA compliant parking space.

6. Equipment shall have a minimum 5-year warranty.

7. For Clean Air Future Electrical Charging Stations (CAFECS)

a. Underground or overhead conduits between CAFECS and electrical room shall have minimum two (2) inches diameter. Provided electrical circuit breaker per item #3 to satisfy the power need of all CAFECS.

b. All conduits must be terminated in weatherproofed concrete steel pull boxes near CAFECS locations. Pull strings and identification tag must be installed in every empty conduit.

c. The pull boxes shall be installed with easy access at following preferences locations.

i. Landscape Area

ii. Hardscape Area

iii. Concrete Sidewalk

iv. Center Parking Space with 5 ft. clearance, if possible, to the nearest potential charging station.

v. Parking Structure or building wall.

d. Provide minimum of one (1) 2 inches diameter conduit from each CAFECS are to IT room for future communication need. Provide adequate data switch ports and/or router ports for meeting the data needs of all CAFECS. Pull strings and identification tag shall be installed in all empty conduits.

Q. SUSTAINABLE MEASURES

1. Energy efficient lighting comprising of LED Lighting and LED exit signs.

2. Occupancy sensor controls in offices, conference rooms, restrooms, etc. shall be configured to require manual activation of the lighting with the wall mounted switch. The vacancy sensor shall keep the luminaries energized while the space is occupied. The sensor shall turn the luminaries off after 15 minutes of vacancy but will reenergize the luminaries to their previous setting if occupancy is detected within 30 seconds of the “Off” event.

3. The manual controls described above shall not override the daylight harvesting sensor(s) where present.

4. Photo sensors or day lighting sensors where natural light is available.

5. Use high efficiency motors and transformers.

1.2 INSTALLATION OF EQUIPMENT

A. Install electrical equipment as specified in individual specification sections, and in accordance with the manufacturer’s instructions, code requirements, and required access clearances.

B. Rough-in locations for fixtures and equipment shall be determined from the unit itself or from the approved shop drawings.

C. Arrange for necessary openings to allow for admittance of equipment. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, or other devices to allow later installation.

D. Install equipment to permit easy access for normal maintenance.

1. Maintain easy access to switches, motors, drives, pull boxes, receptacles, etc.

2. Notify the Owner's Representative in writing of relocation items which interfere with access.

E. Suspended raceways and equipment shall be installed in accordance with the Applicable local, state and national Building Codes.

F. Provide all necessary anchoring devices and supports as required and stated elsewhere.

1. Use structural supports suitable for equipment, or as indicated.

2. Check loadings and dimensions of equipment with shop drawings.

3. Do not cut or weld to building structural members.

G. No material, device or equipment shall be shipped to site unless shop drawings have been approved for such, prior to shipment.

1.3 CONCRETE

A. General: All concrete required shall be provided as specified in Division 03, Concrete.

B. Housekeeping Pads and Isolation Bases:

1. Provide all required dimensional drawings for bases and pads and location thereof.

2. Provide all embedded anchor bolts and sleeving and ensure installation of same.

3. Provide seismic calculations.

C. Provide housekeeping concrete pads with minimum 3-inch (or larger per equipment anchorage requirement) wide edges and 3-inch high for indoor or 4-inch high for outdoor equipment, unless otherwise noted or required.

1.4 SEISMIC RESTRAINTS

A. Provide seismic restraints and supports for equipment and work as specified in the Specification Section 26 0548, this and other specification sections, and as shown on drawings.

1. Seismic restraints and supports shall be installed directly after installation of any work requiring them, to avoid concealment or difficulty of access.

2. Contractor shall be responsible for any costs and delays associated with gaining access to any installation needing restraints or supports.

1.5 PENETRATIONS

A. All penetrations through fire and smoke rated walls shall be sealed with fire-stopping material.

B. All penetrations through exterior walls and beneath slabs-on-grade shall be sealed with weatherproofing material.

C. All penetrations through acoustically treated walls shall be sealed with non-hardening resilient acoustic sealant.

D. All below grade conduit penetrations through the walls shall be individually sealed with Link-Seal or equal.

1.6 FIRESTOPPING

A. Provide sealing or stuffing material or assembly in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat and hot gases through fire rated construction.

B. Materials and Products:

1. Provide material listed in the UL Fire Resistance Directory for the UL system involved to achieve fire ratings of adjacent construction.

2. Materials shall have been tested to provide fire rating at least equal to that of the construction.

3. All firestopping products shall be from a single manufacturer.

C. Environmental Requirements:

1. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

2. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

3. Provide ventilation in areas to receive solvent cured materials and as required by manufacturer.

1.7 IDENTIFICATION

A. The Contractor shall identify all conduit, cabling, devices, and equipment in accordance with Section 26 0553 – Identification for Electrical Systems.

B. The Contractor shall submit a schedule for equipment identification.

1.8 SETTING OF PROTECTIVE DEVICES

A. Prior to completion of the Project, set all protective device relays and internal settings to provide adjustment between upstream and downstream protective devices. Settings shall be based on the accepted coordination study.

PART 2- FIRE ALARM SYSTEM

A. CODES AND STANDARDS

1. NEMA – National Electrical Manufacturers' Association

2. UL – Underwriters' Laboratory

3. California Building Code

4. California Electrical Code

5. California Fire Code

6. CEC - California Electrical Code

7. NEC - National Electrical Code

8. NFPA - National Fire Protection Association

9. IEEE – Institute of Electrical and Electronic Engineers

10. ANSI – American National Standards Institute

11. NETA – National Electrical Testing Association

12. Americans with Disabilities Act

B. FIRE ALARM SYSTEM

1. The fire alarm system shall be consistent with the DSA Fire and Life Safety and other applicable codes and shall be approved by DSA. The system shall be combination manual and automatic detection through complete area coverage as defined in NFPA 72. It shall also provide ADA compliant audible and/or visual alarm notification devices inside buildings and areas of assemblies within the site. The system shall be remotely monitored by UL listed central monitoring station. Each College Campus shall not have more than one fire alarm system if possible.

2. The fire alarm system shall consist of but not limited to the following basic elements and components to be included in the design and installation:

   a. Intelligent Fire Alarm Control Panel(s), network capable and expandable. Main Fire Alarm Control Panel shall be in the Main Electrical Room.

   b. No stand-alone systems. All systems and stations must register on the main fire alarm control panel.

   c. No Fire Alarm Control Panel shall be installed outdoor.

   d. Remote LCD display or FA annunciator in the Building Lobby.

   e. Remote power supplies and batteries for secondary power, 90-minute run-time.

   f. Manual pull stations selected areas.

   g. Addressable smoke and heat detectors necessary for complete area coverage, elevator recall / shut down and fan shut down.

   h. Addressable duct smoke detectors in HVAC supply and return ducts where required by code.

i. Addressable beam smoke detectors in high ceiling areas such as gymnasiums and auditorium.

j. Addressable devices to monitor fire sprinkler system tamper and flow switches including fire pump operational status and other fire protection/ suppression systems.

k. Addressable control relays to initiate elevator recall / shutdown, fan shutdown, door holder power shutoff, unlock secured egress doors.

l. Audible and visual alarm devices such as speakers and/or strobes to notify occupants of the school campus when under fire alarm condition.

m. All fire alarm system components shall be CSFM and UL listed.

n. Fire alarm system shall be installed with fiber network and to be installed in conduit.

o. The fire alarm system shall have emergency battery back-up if back-up generator is not available.

p. The fire alarm system must pass commissioning prior to acceptance.

q. All fire alarm devices shall be tested to NFPA 72E and results provided to the Facilities Director prior to acceptance of the system.

r. New buildings must be integrated into the existing main campus fire alarm system.

s. No manual pull stations in public hallways.

t. The fire alarm system shall be designed only for the space required. Oversizing the fire alarm control panel is not allowed.

END OF SECTION

SECTION 26 0509

EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment specified under other Sections or furnished by the Owner.

1.2 REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices

B. NEMA WD 6 - Wiring Device Configurations

C. ANSI/NFPA 70 - National Electrical Code

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Straight-blade Attachment Plug: NEMA WD 1.

B. Locking-blade Attachment Plug: NEMA WD 5.

C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

D. Cord Construction: Oil-resistant thermoset insulated Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

E. Cord Size: Suitable for connected load of equipment and rating of branch circuit over-current protection.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

B. Make cord connections to equipment using flexible conduit. Use liquidtight flexible conduit in damp or wet locations.

C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

G. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 0519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire

B. Remote control and signal cable

1.2 REFERENCES

A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy

B. NFPA 70 - National Electrical Code (NEC)

C. UL 44 – Thermoset-Insulated Wires and Cables

D. UL 83 – Thermoplastic-Insulated Wires and Cables

E. UL 854 – Service-Entrance Cables

F. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

G. UL 2196 – Fire Resistive, Fire Resistant and Circuit Integrity Cables

H. California Division of State Architect (DSA) Interpretation of Regulations

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.

B. Feeders and Branch Circuits Larger Than 6 AWG in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.

C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600-volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings.

D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings.

E. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.

F. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60ºC, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

END OF SECTION

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment grounding system

B. Bonding system

C. Grounding electrode system

D. Grounding of systems over 1kV

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.

D. Isolated Ground Conductors: Insulated. Refer to Section 26 05 53 for insulation color.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. Grounding Bus:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4” x 2”, length of electrical room.

I. Intersystem Bonding Termination:

1. Copper bar, 1/4” x 2” x 24”. Provide with wall mounting brackets, insulators and pre-tapped holes.

2. Approved Manufacturers: Harger, Erico.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

C. Bolted Connectors: Bolted-pressure-type connectors.

D. Substation connectors shall comply with IEEE 837 listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel Stainless steel.

B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

C. Test Wells: Provide handholes as shown on drawings or as specified in Division 2 Section "Underground Ducts and Utility Structures."

D. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to NFPA 70, Paragraph 52-(3), using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet (6.0 m) of 1/2" (13mm) steel reinforcing bar.

END OF SECTION

SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid metallic conduit and fittings (RMC)

B. Electrical metallic tubing and fittings (EMT)

C. Flexible metallic conduit and fittings (FMC)

D. Liquidtight flexible metallic conduit and fittings (LFMC)

E. Rigid polyvinyl chloride conduit and fittings (PVC)

F. Wall and ceiling outlet boxes

G. Electrical connection

H. Pull and junction boxes

I. Rough-ins

J. Handholes

K. Accessories

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Acceptable Manufacturers:

1. Acceptable Manufacturers: Allied, LTV, Steelduct, Calbond Calpipe, Wheatland Tube Co, O-Z Gedney, or approved equal.

2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp.

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

D. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system. Acceptable Manufacturers: Calbond Calpipe, Robroy, T&B Ocal or approved equal.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers of EMT Conduit: Allied, Calbond Calpipe, LTV, Steelduct, Wheatland Tube Co, or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression or steel set screw type of steel designed for their specific application.

2. 1/2” and 3/4” Conduit: Push-on connectors and couplers with locking ring and washer of zinc plated steel, listed for use in dry locations.

3. Larger than 2": Compression type of steel designed for their specific application.

4. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8” flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8” FMC shall be six (6) feet.

B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.

C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline, Bridgeport, Midwest, Regal, or approved equal.

2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

2.5 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.

C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.6 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2-inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB1, Type FD, Aluminum, cast feralloy, or stainless steel deep type, gasketed cover, threaded hubs.

D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.

G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.7 ELECTRICAL CONNECTION

A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.8 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless-steel cover screws.

D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless-steel cover screws.

E. Flanged type boxes shall be used where installed flush in wall.

2.9 ROUGH-IN

A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,

B. Conduit stubbed to above the lay-in ceiling routed to the corridor cable tray.

C. Technology Rough-in:

1. Rough-in shall have one (1) 1” conduit.

D. Technology Rough-in - Wall Phone:

1. Mount on wall +54” or as noted in plans. Rough-in shall have one (1) 1” conduit.

E. Technology Rough-in - Ceiling Flush Mounted:

1. Mount flush in finished ceiling or as noted in plans. Rough-in shall have one (1) 1” conduit.

F. Television Antenna Outlet Box Rough-in:

1. Rough-in shall have one (1) 3/4” conduit.

2.10 HANDHOLES

A. Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid cover rated for 10,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve depth shown on plans. Units in landscaped areas shall be green in color. Dimensions as shown on plans.

1. Approved Manufacturers:

a. Hubbell/Quazite

b. Carson Industries

c. Armorcast

d. Highline Products

e. Synertech

B. Handhole, cast iron, hot dipped galvanized with checkered cover sidewalk weatherproof box, flat neoprene cover gasket. Stainless steel screw hardware. Mounted flush in concrete. 12”W, 18”L, 12”D or dimensions as shown on plans.

1. Approved Manufacturers:

a. Appleton Electric

b. OZ Gedney

c. Crouse Hinds

C. Handhole, concrete traffic box and galvanized steel checkered cover. Stainless steel hardware. Bolted cover and box rated for H/20 vehicular traffic. Reinforced concrete slab for bottom. 11”W, 18”L, 24”D or dimensions as shown on plans.

1. Approved Manufacturer: Oldcastle Precast

2.11 ACCESSORIES

A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control – Pad, SpecSeal, 3M or equal.

B. Sound Barrier Insulation Pads: Mastic, non-hardening, sheet material, minimum 1/8" thickness applied to all five sides of back boxes. Kinetics Noise Control – SealTight Backer Pad, L.H. DOTTIE Co., #68 or equal.

END OF SECTION

SECTION 26 0553

IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Adhesive labels, markings, nameplates, and signs

B. Wire and cable markers

C. Raceway, box, and wire identification

D. Equipment short circuit current rating (SCCR) labeling

E. Electrical equipment labeling

F. Series rating identification

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).

1. Label Size as follows:

a. Raceways: Kroy or Brother labels 1-inch (25mm) high by 12-inches (305mm) long (minimum).

2. Color: As specified for various systems.

B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch (25mm) to 2 inches (50mm) in width.

C. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch (5mm) minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F (10°C to 176°C). Provide ties in specified colors when used for color coding.

F. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

G. Aluminum, Wraparound Marker Bands: 1-inch (25mm) width, 0.014 (5mm) inch thick aluminum bands with stamped or embossed legend and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

H. Brass or aluminum Tags: 2" (50mm) by 2" (50mm) by .05-inch (2mm) metal tags with stamped legend, punched for fastener.

I. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

J. Text Sizes:

1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.

a. Font: Normal 721 Swiss Bold

b. Adhesive Labels: 3/16 inch (5mm) minimum text height

c. Vinyl / Plastic Laminate Labels: 3/4” inch (19mm) minimum text height

2.2 NAMEPLATES AND SIGNS

A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch (2mm) minimum thick for signs up to 20 square inches (13 square cm), or 8 inches (200mm) in length; 1/8 inch (3mm) thick for larger sizes. Labels shall be punched for mechanical fasteners.

B. Text Sizes:

1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.

a. Text Height: 3/8 inch (10mm) minimum

C. Baked–Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch (10mm) galvanized-steel backing: and with colors, legend, and size required for application. Mounting 1/4" grommets in corners.

E. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

F. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

2.3 PRODUCT COLORS

A. Adhesive Markings and Field Labels:

1. All Labels: Black letters on white face

2. Normal Power and General Labels: Black letters on white face

3. Medium Voltage (greater than 100 volts): Black letters on white

4. Fire Alarm: Red letters on white face

5. Emergency: Red letters on white face

B. Nameplates and Signs:

1. NORMAL POWER: Black letters on white face

2. EMERGENCY: White letters on red face

3. GROUNDING: White letters on green face.

4. CAUTION or UPS: Black letters on yellow face

C. Raceways and Conduit:

1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:

a. Normal Power and General Distribution: Silver

b. Emergency Power Distribution System:

1) All Emergency: Orange

2) Legally Required Standby: Yellow

c. Fire Alarm System: Red

d. Temperature Controls: Blue

e. Ground: Green

f. Low Voltage and Telephone: Purple

END OF SECTION

SECTION 26 0573

ELECTRICAL DISTRIBUTION SYSTEM STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Medium and low voltage distribution system power study.

B. Short-circuit analysis and report.

C. Selective coordination analysis and report.

D. Arc-flash hazard analysis and report.

1.2 SCOPE

A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, selective coordination analysis and arc flash hazard analysis.

B. Contractor is required to provide a fully coordinated system for the normal and essential electrical system and all other locations indicated on the one-line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a selectively coordinated system.

PART 2 - PRODUCTS

2.1 Power systems study shall be completed in Power Tools for Windows (PTW) 8.0 or later version or pre-approved equivalent program.

END OF SECTION

SECTION 26 0800

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by LACCD will manage the commissioning process.

1.2 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

END OF SECTION

SECTION 26 0933

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Line and low voltage standalone lighting controls

B. Emergency transfer devices

C. Distributed lighting control

D. Central lighting controls

E. Digital addressable lighting interface (DALI)

F. Architectural dimmer rack and accessories

G. DC dimming systems

H. Time switches

PART 2 - PRODUCTS

2.1 LIGHTING CONTROLS

A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications.

B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.

C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

2.2 LIGHTING CONTROL STATION

A. The lighting control station shall contain the controls required by the lighting sequence of operation in a common coverplate. The controls may consist of switches, dimmers, occupancy sensors, pushbuttons, etc.

1. In spaces where the wall control station is shown in multiple locations, the sequence of operation shall be the same at all locations, unless noted otherwise.

2. The controls supplier shall prepare control station shop drawings showing arrangement of controls, dimensioned elevations, wiring diagram, and recommended backboxes. The shop drawing submittal should be identified with the lighting sequence that the station provides. Submit data sheets on the switches, dimmers, sensors, buttons, etc. contained in the control station.

2.3 DEVICE COLOR

A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated otherwise.

2.4 COVERPLATES

A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate-securing screws shall be metal with head color matching the wall plate finish.

2.5 WALL SWITCHES

A. Single Pole Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL1221, Leviton 1221-2, Pass & Seymour PS20AC1, Cooper AH1221.

3. Single throw, 120/277-volt, 20-amp maintained contact. Rocker handle, side and back wired.

4. Approved Manufacturers: Hubbell DS120, Leviton 5621, Pass & Seymour 2621, Cooper 7601.

B. Explosion Proof Single Pole Switch:

1. 120/277-volt, 20-amp maintained contact. Toggle handle. Suitable for use in Class 1, Division 1 areas.

2. Approved Manufacturers: Appleton EDSC175-F2, Crouse Hinds, Killark.

C. Key Lock Single Pole Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1221L, Leviton 1221-2L, Pass & Seymour PS20AC1-L, Cooper AH1221L.

D. Lighted Handle Single Pole Switch:

1. 120 volt maintained contact. Toggle handle. Light on when contact open (switch off). Side and back wired.

2. Approved Manufacturers: Hubbell HBL1221ILC, Leviton 1221-LHC, Pass & Seymour PS20AC1-CSL, Cooper 2221LTW.

E. Weatherproof Single Pole Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired. Provide with weatherproof coverplate.

2. Approved Manufacturers: Hubbell1221/HBL1795, Leviton 1221-2, Taymac MM180, Pass & Seymour PS20AC1/CA1-GL, Cooper 2221.

F. Two Pole Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL 1222, Leviton 1222-2, Pass & Seymour PS20AC2, Cooper 2222.

3. Single throw, 120/277-volt, 20-amp maintained contact. Rocker handle, side and back wired.

4. Approved Manufacturers: Hubbell DS220, Leviton 5622, Pass & Seymour 2622.

G. Three-way Switch:

1. 120/277 volt, 20 amp. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell 1223, Leviton 1223-2, Pass & Seymour PS20AC3, Cooper AH1223.

3. 120/277-volt, 20-amp maintained contact. Rocker handle, side and back wired.

4. Approved Manufacturers: Hubbell DS320, Leviton 5623, Pass & Seymour 2623, Cooper 7623.

H. Key Lock Three Way Switch:

1. Single throw, 120/277-volt, 20-amp maintained contact. Side and back wired. Provide key to Owner.

2. Approved Manufacturers: Hubbell HBL1223L, Leviton 1223-2L, Pass & Seymour PS20AC3-L, Cooper AH1223L.

I. Four-way Switch:

1. 120/277 volt, 20 amp. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell 1224, Leviton 1224-2, Pass & Seymour PS20AC4, Cooper AH1224.

J. Three Position-Center Off Switch:

1. 120/277-volt, 20-amp, 2 pole maintained contact. Toggle handle, side and back wired.

2. Approved Manufacturers: Hubbell HBL1386, Leviton 1286, Pass & Seymour 1226, Cooper 2226.

K. Combination Single Pole Switch and GFCI Receptacle:

1. Single throw switch, 120-volt, 15-amp maintained contact. Toggle handle, side and back wired. NEMA 5-15R GFCI receptacle with test and reset buttons.

2. Approved Manufacturers: Hubbell GFSP15, Leviton 7229, Pass & Seymour 1595-SWTTR, Cooper VGFS15.

2.6 WALL DIMMERS

A. UL listed with integral air-gap switch for on/off control.

B. Integral EMI/RFI suppression.

C. Non-viewable heat sink.

D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.

E. Dimmer to match device color.

F. LED Electronic Driver Dimmer:

1. 120-277-volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60629 Annex E.

2. Approved Manufacturers: Compatible with provided LED driver.

G. LED Electronic Driver Three-Way Dimmer:

1. 120/277-volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60929 Annex E.

2. Approved Manufacturers: Compatible with provided LED driver.

H. Wall 0-10V Dimmer / Occupancy sensor:

1. Wall switch with manual on/auto off. 120VAC load rating of 0-800 W for electronic ballast, LED. 277VAC load rating of 0-1,800 W for electronic ballast, LED. adjustable OFF delay. 0-10V dimming with up to 30ma sink. Automatic ON/OFF, manual ON/automatic OFF, or occupancy on to predetermined dimming level go to last dimming setting upon occupancy.

2. Approved Manufacturers: Sensor Switch WSX D Series

2.7 LOCAL DAYLIGHTING CONTROLS

A. Standalone Interior Photo Sensors:

1. Daylight Level Sensor - On/Off Control - One Zone:

a. On/Off control. Range of 10-200 FC. Adjustable deadband prevents cycling. Adjustable time delay. 120/277 volt.

b. Approved Manufacturers: Watt Stopper LS-102, Sensor Switch CM-PC, Hubbell Automation DLCPC Series, Greengate PPS-4.

2. Daylight Level Sensor and Controller - On/Off Control - Three Zones:

   a. On/off control of up to three 10-amp zones. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. 120/277 volt.

   b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation LUXSTATOCM/LUXSTATLS, LC&D Micro GR/2404 iDH/Pcell, Sensor Switch N-CMPC.

3. Daylight Level Sensor and Controller - 0-10V Dimming - One Zone:

   a. Dimming control of one 0-10V zone. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. Coordinated with dimming ballast prior to submittal.

   b. Approved Manufacturers: Watt Stopper LS-301, Hubble Automation DLC7, Sensor Switch N-CMADC.

4. Daylight Level Sensor and Controller - Dimming - Three Zones:

   a. Dimming control of up to three zones of 0-10V. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. Coordinate with dimming ballasts prior to submittal.

   b. Approved Manufacturers: Watt Stopper LCD-203/LS-290C, Hubbell Automation LUXSTATDCM/LUXSTATLS, LC&D Micro GR/2404 IDIM/Pcell, Sensor Switch N-CMADC.

5. Daylight Level Sensor and Controller - Multilevel/Bi-level On/Off Control - Dual Zones:

   a. Multilevel/bi-level on/off control of up to two 10-amp zones. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. 120/277 volt.

   b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation DLCPCC/DLCPCI, Sensor Switch CM-PC-DZ.

6. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area based on sequence of operation.

7. Sensor shall be configurable via DIP switches at device or via handheld wireless remote programming unit. Settings shall include:

   a. Ambient sensitivity range between 1 and 1,000 foot-candles.

   b. Time delay of 5 to 300 seconds.

   c. Trigger setpoints with deadband adjustment.

8. Sensor shall provide on/off setpoints in quantity as specified on drawings and as shown in the sequence of operation.

9. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application requirements as outlined in the sequence of operation.

10. Output signal from sensor shall be linear with light level.

B. Standalone Exterior Photo Sensors:

1. Sensor shall be within a weatherproof enclosure, with design operation in temperatures of -30°F to +130°F. Sensor shall have threaded stem for box mounting, with knuckle to permit aiming of receptor after installation. Sensor shall be mounted facing north.

2. Sensor shall contain an integral switching contactor rated for 277-volt operation, with loads of up to 1,800 VA. Contacts shall be configured for zero-crossing closure to provide 100,000 cycle minimum operation.

3. Sensor shall detect changes in daylight levels to provide triggering of exterior lighting equipment based on the sequence of operation.

4. Sensor shall be field configurable at the device or via handheld wireless remote controller. Configurable settings shall include:

a. Ambient sensitivity range of 5 to 1,500 foot-candles.

b. Adjustable setpoint.

c. Deadband adjustment by percentage of setpoint.

d. Time delay of up to five minutes.

5. Sensor shall be equipped with a lens cover that can be applied for system testing during daylight conditions.

6. Approved Manufacturers: Paragon, Tork, Intermatic.

2.8 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13-amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.

c. Time Delay and Sensitivity Adjustments: Recessed and concealed.

5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

7. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.

8. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.

9. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

10. Warranty: Five (5) year warranty.

B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. 360 Degree Coverage Pattern:

a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay. Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient sensor 40 FC.

b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or ATD2000C, Greengate OAC-DT, Leviton OSC##-MOW, Sensor Switch CM PDT 10.

2. Wall Mounted on Adjustable Swivel Mount:

a. Wall or ceiling sensor with adjustable settings to allow manual on/auto off or auto on/auto off. Integrated ambient light level sensor (2 to 100 FC range).

b. Approved Manufacturers: Watt Stopper DT-200 Series, Hubbell LODTRP, Leviton OSM12--M series, Sensor Switch WvPDT 16 Series.

3. Wall Switch:

a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.

b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Leviton OSSMT series, Sensor Switch WSD-PDT SA Series.

4. Wall Switch:

   a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12’ x 15’ pattern.

   b. Approved Manufacturers: Watt Stopper DW-200 Series, Hubbell LHMTD, Leviton OSSMD series, Sensor Switch WSD-PDT 2P Series.

5. Sensitivity Adjustment: Separate for each sensing technology.

6. Detection Coverage:

   a. Task Areas: Detect occupancy anywhere in an area based on hand motion.

   b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.

C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.

D. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.

1. High Bay - Aisle Coverage Pattern:

   a. 20’ to 40’ mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area. Initial settings: Time delay 10 minutes.

   b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

2. High Bay - 360 Degree Coverage Pattern:

   a. 20’ to 40’ mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area.

   b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.

3. Wall Switch Occupancy Sensor:

   a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

   b. Approved Manufacturers: Watt Stopper PW-100 Series, Sensor Switch WSX, Hubbell LHIRS1 or AP1277, Leviton ODS15, Greengate OSW-P-0451.

4. Dual Wall Switch Occupancy Sensor:

   a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays. Integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.

   b. Approved Manufacturers: Watt Stopper PW-200 Series, Sensor Switch WSD-2, Hubbell LHIRD2 or AP127712, Leviton ODS, Greengate OSW-P-0451.

5. Ceiling Mounted - 360 Degree Coverage Pattern:

   a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.

   b. Approved Manufacturers: Watt Stopper CI Series, Sensor Switch CM-9, Hubbell Automation Omni-IR, Leviton OSC Series, Greengate OMR-P Series.

6. Ceiling Mounted - 100 Degree Coverage Pattern:

   a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.

   b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.

7. Wall Mounted - 100 Degree Coverage Pattern:

   a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: Ambient sensor 40 FC.

   b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.

8. With daylight filter and lens to afford coverage applicable to space to be controlled.

E. Ultrasonic Type: Ceiling mounting. Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. 360 Degree 20’ x 20’ Hand Motion Coverage Pattern:

   a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated 1-amp relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-1100 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.

2. 35’ x 30’ Hand Motion Coverage Pattern:

a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-2200 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.

3. 360 Degree Two-Sided Corridor Coverage Pattern:

a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.

b. Approved Manufacturers: Watt Stopper WT-2250 Series, Hubbell OMNI-US or ATU series, Greengate ODC-U Series.

4. Wall Mounted:

a. Wall switch with adjustable settings to allow manual on/auto off or auto on/auto off.

b. Approved Manufacturers: Watt Stopper UW-100 Series, Hubbell AU1277I,

5. Crystal controlled with circuitry that causes no detection interference between adjacent sensors.

2.9 EMERGENCY TRANSFER DEVICES

A. Loss of power on normal circuit shall switch load to emergency power source.

B. Provide suitable NEMA 1 enclosure and mounting per manufacturer specification.

C. Emergency Lighting Control Override - Single Luminaire:

1. Rated 2 amps at 120 volt incandescent and 10 amps at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD, Iota ETS, Watt Stopper ELCU-100.

D. Emergency Lighting Control Override - Branch Loads:

1. Rated 1000 watts at 120 volt incandescent and 20 amp at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD20, Chloride Lightstar, Dual-Lite ATSD, Nine24 ELCR, Highlites HEPC.

E. Emergency Lighting Dimming Control Override:

1. Loss of power on normal circuit shall switch luminaires on at 100% rated light output.

2. Approved Manufacturers: Nine24 BLTCv3, nLight nPP16D (ER)

2.10 DISTRIBUTED LIGHTING CONTROL

A. Acceptable manufacturers as listed below meet the qualifications as outlined in this specification. Contractor is responsible for verifying that selected manufacturer is capable of furnishing the complete system as specified herein.

1. Acuity Controls nLight Series

2. Legrand Watt Stopper DLM Series

3. Hubbell Automation NX Series

4. Eaton Greengate RC3 Series (room-based system)

5. Osram Encelium Series

6. Lutron

B. System Description: The lighting control system shall be a network of remote modules connected to a digital network via network hubs and controlled through a system server / central station. Lighting control devices connect to the modules and communicate via the digital network with the system server. System includes all associated wiring, relay modules, photocells, switches, dimmers, time clock, occupancy sensors, network interfaces, and hubs. System shall utilize distributed relays modules, allowing these relay modules to be located above accessible ceilings in or adjacent to rooms they are controlling.

C. Control Devices: All occupancy sensors (ultrasonic, IR and dual technology type), photocells, switches, and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

D. Relay Modules: Mounted in NEMA enclosure with physically separate 120/277-volt wiring compartment from low voltage control wiring. Provide low voltage digital communication to control devices as shown on drawings and schedules. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission. Dimmable relay modules shall be provided where indicated. Relay modules shall contain up to four (4) relays. Relay modules shall be labeled with room number that relays control lighting within.

E. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125-volt AC for tungsten filaments and 20 A, 277-volt AC for electronic ballasts, 50,000 cycles at rated capacity.

F. System shall include server / central station with operating software, data network, and BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system.

G. System server / central station shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation, and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

H. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between relay modules, network hubs, and control system server/ central station such that system performs as described. Server shall be provided with monitor, keyboard, and mouse, and plugged into a receptacle connected to an equipment emergency circuit as a minimum.

I. Network Hub: Network Hub shall contain processor and astronomic time clock for control and monitoring of lighting. Network hub shall be fed from an equipment emergency circuit at a minimum.

2.11 CENTRAL LIGHTING CONTROL - RELAY PANEL TYPE (NETWORK)

A. Acceptable manufacturers listed below meet the qualifications as outlined in this specification. Contractor is responsible for verifying that selected manufacturer is capable of furnishing the complete system as specified herein.

B. Lighting Control. Refer to schedules for size, rating, and configuration.

1. The lighting control system shall be a network of lighting relay panels connected to a digital network and controlled through a system server / central station. Lighting control devices connect to the relay panels and communicate via the panel controller with the system server. System includes all associated network interfaces and wiring, relay panels, control modules, input modules, panel processors, relays, photocells, switches, dimmers, time clock, and occupancy sensors.

2. System shall include server / central station with operating software, data network, and BACnet IP communication, with other systems as described. System communication protocol shall be compatible with the building automation system (BAS).

3. System server / central station shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

C. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between system devices, network, and control system server/ central station such that system performs as described. Server / central control station shall have a minimum 80 GB hard drive, 2 4 8 GB RAM, 3 GHz speed minimum, three Ethernet ports, 1024 x 768 resolution graphic card, and 3 USB 2.0 ports. Server shall be provided with monitor, keyboard, and mouse, and plugged into a receptacle connected to an equipment emergency circuit as a minimum.

D. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.

1. Typewritten Directory: Identifies each relay as to load controlled.

E. System Power Supply: Transformer and full-wave rectifier with filtered DC output for panel, controllers, and control devices. Feed from an equipment emergency circuit at a minimum.

F. Relays: Mechanically latched unless otherwise indicated; split-coil, momentary-pulsed type, rated 20°A, for tungsten filaments and NEMA for electronic ballast rated. Rated for 50,000 ON/OFF cycles at rated capacity.

G. Controllable Breaker (Option):

1. Solenoid operated thermal magnetic breakers to provide control, overload protection, and short circuit protection.

2. Ratings of 120/240V AC; 15, 20 and 30-amp; 1- and 2-pole, 277/480V AC, 15, 20 and 30-amp: 1 and 2-Pole. Minimum AIC rating to be 14,000 at 480Y/277 and 65,000 at 120/240.

H. Control Devices: All occupancy sensors (ultrasonic, IR and dual technology type), photocells, switches, and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

I. Central Lighting Control Features and Functions:

1. Dimming system presets shall be programmable via preset/fader station directly at the control panel, or via network-based workstation software. Dimming presets shall have discrete fade times with 0.1 second resolution, programmable from zero to 24 hours, and shall be selectable via button, fader, clock event, macro or network interface.

2. Clock events shall be activated by calendar schedule, by day type and/or specific day programming, including every day, weekday, weekend, S, M, T, W, H, F, S, Holiday. Clock events shall also be activated by astronomical events, which will compensate for daylight savings time and will have programmable setback periods relative to sunrise and sunset.

3. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, web-based software or other devices connected to programmable inputs in a lighting control panel.

4. Channels for grouping relays shall be provided, each with an associated pushbutton to toggle the channel ON/OFF and a terminal block for a separate dry contact input. Any number of relays in the panel can be assigned to each channel, with overlapping allowed. Channels shall be set up via communication line communications and networking. Each channel pushbutton shall provide LED status indication. The panel shall also have the ability to assign functions to relays independently of the channels. Panels shall be addressable with DIP switches or other local means to set panel address.

5. System shall accept any type of switch input, including momentary or maintained.

6. System shall support by relay or zone the "blink warning" function. System shall be capable of flashing lights Off/On prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and shall not exceed two (2) hours.

7. System shall provide temporary override conditions for each relay or dimmer so that lights can always be turned on.

8. All programming and scheduling shall be able to be done locally at the master lighting control panel and remotely via the Internet. Remote connection to the lighting control system shall provide real-time control and real-time feedback. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go offline, all system programming uploaded to the lighting control system shall continue to operate as intended.

9. All programs, schedules, time of day, etc., shall be held in non-volatile memory for a minimum of two (2) years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.

10. Lighting control shall be configured to allow individual users to turn lighting on and off with their PCs. Software shall be written for Windows operating system, with web page as the display and ActiveX controls that can be accessed through an Internet browser. Include at least three levels of password protection.

J. BACnet or Facility Management Control System (FMCS) Protocol Interface: Provide BACnet-over-IP interface to building controls system or a Direct Digital Controls native protocol interface to read, control and monitor status of all lighting zones and groups in real time.

K. Telephone Override Interface: A voice-prompted telephone override interface module shall accept up to three (3) phone lines and allow up to three (3) simultaneous phone calls. Voice-prompted menu and up to 999 unique passcodes shall be standard with each interface module. Override time shall be a maximum of 120 minutes.

L. Ethernet Connection Port - Interoperability:

1. System shall include an Ethernet port for connection to Owner's TCP/IP network, permitting remote management of system from local or wide area network connection.

2. Contractor shall coordinate with technology vendor to provide an Ethernet connection to (LCP) panel as specified by manufacturer.

M. RS232 Interface for Audio/Visual Interface - Control Interface Stations:

1. Control interface stations shall provide an interface for PC and/or A/V connection to lighting control system.

2. Stations shall utilize RS-232 standard protocol and shall be appropriate DIN-style connector.

2.12 CENTRAL LIGHTING CONTROL INTERFACES

A. Manual Switches, Stations and Plates:

1. Switches: Modular, momentary pushbutton, with addressable capabilities to control the luminaires assigned to that switch. The switch shall be able to actuate the functions based on the described sequence of operation and intended functions.

2. Preset/fader stations shall operate using programmable buttons and/or faders as indicated on drawings.

3. Integral Pilot Light or LED: Indicate that controls are active or powered by being on continuously when powered or when pushbuttons are actuated.

4. Labeling of buttons and faders shall be engraved/screened by manufacturer, using approved text returned with shop drawing submittals.

5. Station control components shall be designed to operate standard default or custom system functions. Components shall operate default functions unless re-assigned via direct or network connection. Function options include: preset selection, manual mode, record mode, station lockout, raise/lower, macro, cue, and room join/separate.

B. LCD Station:

1. Backlit liquid crystal display (LCD) shall operate using buttons, faders, and other images on separate programmable control pages via touchscreen interface.

2. LCD station contrast and brightness shall be adjustable. It shall be possible to program the station to dim during periods of inactivity.

3. LCD stations shall support import of bitmap image files to customizable pages.

4. Permanently installed stations shall be either fully or semi-recessed in manufacturer-furnished backbox and trim assembly, with no visible fasteners or hardware.

5. Portable stations shall nest into permanent wall docking station furnished by manufacturer and shall not require user to connect any umbilicals or plugs when inserting or removing the portable device. Docking station shall provide charging and communication with portable device when docked.

C. Wireless Controls (Infrared):

1. Portable wireless IR transmitter for remote control of lighting control panel. Transmitter shall have at least four (4) eight (8) scene control with engraved names below each button.

2. Infrared receiver shall be recess mounted with an integral LED to indicate when signal has been received. Receiver shall operate reliably within a 40-foot distance.

D. Portable Control Console and Connector Station:

1. Portable control console with minimum 10-foot cable and interface plug.

2. Connector station receptacle, flush mounted, to allow portable console to communicate with lighting control system. Mounts in industry standard backbox.

F. Network Daylight Level Sensor:

1. Networked sensors shall serve as a measurement device that provides ongoing read-back of sensor settings to lighting control network or daylight controller. Refer to the sequence of operation for actions to be triggered at various read-back values.

2. Sensor shall be ceiling- or wall-mounted for range and viewing angle, meeting application requirements as outlined in the sequence of operation. Outdoor sensors shall be wet location listed and designed specifically for outdoor use.

3. Output signal from sensor shall be linear with light level. Network connection permits remote query of sensor status and value via control software. All adjustments, with the exception of sensor range, shall be made via network connection.

4. Sensor shall have adjustable sensitivity range to permit use as scheduled.

2.13 LIGHTING CONTROL SYSTEM – DIGITAL ADDRESSABLE LIGHTING INTERFACE (DALI)

A. Acceptable manufacturers listed below meet the qualifications as outlined within this specification. Contractor is responsible for verifying that selected manufacturer is capable of furnishing the complete system as specified herein.

1. Starfield Controls, Inc.

2. Tridonic Inc.

B. System Description: The lighting control system shall consist of digital lighting control network connecting DALI-compliant digital addressable ballasts, control modules, and lighting control devices directly with a system server / central control station. Individually addressable electronic ballasts, control modules, and control devices are operated from signals received through DALI-compliant bus from a variety of DALI-compliant digital controllers and interfaces and programmed through the system server / central control station. System includes all associated network bus and wiring, DALI controllers and interfaces, panels, photocells, switches, dimmers, time clock, and occupancy sensors. System shall utilize DALI-compliant ballast and dimming modules provided with light fixtures.

C. Control Devices: All occupancy sensors (ultrasonic, IR, and dual technology type), photocells, switches, and timers shall be provided with system and be DALI compliant. Devices shall be designed to operate on system network. Supplemental DALI-compliant signal repeaters and controllers shall be provided as required. This equipment shall be identified in shop drawing submission.

D. System shall include server / central station with DALI operating software, data network, and BACnet IP communication with other systems as described. System communication protocol shall be compatible with the building automation system.

E. System server / central station shall provide programmable operation of lights connected via system bus and controlled with system devices. System software shall provide control of DALI ballast, control modules and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components. Initial programming shall be as shown on plans and schedules.

F. Server / Central Control Station: Lighting control system manufacturer shall be responsible to assure coordination between relay modules, network hubs, and control system server/ central station such that system performs as described.

2.14 ARCHITECTURAL DIMMER RACK AND ACCESSORIES

A. Dimmer Rack and Control Processor:

1. 12 24 48 dimmer capacity. 120/208 volt, 3-phase, 4-wire, _____-amp main breaker. Refer to Dimmer Rack Schedule on drawings for further information.

2. Approved Manufacturers: Unison DR Series, Strand DE Series, Lutron Grafik Eye 4000/5000/6000.

B. Dimmer Control Station

1. _____ buttons, presets, and on/off control.

C. Dimmer Control Station with Faders

1. _____ buttons, _____ faders.

D. Dimming / Relay Performance Requirements:

1. The component's maximum current rating shall be at least two times the dimmer's/relay's rated operating current.

2. Capable of withstanding repetitive in-rush current of 50 times operating current without impacting lifetime of dimmer/relay. Design and test dimmers/relays to withstand line-side surges without impairment to performance.

3. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

E. Dimmers:

1. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.

2. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.

3. Each dimmer to be assigned a load type that will provide a proper dimming curve for the specific light source.

4. Possess ability to have load types assigned per circuit, configured in field.

5. Minimum and maximum light levels user adjustable on output-by-output basis.

6. Line Voltage Dimmers: Meet following load-specific requirements:

a. Magnetic Low Voltage (MLV) Transformer:

1) Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.

2) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.

b. Electronic Low Voltage (ELV) Transformer:

1) Dimmer to operate electronic low voltage transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.

c. Fluorescent Electronic Dimming Ballast: Refer to Section 26 51 00 for dimming ballast specifications and performance.

7. Low Voltage Dimming Modules: Meet the following requirements:

a. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.

b. Single low voltage dimming module; capable of controlling following light sources:

1) 0-10V analog voltage signal

2) DSI digital communication

3) DALI broadcast communication IEC 60929

4) PWM IEC 60929

F. Non-dim circuits to meet the following requirements:

1. Rated life of relay at full load: Minimum 1,000,000 cycles.

2. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.

3. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

2.15 TIME SWITCH

A. Time switch, 7-day, electronic, 30 setpoints available, LCD display, 12 or 24-hour format, minimum 200 hours battery backup, one SPDT 15-amp contact, UL listed.

1. Approved Manufacturers: Paragon EC71/30S, Tork EW101S, Intermatic ET70115C.

B. Time switch, 7-day, 2 channel, electronic, two SPDT 15-amp contacts, two separate programs with 16 setpoints available, LCD display, 12 or 24-hour format, minimum 100 hours carry-over, UL listed.

1. Approved Manufacturers: Paragon EC72, Tork DTS 200A, Intermatic ET70215C.

C. Astronomical time switch, 7-day, 1 channel, electronic, one SPDT 5-amp contact, LCD display, 12 or 24-hour format, minimum 100 hours carryover, UL listed.

1. Approved Manufacturers: Paragon EC71ST, Tork DWZ100A, Intermatic ET70115C.

D. Timer, 24-hour, 20-amp continuous contacts, 1 N.O. and 1 N.C. contacts, spring wound backup, 120 volt, override switch, UL listed.

1. Approved Manufacturers: Paragon 4213-OS, Tork 7200L, Intermatic T173CR.

2.16 CONDUCTORS AND CABLES

A. Control Wiring:

1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."

2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG with insulation rating equal to that of the line-voltage wiring.

3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.

4. Network cabling as required by manufacturer.

B. Splices and Taps:

1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 2200

LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dry type two winding transformers

B. Dry type harmonic mitigating transformers

PART 2 - PRODUCTS

2.1 DRY TYPE TWO WINDING TRANSFORMERS

A. Dry Type Transformers: NEMA ST 20, factory-assembled, air-cooled dry type transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.

B. Insulation system and average winding temperature rise for rated KVA as follows:

Ratings	**Class**	**Rise (degree C)**
Less than 15	185	As shown on the drawings
15 or higher	220	As shown on the drawings

C. Case temperature shall not exceed 40°C rise above ambient at its warmest point.

D. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

E. Winding Taps, Transformers 15 KVA and Larger: Two (2) 2-1/2% below and two (2) 2-1/2% above rated voltage, full capacity taps on primary winding.

F. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

	Average Sound Level, Decibels			
	Self-Cooled Ventilated			**Self-Cooled Sealed**
Equivalent Winding kVA Range	**K-Factor = 1 K-Factor = 4 K-Factor = 9**	**K-Factor = 13 K-Factor = 20**	**Forced Air w/ Fans Running**	
0-9	40	40	67	45
9.01-30.00	45	45	67	50
30.01-50.00	45	48	67	50
50.01-150.00	50	53	67	55
150.01-300.00	55	58	67	57
300.01-500.00	60	63	67	59
500.01-700.00	62	65	67	61
700.00-1000.00	64	67	67	63

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

I. Coil Conductors: Continuous windings with terminations brazed or welded.

J. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.

K. Isolate core and coil from enclosure using vibration-absorbing mounts.

L. Nameplate: NEMA TP 3; Include transformer connection data and overload capacity based on rated allowable temperature rise.

END OF SECTION

SECTION 26 2300

LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low-voltage, metal-enclosed switchgear, including low-voltage power circuit breakers.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Square D

B. General Electric

C. Cutler Hammer

D. Siemens

2.2 RATINGS

A. The switchgear for this project shall be fully rated unless otherwise specifically noted in the specifications.

2.3 SWITCHGEAR CONSTRUCTION AND RATINGS

A. Factory-assembled, dead-front, low-voltage, metal-enclosed, and self-supporting switchgear assembly, and complete from incoming line terminals to load-side terminations.

B. Switchgear electrical ratings and configurations as shown on the drawings. The entire assembly shall be suitable for 600-volt maximum AC service.

C. Line and Load Terminations: Accessible, NEMA 2-hole lugs suitable for the conductor materials used, rated at 75°C.

D. Main Section Devices: Individually mounted and compartmented.

E. Distribution Section Devices: Individually mounted

F. Auxiliary Section Devices: Individually mounted and compartmented.

G. Bus Material: Copper with silver plating, sized in accordance with ANSI temperature rise criteria of 65°C over a 40°C ambient. Bus shall be extended to the maximum vertical height in each section.

H. Bus Connections: Bolted, with Belleville-type washers. The bus arrangement shall be designed to permit future additions.

I. Bus bars shall be fully isolated, braced for minimum ANSI 4-cycle short-circuit withstand rating of 65,000 85,000 100,000 150,000 ampere rms symmetrical.

J. Provide a copper ground bus through the length of the switchboard, with a short time withstand rating equal to the largest circuit breaker in the assembly.

K. Provide metering transformer compartment for Utility Company's use. Compartment size, bus spacing and drilling, door, and locking and sealing requirements shall be in accordance to Section 26 20 00 and Utility Company specifications for a stand-alone building.

L. Enclosure shall be Indoor type NEMA 1 if installed indoors or NEMA 3R non-walk-in enclosure if installed outdoors Sections shall align at front and rear. Switchgear shall provide complete bottom enclosure, preventing the entrance of small animals or rodents.

M. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one-coat, corrosion-resisting paint, or plate with cadmium or zinc.

N. Each breaker compartment shall be isolated completely from other breaker compartments by grounded metal barriers. A front-hinged door with quarter-turn lath and padlock provisions shall be provided for each breaker and metering compartment.

O. Engraved identification nameplates for each breaker compartment and each control switch. Owner shall provide designation for breakers.

2.4 OVER-CURRENT PROTECTIVE DEVICES

A. Low-voltage Power Circuit Breakers with Microprocessor Trip Units: All power circuit breakers shall be UL 1066 listed for application in their intended enclosures for 100% of their continuous ampere rating. Provide power circuit breaker with two-step stored energy closing. Provide manual charging handle and electric charging motor where indicated as electrically operated**.** Electrically operated breakers shall be complete with 120V AC motor operators. The charging time of the motor shall not exceed six (6) seconds. Provide stationary mounting draw-out construction. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

B. Solid-state Microprocessor-based Trip Unit: Non-volatile memory, continuously adjustable, true RMS sensing with three current sensors. The trip unit shall be front mounted and shall allow access to all information without opening the cell door. The trip unit shall have information system that indicates mode of trip following an automatic trip operation. Provide rating plug as required on drawings and electronic circuits for true RMS current sensing, timing, and tripping for fully adjustable time current characteristics including ground fault trip, instantaneous trip, long time trip, and short time trip. Trip settings shall be field programmable with a sealable clear cover. Ground fault sensing shall be summation type integral to breaker. The trip unit shall have 4-character display, showing phase, neutral, and ground current. The metering accuracy shall be ± 2% of full scale. Trip unit shall have RS485 Modibus RTU communications to communicate all status conditions, settings, and metering parameters to network.

2.5 ARC ENERGY REDUCTION

A. Provide circuit breakers 1200A and larger with:

1. An energy reducing maintenance bypass switch with visual status indicator. Switch, indicator, and associated circuitry and connections shall meet the requirements of NEC 240.87.

2.6 INSTRUMENTS AND SENSORS

A. Digital AC Power Monitor: Capable of measuring, calculating, and directly displaying volts (L-L, L-N), amps, KW, KWH. Monitor shall be true RMS measurement with programmable setup parameters. All setup parameter data shall be stored in non-volatile memory to protect from power outages.

B. Control Power Transformers(s): Fused primary and 240//120 volt fused secondary, UL RK1 current limiting fuses. Size the transformer to supply power for heaters(s), electronic metering, and other auxiliary equipment.

2.7 USER METERING

A. All breakers shall be monitored for the following parameters. Breaker trip devices are acceptable if they provide all the indicated data as a minimum. Otherwise, provide separate electronic power meters.

1. Amperes phase A, amperes phase B, amperes phase C, amperes of the neutral (on a 4-wire system).

2. Volts phase A-B, volts phase B-C, volts phase C-A, Volts phase A-N, volts phase B-N, volts phase C-N. (Line-to-neutral voltage applies to 4-wire systems).

3. Positive Real Energy (+ watt-hours) – 3 phase total and per phase (on wye connected systems).

4. Maximum interval kW demand.

2.8 ACCESSORIES

A. Provide a floor-running portable circuit breaker transfer truck with manual lifting mechanism.

B. The equipment lineup needs a compact and integral system to lift the fully withdrawn circuit breakers off their rail assemblies. A set of hoist rails shall be provided on top of the switchgear lineup. Additionally, a hoist unit shall be supplied that will serve as the lifting mechanism. If required, a spreader-lifting unit shall be supplied for lifting every circuit breaker frame size contained in the lineup.

C. Provide a remote racking mechanism to allow remote operation of a circuit breaker from 25 feet away.

D. Infrared viewing windows to allow the use of an infrared camera or thermal imager direct line of site to inspect electrical connections without requiring the opening of panels and doors is required. These windows are intended to allow thermographers the ability to inspect the electrical equipment without directly exposing themselves to live electrical components and energized devices.

E. Portable test kit for secondary injection testing and verification of trip units.

F. A mimic bus shall be provided on the front of the equipment to diagrammatically show the internal bus structure of the lineup. Mimic bus material shall be adhesive vinyl strips.

END OF SECTION

SECTION 26 2413

SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Main and distribution switchboards

PART 2 - PRODUCTS

2.1 GENERAL

A. Approved Manufacturers:

1. Square D
2. General Electric
3. Siemens
4. Cutler Hammer

2.2 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. Refer to Section 26 05 53 for additional requirements.
2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The switchboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.3 SWITCHBOARD CONSTRUCTION AND RATINGS

A. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load-side terminations.

B. Switchboard electrical ratings and configurations as shown on the drawings.

C. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.

D. Main Section Devices: Individually mounted and compartmented.

E. Distribution Section Devices: Individually mounted.

F. Auxiliary Section Devices: Individually mounted and compartmented.

G. Bus Material: Aluminum with tin plating, sized in accordance with NEMA PB 2.

H. Bus Connections: Bolted, accessible from front only for maintenance. Plug-on connections may be utilized with Architect/Engineer's pre-approval by addenda.

I. Bus bars shall be fully isolated, braced for minimum ampere rms symmetrical rating as indicated on drawings.

J. The bus shall extend the full height of the distribution sections to provide space for future breakers.

K. Provide a 1 X 1/4-inch copper ground bus through the length of the switchboard.

L. Provide metering transformer compartment for Utility Company's use. Compartment size, bus spacing and drilling, door, and locking and sealing requirements shall be in accordance to Section 26 20 00 and Utility Company specifications.

M. Enclosure shall be NEMA PB 2; Type 1 - General-Purpose. Sections shall align at front and rear.

N. Switchboard Height: NEMA PB 2; 92 inches, excluding floor sills, lifting members and pull boxes.

O. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

P. Pull Box: Same construction as switchboard, size as shown on the drawings. Top and sides shall be removable. Insulating, fire-resistive bottom with separate openings for each circuit to pass into switchboard.

Q. Pull Section: Same construction as switchboard, size as shown on the drawings. Depth and height to match switchboard. Arrange as shown on the drawings.

R. Future Provisions: In addition to the spare devices shown, provide a minimum of 15 inches of fully equipped space for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating as indicated on the drawings.

S. Suitable for use as service entrance equipment.

2.4 SWITCHING, OVER-CURRENT PROTECTIVE DEVICES, AND ARC ENERGY REDUCTION

A. Fusible Switch Assemblies (600 Amperes and Smaller): Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class 'R' fuses, type as specified, with Class 'R' rejection clips.

B. Fusible Switch Assemblies (800 Amperes and Larger): Bolted pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses.

C. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide breaker interrupting ratings as indicated on the plans. Where necessary to meet interrupting ratings, breakers shall be provided with automatically resetting current limiting elements in each pole.

D. Solid State Molded Case Circuit Breakers**: (**All breakers identified on plans as solid-state with 2,500 ampere frame sizes and below.) Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover. Provide stationary mounting. draw-out construction. Ground fault sensing shall be breaker integral with circuit breaker. Provide zero sequence type ground fault sensor. Provide breaker interrupting ratings as indicated on the plans.

E. Solid-State Insulated Case Circuit Breakers: (All breakers identified on plans as solid state with frame sizes above 2,500 ampere.) Provide insulated case switch with two-step stored energy closing. Provide manual charging handle, and electric charging motor where indicated as electrically operated. Provide with rating plug as required on drawings and electronic circuits for true rms current sensing, timing, and tripping for fully adjustable time current characteristics including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip settings shall be field programmable with a sealable clear cover. Ground fault sensing shall be summation type integral to breaker. Provide stationary mounting. draw-out construction. Provide breaker interrupted ratings as indicated on the plans.

F. Arc Energy Reduction:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps or larger.

G. Arc Energy Reduction with Selective Coordination:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps or larger.

2. Zone-Selective Interlocking System: Provide a zone-selective interlocking system for the electrical equipment. The system shall provide the following functions:

a. Selective coordination

b. Permanent arc energy reduction

3. The following arc energy reduction system options are acceptable:

a. Zone-selective interlocking with permanent arc energy reduction

b. Differential relaying with permanent arc energy reduction

c. Listed energy-reducing active arch flash mitigating system

2.5 INSTRUMENTS AND SENSORS

A. Current Transformers: ANSI C57.13; 5 ampere secondary, bar or window type, with single secondary winding, unless otherwise required for application, and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

B. Potential Transformers: ANSI C57.13; 120-volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

C. Ground Fault Sensor: Zero sequence type.

D. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

E. Double-ended Equipment Ground Fault Protection: Provide a modified differential ground fault protection scheme. Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

F. Electronic Power Monitor: Refer to Section 26 09 13.

G. Digital AC Power Monitor. Capable of measuring, calculating and directly displaying; Volts (L-L, L-N), Amps, KW, KWH. Monitor shall be true RMS measurement with programmable set-up parameters. All set-up parameters data shall be stored in non-volatile memory to protect from power outages.

2.6 BUILDING-LEVEL SUB-METERS

A. LACCD buildings over 10,000 square feet shall have sub-meters installed.

1. All central utility plants in any size structure or any configuration, shall also have sub-meters installed subject to this standards.

B. Building-level sub-meters shall be configured to interface and exchange data with the District's existing metering software.

C. Building-level sub-meters shall include an Ethernet communications port or wireless communication capability or other networking capability.

D. Building level utility sub-meters shall be installed to capture the following data at a minimum of 15-minute intervals:

1. Electricity consumption (kWh)

2. Power demand (kW)

3. Power Factor

E. Individual Meters shall retain data for a period of no less than 12 months.

F. Solar photovoltaic arrays installed in or on a building shall have a dedicated meter to track PV productions. This is in addition to the building level sub-meter and must be in compliance with all the requirements outlined in the standards.

END OF SECTION

SECTION 26 2416

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Main and Distribution panelboards

B. Lighting and appliance branch circuit panelboards

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.

2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D

b. General Electric

c. Siemens

d. Cutler Hammer

B. Panelboards: NEMA PB 1; type as shown on the drawings.

C. Enclosure: NEMA PB 1; Type 1 (Indoor type).

D. Provide cabinet front with hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Each door shall be equipped flush lock type, spring latching, Yale lock for metal door keyed to a Yale key. All panelboard locks shall be keyed to operate from one key. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240-volt panelboards; 50,000 amperes rms symmetrical for 480-volt panelboards, or as shown on the drawings.

H. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

I. Molded Case Circuit Breakers with Current Limiters: Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

J. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

K. Solid State Molded Case Circuit Breakers: All breakers identified on plans as solid-state with 1,200 ampere frame sizes and below. Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover.

L. Arc Energy Reduction:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1200 amps or larger.

2. Energy-Reducing Maintenance Switch: Provide an energy-reducing maintenance switch visual status indication when engaged. Install the maintenance switch at the entrance to the electrical room in the first section of the electrical equipment.

M. Suitable for use as service entrance equipment.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D

b. General Electric

c. Siemens

d. Eaton

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1 (Indoor type).

D. Provide cabinet front with hinged trim to allow access to wiring gutters without removal of trim and flush lock all keyed alike. Each door shall be equipped flush lock type, spring latching, Yale lock for metal door keyed to a Yale key. All panelboard locks shall be keyed to operate from one key. Hinged trim shall be secured with screws. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.

J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

END OF SECTION

SECTION 26 2419

MOTOR CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters

B. Magnetic motor starters

C. Combination magnetic motor starters

D. Solid-state reduced voltage motor starters (soft starters)

E. Motor control centers

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS

A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.

B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.

C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, and toggle operator.

D. Enclosure: NEMA ICS 6; Type 1.

2.2 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Full Voltage Starting: Non-reversing type, unless otherwise indicated.

C. Reduced Voltage Starting: Closed-circuit transition wye-delta type: NEMA ICS 2, closed transition with adjustable time delay.

D. Two Speed Starting: Two speed, one winding, variable torque type. NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.

E. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating, and control devices, plus 100% spare capacity.

F. Size: NEMA ICS 2; size as shown on the drawings.

G. Overload Relay:

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 10 20 30 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

2. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 10 20 30 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

H. Enclosure: NEMA ICS 6; Type 1.

I. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide with disconnecting means as indicated on drawings.

J. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.

K. Pushbuttons: NEMA ICS 2; START/STOP in front cover.

L. Elapsed Time Meters: Heavy duty with readout in tenths of an hour.

M. Indicating Lights: NEMA ICS 2; RUN: red in front cover.

N. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

O. Relays: NEMA ICS 2.

P. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:

1. Size 1 - 100 VA

2. Size 2 - 100 VA

3. Size 3 - 150 VA

4. Size 4 - 300 VA

5. Size 5 - 300 VA

6. Size 6 - 300 VA

Q. Provide phase loss protection relay with contacts to de-energize the starter for each starter serving motors 5 HP or greater.

2.3 SOLID-STATE REDUCED VOLTAGE MOTOR STARTERS (SOFT STARTERS)

A. Soft Starters: ANSI/UL Standard 508. Used with NEMA Design B, AC induction motors to reduce in-rush current and mechanical shocks associated with starting and stopping motors.

B. Operation: The soft starter shall utilize a thyristor (SCR) bridge to control the starting and stopping of the motor. A microprocessor shall monitor the current and control the phasing of the SCRs. The soft starter shall provide torque control for linear acceleration without external feedback independent of motor load or motor application.

C. Torque ramp: Adjustable (by keypad) from 1 to 60 seconds.

D. Shorting Contactor: A shorting contactor shall be supplied with all soft starters rated above 40 amps. The shorting contactor shall close after the current is below 130% of motor full-load amps at the nominal voltage. The shorting contactor shall open on a stop command to allow a deceleration ramp, if applicable.

E. Status & Diagnostics: Door-mounted keypad for display of soft starter, motor, and fault statuses.

F. Motor Protection against Solid-State Component Failure: Provide an isolation contactor that opens when the motor is stopped or when the controller detects a fault condition such as a shorted thyristor.

G. Over-Current Protection Device / Power Disconnect: Integral molded case disconnect switch and in-line fuse block for RK type power fuses (up to 600 amps). Short circuit current rating shall be 65,000 AIC minimum or as indicated on drawings.

H. Overcurrent Condition: The soft starter shall be capable of supplying 300% of rated full load current for 30 seconds at maximum ambient temperature.

I. Electronic Protective Features: Thermal overload protection, phase reversal protection, stall protection, locked rotor protection, and underload protection. The display shall also indicate a starter thermal fault, phase fault, frequency fault, external fault, maximum start time exceeded, serial link fault, and internal failure.

J. Controls: The control circuitry shall be fed internally from the line supply, completely independent of the power circuit and separate from the control logic. The control circuitry shall operate at 120 VAC via an integral control power transformer.

K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

L. Input: Remote control start/stop signal, and one logic input for force to freewheel, indication of external fault, force to local control, or remote overload reset.

M. Outputs: Isolation contactor status, torque ramp status, overload pre-alarm, fault alarms, and one field convertible auxiliary contact. One analog output shall be available for 4-20mA indication of motor current, torque, thermal state, or power factor.

N. Current and Horsepower Ratings: As indicated in the Starter/Disconnect Schedule on the drawings.

O. Input/Output Voltage: As indicated in the Starter/Disconnect Schedule on the drawings. The controller shall be capable of operating between -15% to +10% of nominal voltage rating.

P. Environmental Characteristics: Ambient Air Temperature: 0°C to 40°C; Maximum Relative Humidity: 93% (non-condensing); Minimum Elevation without Derating: 3300 feet.

Q. Enclosure: NEMA ICS 6; Type 1, with provisions for padlocking the door.

2.4 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS

A. Molded Case Thermal-Magnetic Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

B. Non-fusible Switch Assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Provide with Class' R' rejection clips. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

2.5 MONITORING AND METERING

A. The starter shall provide the capability to monitor and calculate power consumption (kWh) of the motor load. Each starter shall display the calculated kW and kWh. Additionally, provide either a pulse output (kWh) or 4-20mA analog signal (kW) to the Facility Management and Control System (FMCS) to monitor the power consumption.

B. Starter must be capable of communicating over BACnet. At a minimum, reported points shall include starter mode, terminal input status, run/fault status, voltage, current, power factor, kW and kWh.

2.6 MOTOR CONTROL CENTER

A. Approved Manufacturers:

1. Square D

2. Eaton

3. General Electric

4. Siemens.

B. Motor Control Centers: NEMA ICS 2; Class 1, Type B.

C. Main Overcurrent Protection: As shown on the drawings.

D. Motor Controllers: As scheduled or indicated on the drawings.

E. Feeder Tap Units: Circuit Breakers.

F. Voltage Rating: 480/277 volts, 3-phase, 4-wire, 60 Hertz.

G. Horizontal Bussing: Copper, with a continuous current rating of 600 amperes. Include copper ground bus entire length of control center.

H. Vertical Bussing: NEMA ICS 2; copper.

I. Integrated Equipment Short Circuit Rating: As indicated on the drawings.

J. Configuration: Units front mounting only, accessible from the front only.

K. Enclosure: NEMA 250; Type 1, unless noted otherwise.

L. Finish: Manufacturer's standard gray enamel.

M. Provide phase loss protection relay with contacts to de-energize each motor starter in control center.

N. Control Transformers: Provide individual fused control transformers in the motor control center to provide independent 120-volt control source for each motor controller in the control center.

END OF SECTION

SECTION 26 2716

CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures

B. Cabinets

C. Terminal blocks and accessories

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Construction: NEMA 250; Type 1, 3R, 4, 14 gauge steel.

B. Finish: Manufacturer's standard polyester powder paint finish.

C. Covers: Continuous hinge with stainless steel hinge pin. Covers longer than 24 inches shall have 3-point latching.

D. Locks: Flush 1/4 turn cylinder key latch 3-point latch kit with padlock handle quick-release latch.

E. Provide interior white painted metal panel for mounting terminal blocks and electrical components.

2.2 CABINETS

A. Cabinet Boxes: Galvanized steel with removable endwalls dimensions as indicated on the drawings.

B. Cabinet Fronts: Steel, flush surface type with screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray baked enamel.

2.3 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.

B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide conduit hubs or knockouts on enclosures.

C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

END OF SECTION

SECTION 26 2726

WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Device plates and box covers

B. Modular connectors

C. Receptacles

D. Countertop and furniture receptacle assemblies

E. Pin and sleeve devices

F. Floor boxes

G. Service fitting

H. Pedestal style box

I. Poke-through fittings

J. Pendant cord/connector devices

K. Cord and plug sets

L. Cord reel

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All switch, receptacle, outlet, and coverplate colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

A. All switches, receptacles, and outlets shall be complete with the following:

1. Unbreakable thermoplastic/thermoset plastic coverplates in finished spaces where walls are finished.

2. Decorator thermoplastic wallplates in public finished spaces where walls are finished. Approved Manufacturer: Leviton Decora, Hubbell Decorator, Cooper Decorator, or approved equal.

3. Decorator snap-on nylon or polycarbonate wallplates with sub-base in public finished spaces. Approved Manufacturer: Leviton 803##, Hubbell RCW, Cooper PJS, Pass & Seymour SWP or approved equal.

4. #302 stainless steel coverplates in unfinished spaces for flush boxes.

5. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

A. Refer to Electrical Symbols List for device type.

B. Devices that are shaded on the drawings shall be red.

C. Devices that are shaded on the drawings shall be red and shall have an illuminated face or indicator light to indicate that there is power to the device.

D. NEMA 5-20R Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.

2. Approved Manufacturers: Hubbell 5352A, Leviton, 5362-S, Pass & Seymour 5362, Cooper 5352.

3. Provide decorative style duplex receptacles in public spaces where walls are finished.

4. Approved Manufacturers: (Decorative), Hubbell, Leviton, Pass & Seymour, Cooper.

5. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and brass back strap.

6. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

7. 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.

8. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

E. NEMA 5-20R Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

F. NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

G. NEMA 5-20R Isolated Ground Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with orange impact resistant thermoplastic face. Orange coverplate with 'Isolated Ground' stenciled in black.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

H. NEMA 5-20R Isolated Ground and Surge Suppression Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with orange impact resistance thermoplastic face, light, and alarm. Orange coverplate with 'Isolated Ground' stenciled in black.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

I. NEMA 5-20R Double Duplex Isolated Ground and Surge Suppression Receptacle:

1. Consists of two duplex isolated ground and surge suppression receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Isolated Ground and Surge Suppression Receptacle above.

J. NEMA 5-20R Receptacle with USB Charger:

1. 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Type A USB charging rated at 5VDC 2.1A. Mounted in double gang backbox.

2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

3. 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. One Type A USB charging rated at 5VDC 2.1A. One Two Type C USB charging rated at 5VDC 5.0A. Mounted in double gang backbox.

4. Approved Manufacturers: Hubbell

K. NEMA 5-20R Simplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, , Pass & Seymour, Cooper.

L. NEMA 5-30R Simplex Receptacle:

1. 125-volt, 30 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper 5716N.

M. NEMA 5-50R Simplex Receptacle:

1. 125-volt, 50 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell, Cooper.

N. NEMA 6-20R Simplex Receptacle:

1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper 5461.

O. NEMA 6-30R Simplex Receptacle:

1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

P. NEMA 6-50R Simplex Receptacle:

1. 250-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

Q. NEMA 7-20R Simplex Receptacle:

1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour.

R. NEMA 7-30R Simplex Receptacle:

1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

S. NEMA 7-50R Simplex Receptacle:

1. 277-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

T. NEMA 14-20R Simplex Receptacle:

1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

U. NEMA 14-30R Simplex Receptacle:

1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +24 AFF.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

V. NEMA 14-50R Simplex Receptacle:

1. 125/250-volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4” AFF.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

W. NEMA 14-60R Simplex Receptacle:

1. 125/250-volt, 60 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

X. NEMA 15-20R Simplex Receptacle:

1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

Y. NEMA 15-30R Simplex Receptacle:

1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

Z. NEMA 15-50R Simplex Receptacle:

1. 250-volt, 50 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

AA. NEMA 15-60R Simplex Receptacle:

1. 250-volt, 60 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

BB. NEMA L5-20R Simplex Receptacle, Locking Type:

1. 125-volt, 20 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

CC. NEMA L5-30R Simplex Receptacle Locking Type:

1. 125-volt, 30 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

DD. NEMA L6-20R Locking Type Simplex Receptacle:

1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

EE. NEMA L6-30R Locking Type Simplex Receptacle:

1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

FF. NEMA L7-20R Locking Type Simplex Receptacle:

1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

GG. NEMA L7-30R Locking Type Simplex Receptacle:

1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

HH. NEMA L14-20R Locking Type Simplex Receptacle:

1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

II. NEMA L14-30R Locking Type Simplex Receptacle:

1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

JJ. NEMA L15-20R Locking Type Simplex Receptacle:

1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

KK. NEMA L15-30R Locking Type Simplex Receptacle:

1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

LL. NEMA L16-20R Locking Type Simplex Receptacle:

1. 480-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

MM. NEMA L16-30R Locking Type Simplex Receptacle:

1. 480-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

NN. NEMA L21-20R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 20-amp 5 wire grounding type.
2. Approved Manufacturers: Hubbell, Cooper, Pass & Seymour.

OO. NEMA L21-30R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 30-amp 5 wire grounding type.

2. Approved Manufacturers: Hubbell, Cooper, Pass & Seymour.

PP. NEMA 5-20R Tamper Resistant Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

3. Provide decorative style duplex tamper resistant receptacles in public spaces where walls are finished.

4. Approved Manufacturers: (Decorative), Hubbell, Leviton, Pass & Seymour.

QQ. NEMA 5-20R GFI Tamper Resistant Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type tamper-resistant with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell, Cooper, Pass & Seymour, Leviton.

RR. NEMA 5-20R Double Duplex Tamper Resistant Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Tamper Resistant Receptacle above.

SS. NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap. Bottom half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and NEC 2014 compliant marking on face of device.

2. Approved Manufacturers: Pass & Seymour, Leviton, Hubbell, Cooper.

TT. NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Plug Load Controlled Duplex Receptacles above.

UU. NEMA 5-20R Double Duplex Receptacle:

1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.

2. Approved manufacturers: Refer to Duplex Receptacle above.

VV. NEMA 5-20R Double Duplex GFI Receptacle:

1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.

WW. NEMA 5-20R Double Duplex USB Receptacle:

1. Consists of two duplex USB receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to USB Receptacle above.

XX. NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:

1. Consists of two duplex, GFI receptacles. Double gang box. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Approved Manufacturers:

a. Receptacle: Refer to GFCI Receptacle above.

b. Cover: Intermatic, Pass & Seymour, Thomas & Betts.

YY. 600-volt, 60 amp, 3-pole, 4-wire Locking Type Simplex Receptacle for X-ray Isolated Power Equipment:

1. Black nylon or polycarbonate face. Cast aluminum surface mounted box, 45° angle adapter, weather protective lift cover on receptacle.

2. Approved Manufacturers: Hubbell, Pass & Seymour, Cooper.

ZZ. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

AAA. Side wired devices shall have four binding screws that are undercut for positive wire retention.

BBB. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

CCC. Isolated ground receptacles shall have the equipment ground contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from the mounting strap.

DDD. Integral surge suppression receptacles with integral surge suppression shall comply with the following:

1. Category A3 listed.

2. Line to ground, line to neutral, and neutral to ground modes.

3. Metal-oxide varistors with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 210 joules per mode.

4. Status indication: Light visible in the face of the device and audible alarm to indicate device is no longer active or in service.

5. Distinctive symbol on device face to denote SPD-type device.

6. Device shall be blue with stainless coverplate.

7. NEMA 5-20R duplex receptacle, 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap.

a. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour, Cooper.

EEE. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

2.4 PIN AND SLEEVE DEVICES

A. Industrial heavy-duty pin and sleeve devices shall comply with IEC 309-1.

1. IEC rated pin and sleeve watertight IP67 receptacle, raintight screw cap with safety chain and matching plug.

B. 120/208 277/480-volt, 30 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers: Hubbell, Pass and Seymour, Cooper, Leviton

C. 120/208 277/480-volt, 60 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers: Hubbell, Pass and Seymour, Cooper, Leviton

D. 120/208 277/480-volt, 100 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers: Hubbell, Pass and Seymour, Cooper, Leviton

E. 480-volt, 60 amp, 4-pole, 4-wire Pin and Sleeve Simplex Receptacle:

1. Surface-mount enclosure with 15° mounting box, 1-1/2” conduit hub, raintight screw cap with safety chain.

2. Approved Manufacturers: Appleton, Crouse-Hinds.

F. 480-volt, 100 amp, 4-pole, 4-wire Pin and Sleeve Simplex Receptacle:

1. Surface-mount enclosure with 15° mounting box, 2” conduit hub.

2. Approved Manufacturers: Appleton, Crouse-Hinds, Killark.

G. 600-volt, 30 amp, 3-phase, 3-wire Pin and Sleeve Simplex Receptacle:

1. Provide with raintight, weatherproof enclosure.

2. Approved Manufacturers: Appleton, Crouse-Hinds, Killark.

2.5 FLOOR BOXES

A. Color: Verify with Architect.

B. Coordinate with Technology drawings for voice/data outlet requirements.

C. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Fully adjustable, cast iron.

D. Flush-mounted, round, cast iron floor box with one (1) fully adjustable, round brass cover with duplex flap cover and brass carpet flange.

1. Approved Manufacturers:

a. Hubbell

b. Wiremold

c. Steel City

E. Fully adjustable cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with brass 2-1/8” x 3/4” combination cover for power connections to partitions by others, connection wire by EC. One compartment with brass 1-1/2” x 1-1/2” duplex thread cover with one (1) 3/4” and one (1) 1” conduit stubbed to above the lay-in ceiling routed to the corridor cable tray.

1. Approved Manufacturers:

a. Hubbell

b. Wiremold

c. Steel City

F. Cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with one (1) brass duplex flap cover. One compartment with brass 2-1/8” x 3/4” combination cover and one (1) 3/4” and one (1) 1” conduit stubbed to above the lay-in ceiling routed to the corridor cable tray.

1. Approved Manufacturers:

a. Hubbell

b. Wiremold

c. Steel City

G. Recessed multi-service floor box - tele/power/data. Equivalent mounting space of four (4) single gang boxes consisting of one (1) **[REC-DUP]**, one (1) voice outlet, one (1) data outlet, and one (1) spare. Cast iron adjustable rectangular floor box with cover. Provide one (1) 1” conduit for information outlet cabling, one (1) 1” conduit for audio/visual cabling, and one (1) 1” conduit as spare. Route low voltage cabling conduits to above the lay-in ceiling the corridor cable tray.

1. Approved Manufacturers:

a. Wiremold RFB4-CI

b. Steel City 665-CI

c. Hubbell LCFBCA

H. Three service floor box - tele/power/data. Equivalent mounting space of four (4) single gang boxes consisting of one (1) voice outlet, one (1) data outlet, and one (1) spare. Steel adjustable rectangular floor box with flush cover. Provide one (1) 1" conduit for information outlet cabling, one (1) 1" conduit for audio/visual cabling, and one (1) 1" conduit as spare. Route low voltage cabling conduits to above the lay-in ceiling the corridor cable tray.

1. Approved Manufacturers:

a. Wiremold

b. Steel City

c. Hubbell

2.6 SERVICE FITTING BOX

A. Service fitting style box with 1" chase nipple. Two (2) **[REC-DUP]**. Install back to back in box.

1. Approved Manufacturers:

a. Hubbell

b. Steel City

B. Cast aluminum service fitting style box mounted to underfloor duct. one (1) **[REC-DUP]**.

1. Approved Manufacturers:

a. Walker Duct

b. Square D

c. Thomas & Betts

2.7 PEDESTAL STYLE BOX

A. Cast aluminum pedestal style box with 1" hub. One (1) **[REC-DUP]**. Install back to back in box. Provide stainless steel cover plates.

1. Approved Manufacturers:

a. Hubbell

b. Thomas & Betts

B. Cast aluminum pedestal style box with 1" hub. Two (2) **[REC-DUP]**. Install back to back in box. Provide stainless steel cover plates.

1. Approved Manufacturers:

a. Hubbell

b. Thomas & Betts

2.8 POKE-THROUGH FITTINGS

A. UL listed as fire-rated poke-through device for 1, 1-1/2 and 2 hour rated floors: include fire stops and smoke barriers in through-floor component. UL514A listed for scrub locations.

B. Terminate in 4-inch square by 2-1/2-inch deep junction box.

C. Suitable for installation with a floor thickness of 2-1/4 to 7 inches.

D. Semi-flush die-cast aluminum carpet flange.

E. Spring loaded receptacle covers.

F. Verify color with Architect.

G. Fire Rated Poke-Through:

1. Flush mounted. For use with 3-inch core holes. 125-volt, 20 amp, NEMA 5-20R duplex receptacle with 3/4” conduit and junction box. Provide with two (2) data jacks. With painted aluminum solid brass flange.

2. Approved Manufacturers: Hubbell, Wiremold, Thomas & Betts.

H. Fire Rated Poke-Through:

1. Flush mounted. For use with 4-inch core holes. Provide with _____ 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4” conduit and junction box. Provide with capacity for six data jacks and oversized conduit, with solid brass flange.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell, Wiremold, Thomas & Betts.

I. Fire-Rated Multi-Service Recessed Poke-Through:

1. Recessed mounted. For use with 6-inch core holes. Provide with two 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4” conduit and junction box. Provide with capacity for eight data jacks and 2” conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell, Wiremold.

J. Fire-Rated Multi-Service Recessed 8” Poke-Through:

1. Recessed mounted. For use with 8-inch core holes. Provide with two (2) 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4” conduit and junction box. Provide with capacity for 12 data jacks and 2” conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell, Wiremold.

2.9 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, heavy-duty grade or refer to Details as shown on drawings.

1. Body: Nylon with screw-open cable gripping jaws and provisions for attaching external cable grip.

B. External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire stand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.10 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

2.11 CORD REELS

A. 50’ 3#12 AWG type ‘SOW-A’ cord with adjustable ball stop. 120 volt, NEMA 5-20R, simplex receptacle connector, rated 16 amps continuous.

1. Approved Manufacturers:

a. Daniel Woodhead w/ Hubbell 5369

b. Appleton

c. Hubbell

B. 50’ 3#16 AWG type ‘SJOW-A’ cord with adjustable ball stop. Hand lamp with simplex 120-volt NEMA 5-15R receptacles, rated 6.5 amps.

1. Approved Manufacturers:

a. Daniel Woodhead

b. Appleton

c. Hubbell

C. 25’ 3#16 AWG type ‘SJOW-A’ cord with adjustable ball stop. Two 120-volt NEMA 5-15R receptacles mounted in cast outlet box, rated 10 amps.

1. Approved Manufacturers:

a. Daniel Woodhead

b. Appleton

c. Hubbell

END OF SECTION

SECTION 26 27 29

ELECTRIC VEHICLE CHARGING STATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric vehicle charging stations:

B. Electric vehicle radio frequency identification (RFID) card system

1.2 REFERENCES

A. The equipment and components in this specification shall be designed and manufactured according to the latest revision of the following standards (unless otherwise noted):

1. SAE J1772 Standard for Electric Vehicle Conductive Charge Coupler
2. NFPA 70 Article 625 Electric Vehicle Charging Systems
3. UL 2202, Electric Vehicle (EV) Charging System Equipment
4. UL 2231, Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits
5. UL 2251, Plugs, Receptacles and Couplers for Electric Vehicles
6. UL 2594, Electric Vehicle Supply Equipment
7. UL and cUL listed
8. ISO 15693

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Provide product data showing configurations, finishes, dimensions, cable, and coupling information.

C. Provide manufacturer installation, operation, and maintenance instructions.

D. Cellular Network and Gateway Plan: Submit manufacturer cellular network and gateway site plan for RFID and revenue generation communication. The manufacturer site plan shall clearly identify the following:

1. Location of gateway enabled stations
2. Location of non-gateway enabled stations
3. Manufacturer approval of gateway and non-gateway enabled stations to ensure unobstructed communication between stations types

E. Submit RFID software, hardware, and RFID card information.

1.4 SPARE PARTS

A. Provide RFID cards: 50

1.5 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's installation and maintenance manuals.

B. Contractor shall inspect and report for damage.

C. Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation.

D. Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.

PART 2 - PRODUCTS

2.1 ELECTRIC VEHICLE CHARGING STATION

A. Plan Identification:

1. Electric vehicle charging station, single port type.

2. Electric vehicle charging station, single port type, with network gateway to communicate with non-gateway enabled devices.

3. Electric vehicle charging station, dual port type.

4. Electric vehicle charging station, dual port type, with network gateway to communicate with non-gateway enabled devices.

B. Approved Manufacturers:

1. Single/Dual Port Charging Station Pedestal Style:

a. Square D EVlink

b. Leviton EVR Green 4000

c. Siemens EV Charging

d. General Electric DuraStation

e. Bosch EL series

2. Single Port Charging Station Wall-Mounted Style

a. Square D EVlink

b. Leviton ECR Green 4000

c. Siemens EV Charging

d. General Electric DuraStation

e. Bosch EL Series

C. Electric vehicle (EV) charging station, Level 2 charging, with LCD display, LED display for charging status, fault indication, power available, internal ground fault protection 20mA, integrated single phase revenue grade meter, anti-nuisance tripping, and re-closure feature.

1. Enclosure Construction: NEMA 3R or 4X

2. System Supply: 40 amp, 208-volt, single phase, 60Hz dedicated circuit.

3. Cable / Connector: Flexible, 25ft, with SAE J1772 compliant connector. Provide complete with cable/connector support while not in use bracket.

4. Environment: Wet location, -22°F to 122°F

D. Electronics - Communication:

1. Wi-Fi / wireless cellular network connection

2. Ethernet Network Gateway: Provide identified station with network gateway when applicable.

E. Credit Card Revenue Generation:

1. Provide integral ChargePoint card / contactless credit card interface.

2. The Owner will enter into a contract with a revenue service plan. The contractor shall provide provisions to coordinate and set up the revenue service plan on behalf of the Owner.

F. RFID System Revenue Generation:

1. Provide EVCS with integral radio frequency identification (RFID) reader.

2. Provide manufacturer RFID software and RFID reader for customer programming of RFID cards.

3. Provide RFID cards: Refer to spare parts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide concrete pad and mow apron for pedestal installation.

B. Placement:

1. Verify field measurements with civil and architectural plans.

2. Install pedestal 12 inches behind concrete curb / paving limits or as directed by the manufacturer.

3. Center pedestal in site islands 24 inches or less in width.

4. Center dual port pedestals between parking stalls. Align with vehicle parking lines.

C. Grounding Rod: Provide 5/8 x 10’-0” copper clad steel ground rod for each pedestal, installed 12 inches below finished grade. Provide bare #6 ground wire with exothermic weld for bonding to EVCS pedestal.

D. Labeling: Provide panel and circuit label for all circuits serving the electric vehicle charging station. Locate circuit labels on the inside utility access cover for the charging station.

E. Ethernet Connections: Provide final Ethernet cable and terminations per manufacturer instructions.

F. Cellular Network: Provide setup, testing, and configuration of cellular network per manufacturer instructions.

3.2 OWNER TRAINING AND SYSTEM COMMISSIONING:

A. Provide factory representative for Owner training and demonstration of the system. Owner training shall include service, maintenance, troubleshooting, and general operation of system. The factory representative shall also provide customer in-person training/support for the following:

1. RFID software setup on customer computer

2. Training for RFID card program

3. Cellular network registration, initialization, and testing

END OF SECTION

SECTION 26 2923

VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable frequency drives

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: Refer to Variable Frequency Drive Schedule.

2.2 DESCRIPTION

A. Converts 60 Hertz input power at voltage specified to a variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The controller shall be suitable for use with standard NEMA B squirrel cage 1.15 service factor induction motors without requiring any modifications to the motor or the drive.

B. Controller shall have sufficient capacity to provide speed control of the motors shown or noted throughout the specified environmental operating conditions.

C. Controller shall have the functional components listed below:

1. Door interlocked input circuit breaker/fused switch.

2. Input rectifier section to supply fixed DC bus voltage.

3. Smoothing reactor for DC bus.

4. DC bus capacitors.

5. Control transformer.

6. Separate terminal blocks for power and control wiring.

7. Terminal block for operator controls.

8. Sine weighted PWM generating inverter section.

2.3 RATINGS

A. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

B. Operating Ambient: 0°C to 40°C.

C. Minimum Relative Humidity Range: 5% to 90% (non-condensing).

D. Minimum Elevation without Derating: 3300 feet.

E. Minimum Efficiency at Full Load: 96 percent.

F. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.

G. Starting Torque: 100 percent of rated torque or as indicated.

H. Speed Regulation: Plus or minus 1 percent with no motor derating.

2.4 DESIGN

A. Pulse Width Modulated (PWM) Variable Frequency Drives:

1. Converter shall be of a diode bridge design with a sine-weighted PWM inverter section.

2. Main semi-conductors in the inverter section of controller shall be IGBT transistors capable of a carrier switching frequency of up to 8 kHz. If derating of the inverter is necessary to run at 8kHz, then the unit's derated currents must equal or exceed the motor full load currents listed in NEC Table 430-150.

3. All controllers supplied with semi-conductors capable of switching at less than 8,000 Hertz shall be supplied with a motor acoustic noise reduction filter.

4. Pulse width modulated (PWM) drives shall be supplied with drive input line reactors with a minimum impedance of 3%. Reactors shall be installed to filter entire drive input circuit.

5. Pulse width modulated (PWM) drives shall be supplied with drive input harmonic filter to reduce the total harmonic distortion to less than the IEEE519-1992 limits at the utility service entrance.

6. Drives that are located beyond the manufacturer's recommended maximum distance from the motor shall be provided with dV/dt (long lead) filters.

B. All drives shall have built-in diagnostic capability with status and fault indicators mounted on enclosure door. Complete operating instructions for diagnostics shall be mounted inside of the enclosure door.

C. Drive shall restart after power loss and under-voltage fault. The minimum number of restart attempts required shall be three, field adjustable.

D. The drive shall allow unlimited switching of the output without damage to the drive or motor.

2.5 PRODUCT FEATURES

A. Display: Provide integral digital display to indicate all protection faults and drive status (including overcurrent, overvoltage, undervoltage, ground fault, overtemperature, phase loss, input power ON, output voltage, output frequency, and output current.

B. Protection:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunctions due to system transients,

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Motor thermal overload relay(s) adjustable and capable of NEMA Class 10 20 30 motor protection and sized per motor nameplate data. When multiple motors are connected to the VFD output, each motor shall have a manual starter with properly sized overload protection.

5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

6. Instantaneous line-to-line and line-to-ground overcurrent trips on input and output.

7. Loss-of-phase protection.

8. Reverse-phase protection.

9. Short-circuit protection (fuses or circuit breaker).

10. Motor overtemperature fault.

C. Acceleration Rate Adjustment: 0.5 - 30 seconds.

D. Deceleration Rate Adjustment: 1 - 30 seconds.

E. Minimum Adjustment Range for the Lower Output Frequency shall be: 0 to 40 Hertz.

F. Minimum Adjustment Range for the Upper Output Frequency Range shall be: 40 to 90 Hertz.

G. Minimum Volts/Hertz Range: 3.7 to 8.6 volts/Hertz.

H. Provide MANUAL-OFF-AUTOMATIC selector switch and manual analog speed control mounted on the front of the enclosure.

I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.

J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.

K. Provide adjustable skip frequencies on the drive output (minimum of three ranges).

L. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption, and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

M. Power-Interruption Protection: After a power interruption, it prevents the motor from re-energizing until the motor has stopped.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

S. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
    a. 0 to 10-V dc.
    b. 0-20 or 4-20 mA.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.
    e. RS485.

f. Keypad display for local hand operation.

3. Output Signal Interface:

a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

1) Output frequency (Hz).

2) Output current (load).

3) DC-link voltage (VDC).

4) Motor torque (percent).

5) Motor speed (rpm).

6) Set-point frequency (Hz).

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1A) for remote indication of the following:

a. Motor running.

b. Set-point speed reached.

c. Fault and warning indication (overtemperature or overcurrent).

d. PID high- or low-speed limits reached.

T. Communications: Provide a communications card to interface VFD with Facility Management Control System (FMCS). Coordinate interface requirements with the FMCS provided under Section 23 09 00. Interface shall allow all parameter settings of VFD to be programmed via FMCS control and displayed on FMCS operator workstation. Provide capability for VFD to retain these settings within the nonvolatile memory.

U. Three- Contactor Automatic Bypass:

1. Provide contactors, motor running overload protection, under-voltage and loss of phase protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.

2. All bypass circuitry shall be located within the same enclosure as the variable frequency drive.

3. All fire alarm and/or smoke control interconnections (e.g., air handling unit shutdown) shall apply regardless of whether control is through VFD or bypass.

4. Provide a Drive-Bypass Selector Switch.

5. Provide nameplate with instructions for switching from drive to bypass and from bypass to drive. Provide instructions for isolating VFD for maintenance.

V. Control:

1. With the "Manual-Off-Auto" switch in the "Manual" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the manual speed potentiometer on the drive door.

2. With the "Manual-Off-Auto" switch in the "Auto" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the input signal from an external source.

3. If applicable, with the "Drive-Bypass" in the "Bypass" position, regardless the position of the "Manual-Off-Auto" switch, the motor shall be connected across the lines and shall be run at full speed.

4. With the "Manual-Off-Auto" switch in the "Off" position, if applicable, the drive run circuit shall be open and the VFD shall not operate.

5. If applicable, signal from the fire alarm control panel shall shut down VFD and bypass.

6. All disconnect switches between VFD and motor(s) shall include an auxiliary contact interlock wired to the VFD fault trip input to shut down the drive upon opening of the disconnect main contacts.

2.6 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. All VFD supplied for fans shall have dynamic or DC injection braking capability to provide a means of rapid deceleration of the AC motor in not more than one (1) minute. Adjust controls to stop the motor within 30 seconds.

C. All high inertia loads that cannot be stopped in 30 seconds with the VFD dynamic braking or DC injection braking shall be provided with a chopper module and dynamic braking resistor to stop the motor within 30 seconds.

D. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

E. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

F. Control Relays: Auxiliary and adjustable time-delay relays.

G. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

H. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

I. Fabrication:

1. Enclosure: NEMA 250, Type 1.

2. Finish: Manufacturer's standard enamel.

END OF SECTION

SECTION 26 3213

EMERGENCY MOTOR GENERATOR

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system

B. Exhaust silencer and fittings

C. Fuel fittings and day tank

D. Remote annunciator panel

E. Battery and charger

F. Weatherproof enclosure

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Caterpillar.

B. Cummins Power Generation.

C. Kohler.

D. Generac

2.2 PACKAGED ENGINE-GENERATOR SET

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.

B. Safety Standard: Comply with ASME B15.1 and UL 2200.

C. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, model and serial number, and component rating in integrated set and as required by the contract documents.

D. Fabricate engine-generator set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.

E. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components. Provide a rigging diagram permanently attached to the mounting frame to indicate the capacity of each lifting attachment and the generator-set center of gravity.

2.3 ENGINE

A. Type: Water-cooled in-line or V-type, four-stroke cycle spark-ignition compression ignition diesel electric ignition internal combustion engine.

B. Rating: Sufficient to operate at 100 percent load for two hours at specified elevation and ambient limits.

C. Fuel: Appropriate for use of No. 2 fuel oil.

D. Engine Speed: 1800 RPM.

E. Governor: Isochronous type with speed sensing.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Frequency Response:

1. Steady State Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

2. Transient Response: Less than 5 percent for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady state operating band within 5 seconds.

H. Fuel System: Engine mounted diesel fuel pump and relief-bypass valve. Fuel Supply System: Comply with UL 142 fuel oil tank.

1. Day Tank: UL listed fuel tank with 4 hour rated capacity. Integral rupture basin with 150% of nominal capacity and leak detection. Dual integral self-priming pumps and level control with indication. Low-level sensor at 25% with alarm and contacts. High-level sensor with alarm, contacts, and redundant fuel shutoff. Include flexible fuel line connections for all supply and return lines as indicated on the Mechanical Plumbing drawings. Provide with emergency vent cap.

a. Approved Manufacturers: Simplex, Tramont, Pyrco.

2. Base-Mounted Fuel Tank: UL 2080 listed fuel tank with 8 hour rated (NFPA 110 minimum run time by class) capacity. Integral rupture basin with leak detection. Provide fueling port with an overfill prevention type receptacle and lockable cap for exterior units. The tank shall include structural steel supports for top mounted engine generator set. Furnish complete with flexible fuel line connectors lockable cover, and analog level gauge. Furnish complete with float switches to indicate low fuel level. The footprint of the base-mounted fuel tank shall not exceed the footprint of the generator frame for interior applications or the footprint of the enclosure for exterior installations.

I. Lubrication System: Engine or skid mounted filter and strainer, thermostatic control valve capable of full flow and designed to be fail safe, and crankcase drain arranged for gravity drainage with siphon or pump.

J. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F, and suitable for operation on 120 volts AC. The minimum wattage of the heater shall be watts or as recommended by the manufacturer.

K. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.

1. Remote Radiator: Vertical air discharge. Multiple belt drive from totally enclosed sealed bearing motor. Sized by generator manufacturer.

2. Fan and Core: Nonferrous-metal construction sized to contain expansion of total system. Blower type fan, sized to maintain safe engine temperature in ambient temperature of 110°F. Radiator Airflow Restriction: 0.5 inches of water, maximum.

3. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anti-corrosive additives.

4. Provide expansion tank with gage glass and petcock, and self-contained, thermostatic-control temperature control valve.

L. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel. Provide the following accessories:

1. Battery: Voltage to match starter with capacity for three cranking cycles without recharge. Provide with battery cables and acid resistant battery tray.

2. Battery-Charging Alternator: Factory mounted on engine with solid state voltage regulation.

3. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet ANSI/NEMA 250, Type 1 requirements.

M. Exhaust System: Critical type silencer (85 dBA max at 10 feet), side inlet with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions. Silencer shall include a threaded opening for connection of ¾” drain line. Opening shall be flush on inside of silencer.

N. The packaged engine generator shall comply with the current Environmental Protection Agency EPA Emissions standards.

O. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine-generator control panel.

P. Mounting: Provide unit with suitable spring-type vibration isolators.

2.4 GENERATOR

A. Generator: ANSI/NEMA MG 1; three phase, re-connectible brushless synchronous generator with brushless exciter and PMG alternator excitation.

B. Rating: As indicated on the drawings, at 0.8 power factor, 60 Hertz at RPM to match engine rating.

C. Insulation: ANSI/NEMA MG 1, Class H.

D. Temperature Rise: 105°C continuous.

E. Enclosure: ANSI/NEMA MG 1; open drip-proof.

F. Voltage Regulation:

1. The maximum instantaneous voltage dip (IVD) shall be 30 percent for building loads and 15 percent for the fire pump.

2. Include solid-state type voltage regulator, separate from exciter to match engine and generator characteristics, with voltage regulation ±1 percent from no load to full load. Include manual controls to adjust voltage drop ±5 percent voltage level, and voltage gain.

G. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.5 CONTROLS AND INDICATION

A. Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator–set vibration.

B. Ground Fault: Provide ground fault sensing at the generator. The sensor shall be located ahead of the generator service disconnect. Provide a ground fault indication on the engine-generator control panel. Provide an instruction nameplate at the control panel.

1. Instruction nameplate: Provide operational instructions for a ground fault indication as approved by the local Authority Having Jurisdiction.

C. Engine-Generator Control Panel: ANSI/NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:

1. Alarm indication as required by NFPA 110 for a Level 1 system.

2. AC frequency meter.

3. AC output voltmeter with phase selector switch.

4. AC output ammeter with phase selector switch.

5. Output voltage adjustment.

6. DC voltmeter (alternator battery charging).

7. Engine start/stop selector switch.

8. Engine running time meter.

9. Oil pressure gauge.

10. Engine coolant temperature gauge.

11. Shut down devices for overspeed, coolant high-temperature, coolant low-level, and oil low-pressure.

12. Fuel derangement alarm.

13. Generator overload.

14. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.

15. Remote Alarm Contacts: Pre-wire SPST contacts to terminal strip for remote alarm functions required by ANSI/NFPA 99.

16. Ground fault indication.

D. Remote Engine Annunciator Panel: ANSI/NFPA 99 and NFPA 110 for a Level 1 2 system. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a surface mounted panel with brushed OR color painted finish. Provide all interconnecting wiring in conduit per manufacturer's requirements by the Electrical Contractor. The remotely reported alarms shall include the following.

1. Overcrank

2. Low water (engine) temperature

3. High engine temperature pre-alarm

4. High engine temperature

5. Low lube oil pressure pre-alarm

6. Low lube oil pressure

7. Overspeed

8. Low fuel main tank

9. Low coolant level

10. Not in auto

11. Emergency Power Supply (EPS) supplying load

12. High battery voltage

13. Low battery voltage

14. Battery charger failure (includes AC failure)

15. Generator running

16. Normal utility power

17. Emergency stop

18. Emergency Power Off Switch activated (EPO)

19. Alarm for power supply or UPS serving motorized breakers

E. Building Automation System Integration:

1. Provide a terminal block to allow the Facility Monitoring and Control System (FMCS) to report generator alarms. Provide individual terminal points for each of the annunciator alarms and pre-alarms. Provide an additional terminal point to combine all generator alarms under a single terminal point. Provide a permanent label for each terminal point. Each terminal will provide a binary output for the FMCS to read. Refer to Specification Section 23 09 00 for alarms reported by the FMCS.

2.6 ACCESSORIES

A. Generator Circuit Breaker: Molded or insulated case, service-rated thermal-magnetic electronic trip type; 100% rated breaker complying with NEMA AB1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator is shut down by other protective devices.

4. Mounting: Provide freestanding enclosure or mount integrally with control and monitoring panel.

5. Arc Energy Reduction: Provide and arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy system shall be provided for overcurrent protection devices rated 1200 amps or larger.

B. Remote Manual Stop Station (Emergency Power Off EPO): Provide a remote manual stop station with weather proof stainless steel or die cast housing, red mushroom button - push to stop operation, breakable cover/lens to access mushroom button, 120-volt rated. The manufacturer shall provide automatic monitoring of the EPO switch. Placing the EPO switch in the "Generator Powered OFF" status shall initiate a visual and audible alarm at each generator annunciator panel.

C. Remote Fuel Fill Station: Provide a remote fuel fill station including a fill port within a surface-mounted, lockable, NEMA 3R stainless steel construction with gasketed hinged door and lockable handle. The fill port shall have a minimum overflow holding capacity of five (5) gallons. The fill port inside the cabinet shall be field coordinated. Provide dust cover for fill connection. Include local light and horn alarm with test switch and silence feature when tank level is above 95 percent full. Provide additional float switch in tank for level indication. Include the following accessories:

1. Solenoid valve to prevent additional fuel delivery to the tank when full; 120-volt power provided by Contractor.

2. Lockable drain valve for overflow.

3. Local analog gauge of main tank fuel level.

4. Local digital gauge of main tank fuel level.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE SKIN-TIGHT

A. Prefabricated or pre-engineered skintight enclosure with the following features:

1. Construction: Reinforced galvanized steel, metal clad, integral structural steel framed housing anchored to a concrete foundation. Construction shall allow access to control panels and service points. The panels shall enclose all components, including intake/exhaust louvers and sound attenuators. Extend the enclosure base frame as required for panels.

2. The generator control panel shall be located no greater than 5’-0” above finished grade for ease of access.

3. Structural Design and Anchorage: Wind resistant up to 100 mph.

4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents. Motor operators shall be spring open, power close operating at 24 volts DC. The louvers shall be connected to the generator starting batteries through appropriate control relays.

5. Hinged Doors: Provide a minimum of four doors with padlocking provisions. Single doors shall be 36" wide and 84" high. Double doors shall be 60" wide and 84" high. As standard, doors shall include rain-rail moldings above all door openings, recessed, keyed mortise locks, panic bar door hardware and full weather-stripping. Doors shall be removable.

6. Thermal Insulation: Manufacturer’s standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits as required by engine-generator-set components.

7. Fuel Tank Vent: Provide vent piping from the fuel tank to the exterior of the enclosure.

8. Fuel Fill: Provide fill access on the exterior of the enclosure at an elevation not to exceed 5’-0” above finished grade.

9. The exhaust system silencer shall be installed within the enclosure housing.

2.8 SITE COORDINATION

A. Generator to property line distance: 10 feet

END OF SECTION

SECTION 26 3353

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Static uninterruptible power supply.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - STATIC UNINTERRUPTIBLE POWER SUPPLY

A. Liebert, Emerson Network Power

B. Eaton Corporation

C. Schneider Electric

D. General Electrical (GE Critical Power)

E. Mitsubishi Electric Power Products, Inc.

F. Active Power

2.2 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

A. System Continuous Rating: As shown on the drawings, over entire battery voltage range at specified power factor. Maintain output voltage within specified limits at any load from full load to no-load.

B. Battery Capacity: Capable of operating at full load for 30 minutes.

C. Voltage Rating: 480Y/277 volts, 3 phase input; 480Y/277 volts, 3 phase output.

D. Input Voltage Limits: +10 percent/-15 percent without battery discharge.

E. Input Frequency: 60 ±6 Hertz.

F. Input Current Limit: Adjustable to maximum of 120 percent of that required to operate at full load with battery bank on float charge.

G. Current Walk-In: 25 to 100 percent in 30 seconds (programmable).

H. UPS Power Factor Over Full Range of Loads and Input Voltages: 0.99 lagging.

I. Harmonic Distortion of Input Current Wave Form: 5 percent maximum at full load.

J. Output Voltage Regulation:

1. ±0.5 percent for balanced load, full range of DC input and no load to full load variations.

2. ±2 percent for 50 percent unbalanced load, full range of DC input and no load to full load variations.

3. ±5 percent during maximum overload of the system.

K. Output Voltage Adjustment: ±5 percent.

L. Output Free Running Frequency: 60 Hertz ±0.1 percent.

M. Frequency Adjustment: ±2 Hertz.

N. Output Harmonic Distortion: Maximum 5 percent rms total harmonic distortion (THD) and maximum 3 percent any single harmonic, at rated frequency and voltage, from 10 percent load to full load and over battery voltage range, measured into a linear load.

O. Voltage Transient Response for Application of 0 to 50 Percent, 50 to 100 Percent, 100 to 50 Percent, and 50 to 0 Percent Step Loads, and Transfer to and From Bypass Line:

1. +8, -10 percent for a maximum of 8.3 milliseconds.

2. ±5 percent for a maximum of 25 milliseconds.

3. ±3 percent for a maximum of 50 milliseconds.

4. Recovery to steady state within 100 milliseconds after any out-of-tolerance variation.

P. Phase Displacement:

1. 120 ±1 degree for balanced loads.

2. 120 ±4 degrees for 50 percent unbalanced loads.

Q. Three-phase Overload Ratings:

1. 1000 percent for 10 ms; via static switch.

2. 110 percent continuous.

R. Output Current Limit: 110 percent of rated output current.

S. Voltage Unbalance: 3 percent maximum line-line with 100 percent load unbalance.

T. Efficiency: 96 percent at full load. 96.5 percent @ 50% load.

U. Surge Protection: IEEE 587, Class A & B.

2.3 PHYSICAL CHARACTERISTICS

A. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service, except as required during factory testing. All active electronic devices shall be solid-state. All power semi-conductors shall be hermetically sealed. All relays and semi-conductors shall be dust-tight.

B. Wiring: Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA, and applicable local codes and standards. All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked.

C. All power, control, and printed circuit components shall be mounted in bolt-on and/or swing-out type assemblies for ease of maintenance and replacement. Replacement of components shall not require the use of a soldering iron.

D. Construction and Mounting: The UPS shall be NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling. Wire runs shall be protected in a manner which separate power and control wiring. Provisions shall be protected in a manner which separate power and control wiring. Provisions shall be made in the cabinets to permit installation of input, output, and external control cabling, using raceway or conduit.

E. Ventilation: Adequate ventilation shall be provided to ensure that all components are operated within environmental ratings. Cooling fans shall be redundant. All fans are to be equipped with fan failure sensors connected to an alarm on the UPS control panel.

F. Temperature sensors shall be provided to monitor UPS internal temperature. Upon detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded on the UPS control panel. A separate room ambient temperature sensor shall be provided to give an alarm if the temperature of the inlet air to the UPS is above specified limits.

2.4 RECTIFIER/CHARGER

A. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter and for charging the battery.

B. Input Circuit Breaker: Internally mounted circuit breaker shall be of the frame size and trip rating to supply full rated load and recharge the battery at the same time. The circuit breaker shall have a shunt trip device operated by internal UPS control equipment.

C. Transformer: A dry power transformer of the isolated winding type with vacuum impregnated windings shall be used. It shall be all copper wiring and have one 5% tap below and one 5% tap above rated voltage. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material when operating full load at maximum ambient temperature.

D. Battery Charge Current Limiting: The rectifier/charger shall be equipped with a battery charge current limit circuit that shall limit battery charging to an adjustable level of 2% to 25% of full rectifier input current. The circuit shall have a second adjustment to provide greater limiting when signaled by the emergency generator. This circuit shall allow input power limiting but shall not cause battery discharge when a low AC input voltage condition occurs. Battery charge current limit is to be set at 15% for normal operation and 2% for "generator" operation. Electrical Contractor shall make required connections to generator.

E. Input Current Walk-In: The rectifier/charger shall provide feature which upon AC power return to the AC input bus, after the UPS has been operating on battery power or has been de-energized, limits the total initial power requirement at the input terminals to 20% of rated load, and gradually increases power to 100% of full rating over the 15-second time interval.

F. Fuse Failure Protection: Semi-conductors in the rectifier/charger shall be fused with fast-acting fuses so that loss of any semi-conductor shall not cause cascading failures. All fuses shall have a blown fuse indicator with an alarm light on the control panel.

G. Output Filter: The rectifier/charger shall have an output filter to minimize ripple current into the battery. Under no conditions shall ripple current into the battery exceed 2% RMS. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier with the battery disconnected.

H. Battery Recharge: In addition to supplying power for the load, the rectifier/charger shall be capable of recharging the battery as specified herein. The charging rate shall be sufficient to restore the battery from discharge to 95% charge within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

I. Battery Equalize Charge: An automatic equalize charge timer feature shall be provided to automatically apply an equalize voltage to the battery after a 5 second or longer utility outage. The duration of equalize charge time shall be adjustable from 0-72 hours. Manual override shall be provided for the automatic equalize circuit.

J. Over-voltage Protection: There shall be DC over-voltage protection so that if the DC voltage raises to the pre-set limit, the UPS is to shut down automatically and the load transferred to the bypass line uninterrupted.

2.5 INVERTER

A. The term inverter shall denote the equipment and controls to convert DC from the rectifier/charger or battery to precise AC to power the load. The inverter shall be solid-state, capable of accepting the rectifier/charger or battery output and providing rated output. The inverter is to be power SCR type, six (6) twelve (12) pole design. power transistor type, phase controlled pulse width modulated (PWM) design.

B. Overload Capability: The inverter shall be able to sustain an overload across its output terminals up to 150% for 30 seconds without reducing output voltage. The inverter shall be capable of at least 300% current for short circuit conditions. If the short circuit is sustained, the inverter shall shut down and disconnect automatically from the critical load bus.

C. Output Frequency: Output frequency of the inverter shall track the static bypass source provided source frequency maintains 60 Hz ± 0.5 Hz to maintain synchronous operation for automatic transfers. If the bypass source fails to maintain proper frequency then control shall revert to an internal oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady-state and transient conditions. Drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

D. Phase Balance: Electronic controls must be used to provide individual phase voltage compensation to obtain phase balance under all conditions including up to 50% load unbalance.

E. Internal Protection: Fault sensing and static isolation shall be part of the inverter as well as an output circuit breaker for removal of a faulted module from the load, without affecting the critical load but beyond the stated limits.

F. Fuse Failure Protection: Semi-conductors in the inverter shall be fused with fast acting fuses to prevent cascading failures. Each fuse shall be provided with blown fuse indicator with an alarm light on the control panel.

G. Output Circuit Breaker: Internally mounted circuit breaker shall be of the frame size and trip rating to supply full rated load. The circuit breaker shall have a shunt trip device operated by internal UPS control equipment.

H. Load Sharing: The inverter shall be capable of load sharing operation with like UPS modules without the use of master controls, oscillators, or sharing reactors. The inverters shall load share to within ± 5% of the average individual inverter load current.

I. Output Power Transformer: A dry power transformer of the isolated winding type with vacuum impregnated windings shall be used. It shall have copper wiring exclusively. The transformers hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material when operating at full load at maximum ambient temperature.

J. Output Filter: The inverter shall have an output filter to maintain the total harmonic distortion (THD) of the output voltage to the specified limits.

2.6 SYSTEM PROTECTION

A. Built-in Protection: Against surges, sags, and over-current from the AC source, over-voltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.

B. The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions.

C. Fast-acting current limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping. The load shall be automatically transferred to the bypass line uninterrupted for an internal UPS malfunction. Open protective devices shall be indicated by Light Emitting Diodes (LEDS) on the control panel.

2.7 DISPLAY AND CONTROLS

A. The term UPS Module Control Panel, as used herein, denotes that portion of the UPS module containing the display screen and control functions. The display panel shall be liquid crystal type to provide complete monitoring and control using menu-prompted commands. Switches shall be used to select and execute operations from a Master Menu. The display and control panel shall be mounted on the control section door.

B. UPS module system logic and control programming shall be resident in Application Specific Integrated Circuits. Logic components shall be physically isolated from heat sources and voltage hazards. There shall be two power supplies for the logic and control circuits, one connected to the input AC source and the other connected to UPS module output.

C. Monitoring: UPS module monitoring shall be provided by a microprocessor-based graphic display capable of simultaneously reporting input and output and battery voltage and current; output frequency and total load KVA and KW for all three phases, within 1% accuracy.

1. History File: The control system shall maintain this information in discrete windows updating memory on a First-In First-Out basis. This shall provide status recall of a period of at least 256 milliseconds (64 windows); 160 milliseconds before the malfunction (40 windows), and 96 milliseconds after the malfunction (24 windows).

2. Power Flow Indication: Power flow indicators shall graphically depict whether the load is being supplied from UPS, bypass or battery and provide, on the same screen, input, output and battery voltage, amperages, frequency, KVA and KW. The following components must be indicated:

    a. AC Input Circuit Breaker

    b. Battery Circuit Breaker

    c. Inverter Output Circuit Breaker

    d. Bypass Switch

    e. Static Transfer Switch (Off-Line/Available)

3. Battery Status Indicator: The battery status indicator shall display DC alarm and shutdown voltages and maintain the battery voltage drop during discharge. Battery time remaining after a power outage shall be graphically displayed to permit prediction of battery shutdown.

D. Alarms: The control panel shall report the system level alarms listed below. An audible alarm is to be activated when any of the above alarms occur. All alarms shall be displayed in text form.

1. Input Power Fail

2. Output Overload

3. Overload Shutdown

4. Overload Transfer

5. Emergency Power Off

6. DC Over Voltage

7. DC Cap Fuse

8. Ambient Over-temp

9. UPS Over-temp

10. Over-temp Shutdown

11. Low Battery Reserve

12. Battery Disconnected

13. Battery Discharging

14. Rectifier Fuse Failure

15. Inverter Fuse Failure
16. Fan Failure
17. Static Switch Disabled
18. Bypass Not Available
19. Auto Transfer to Bypass
20. Reverse Power
21. Control Power Failure
22. Load on Bypass
23. Output Over/Under Voltage

E. Controls: System level control functions shall be:

1. UPS/Bypass Transfer Pushbuttons.
2. AC Output Voltage Adjust 5%.
3. Battery Circuit Breaker Trip Pushbutton.
4. Emergency Power Off Pushbutton with Protective Cover.
5. Alarm Silence Pushbutton.
6. Control Enable Pushbutton.
7. Display Control Switches.
8. Alarm Reset Switch.

F. Manual Procedures: Start-up, load transfers, and shutdown procedures shall be detailed on the display panel in text and graphic form.

1. Start-Up:
    a. Step-by-step procedure screen.
    b. Walk-in display screen to simultaneously indicated DC volts, output volts, and input phase amps.
    c. Mimic screen to indicate power flow.
2. Load Transfers:
    a. Step-by-step procedure screen.
    b. Mimic screen to indicate power flow.
3. Shutdown:
    a. Step-by-step procedure screen.

b. Mimic screen to indicate power flow.

G. Emergency Power Off: The UPS control panel shall have a local emergency shutdown. Pressing the emergency shutdown shall cause:

1. Uninterrupted transfer of the load to bypass.

2. The input, output, and battery breakers.

3. Power off circuit, which completely removes power from the critical bus when activated.

H. Self-Diagnostics: The UPS module shall be provided with the following built-in diagnostics for troubleshooting and circuit alignment aids:

1. Rectifier in control mode.

2. UPS synchronizing with critical load bus.

3. Positive DC bus ground fault.

4. Negative DC bus ground fault.

5. Bypass frequency higher than system output frequency.

6. Bypass frequency lower than system output frequency.

7. Automatic static transfer lockout.

8. Command given to close inverter output circuit breaker.

9. Command given to close bypass switch.

10. Command given to open inverter output circuit breaker/bypass switch.

11. Degree of overload.

12. Under-voltage trip for battery disconnect switch.

13. Under-voltage trip for input circuit breaker.

I. Remote Monitoring Capability: UPS control circuits shall be interfaced with the site central monitoring system (CMS). Interface shall be built into the UPS. The site monitoring signal processing module shall be factory installed. The following shall be available for display:

1. Metering:

a. Bypass volts (line-line, all phases)

b. Critical bus volts (line-line & line-neutral, all phases)

c. Critical bus current (all phases)

d. Critical bus frequency

e. Critical bus KVA

f. Critical bus KW

g. DC volts

h. Battery amps (±)

i. % Capacity

2. Digital Alarms:

a. Fuse Cleared

b. Output Overload

c. Emergency Power Off

d. Ambient Over-temp

e. Battery Flywheel Discharging

f. Low Battery Reserve

g. Load On Bypass

h. Static Switch Disabled

i. Battery Flywheel Disconnected

j. Module Cooling Failure (Fan Failure or Over-temp)

k. Control Power Failure

3. Alarm Outputs: The following will have a N.O. isolated contact for remote indication on the RTU provided by others. Electrical Contractor shall route conduit and wire, make all connections.

a. UPS System Mode

b. Battery Flywheel Discharging

c. Low Battery Reserve

d. UPS Alarm Condition

J. Communication Port: The UPS shall be provided with an RS-232 port capable of interfacing with a remote location. All monitoring information shall be capable of being downloaded to remote device.

2.8 STATIC TRANSFER SWITCH

A. The term static transfer switch shall denote the solid-state device that automatically transfers the critical load to bypass without interruption if the UPS cannot supply continuous power. The term bypass switch shall denote the electromechanical device that will connect the load to bypass. Automatic load transfers are to be initiated when a malfunction occurs within the UPS or a sustained system overload occurs.

B. Momentary Overloads: In the event of a branch load circuit fault or load current inrush, the static transfer switch is to pulse-on for at least 40 milliseconds allowing at least 1000% load current to flow from bypass line to clear the overload. If the overload is cleared, a load transfer shall not be made. If the overload is not cleared, then the transfer is to be accomplished maintaining load voltage within specified limits.

C. Automatic Closing: The static transfer switch is to be of the energy saving type. Once the load is transferred to the bypass line by the static transfer switch, the bypass switch is to automatically close removing the static transfer switch from the power flow.

D. Manual Transfers: A manual load transfer between the UPS and bypass line is to be initiated from the control panel. All transfers from bypass to the inverter shall be manually initiated.

E. Switch Isolation: The static switch SCR device shall include series connected switch/circuit breaker and backfeed circuit monitoring per UL Standard 1778 for automatic (and manually) initiated circuit isolation of static switch SCR device.

2.9 BATTERY DISCONNECT BREAKER

A. The UPS shall have a properly rated circuit breaker (500 VDC) to isolate it from the battery.

B. The switch shall be in the battery compartment of the UPS module housing. When open, there shall be no battery voltage in the rectifier/inverter compartment.

C. The UPS shall automatically be disconnected from the battery by opening the switch when the battery reaches the minimum discharge voltage level or when signaled by other control functions.

D. The UPS shall be provided with a pushbutton to trip the breaker from the control panel.

2.10 BATTERY

A. Storage Battery: Valve regulated (sealed, reduced maintenance) type. Maximum specific gravity of 1.3, and minimum cell end voltage of 1.65 volts. Heavy duty industrial design. Provide with impact resistant plastic case which meets or exceeds 94V2 to meet UL Standard 1778 requirements.

B. Batteries shall be furnished with flame arrestors, lead covered solid copper terminal posts, and transparent container to allow visual inspection of the plates and sediment spaces.

C. Battery system shall be furnished as a part of the UPS system and sized to maintain the rated UPS system load output for the specified duration. Submit battery Amp-hour rating, cell end voltage, specific gravity, and battery system calculations with shop drawing submittals.

D. Battery system design life shall be 10 years under full float operation and shall be provided with a pro rata cycle duty warranty based on the following discharges at the 15-minute rate:

	CYCLE DURATION			
NUMBER OF CYCLES	**0 to 30s**	**30s to 1M**	**1M to 5M**	**5M to 15M**
	3,700	1,125	410	225
	2,700	600	200	120
	10,500	2,100	660	300
	4,571	2,560	853	481

E. The battery system shall provide 100% of specified capacity at initial start-up.

F. Batteries shall be mounted on slide out racks in battery compartment of UPS module enclosure.

G. Rack system shall be painted with corrosion resistant paint and supplied with all required lead plated copper bolted connectors, terminal lugs, cable supports, rack mounting bolts, and accessories. Provide acid resistant aisle matting adjacent to racks.

H. Racks shall be sized to fit into battery room as shown on the drawings and configured to hold batteries totaling 250 VDC maximum. Contractor shall size conductors and conduit between UPS and battery disconnect breaker, and between battery disconnect breaker and battery racks as required by UPS supplier. All cables leaving a continuous rack area shall be in conduit.

I. Provide the following battery system accessories:

1. Set of battery identification numbers.

2. Battery arrangement and wiring diagram indicating battery numbers.

3. Lifting strap and spreader block.

4. Anti-corrosion compound.

2.11 EMERGENCY POWER OFF

A. The UPS shall include an Emergency Power Off (EPO) circuit. Activating this circuit shall cause immediate shutdown of all UPS operations. This operation will shut down the critical load.

B. The UPS module shall include provisions to activate the EPO circuit remotely by a contact closure.

END OF SECTION

SECTION 26 3600

TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Automatic transfer switch

B. Manual transfer switch

C. Remote annunciator for ATS

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. ASCO.

2.2 AUTOMATIC TRANSFER SWITCH

A. Description: NEMA ICS 2; automatic transfer switch.

B. Configuration: Electrically-operated, mechanically-held transfer switch.

C. Control panel shall be micro-processor based.

2.3 AUTOMATIC TRANSFER

A. Description: NEMA ICS 2; automatic transfer switch

B. Configuration: Draw-out type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST, and DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch.

2.4 MANUAL TRANSFER SWITCH

A. Description: NEMA ICS2; manual transfer switch.

B. Configuration: Manually-operated, three-position center-off transfer switch.

C. Engine start switch.

2.5 SERVICE CONDITIONS

A. Service Conditions: NEMA ICS 1.

2.6 RATINGS

A. The transfer switch shall be series rated with the equipment feeding the transfer switch. The series rating shall be the larger of the two AIC values when the AIC rating of the equipment feeding the normal and emergency sides of the transfer switch is not equal.

B. Series rating with upstream devices shall be allowed per UL-1008.

2.7 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

B. Time Delay to Start Alternate Source Engine Generator: 0 to 10 seconds, adjustable.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay Before Transfer to Alternate Power Source: 0 to 30 seconds, adjustable.

E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

F. Time Delay Before Transfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, of unloaded operation.

2.8 ENCLOSURE

A. Enclosure: NEMA ICS 6; Type 1.

2.9 ACCESSORIES

A. Load Shed:

1. The controller shall be capable of being programmed to automatically shed the connected load from the generator in the event of a user configurable under-frequency, under-voltage or overload condition. Under-frequency shedding shall occur if generator is less than 58Hz for greater than 3 seconds or less than 50 Hz for greater than 0.5 seconds.

2. Switch shall be configurable to pick up an output status relay upon activation of the auto load shed feature. Output shall be usable to trip/isolate downstream loads in the event of an overload.

3. Reset of the auto load shed function shall be via operator reset on display, remote reset contact input, or via network signal.

B. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.

C. Test Switch: Key operated or password protected switch. Mount in cover of enclosure to simulate failure of normal source.

D. Engine Start Signal: Rated 10 amps at 30VDC shall be provided to start the engine generator in the event of a normal source outage.

E. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

F. Transfer Switch Auxiliary Contacts: 2 normally open; 2 normally closed indicating switch to normal source or emergency source.

G. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 Hertz from rated nominal value, values shall be field adjustable.

H. Alternate Source Monitor: Monitor each line of alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent Hertz from rated nominal voltage, values shall be field adjustable.

I. Engine Exerciser: Start engine every 28 days. Run for 30 minutes before shutting down. Each event shall be configurable for Test with Load or Test Without Load. Bypass exerciser control if normal source fails during exercising period.

J. In-Phase Monitor: Inhibit transfer until source and load are within 30 electrical degrees.

K. Provide 2 N.O. and 2 N.C. isolated contacts to indicate:

1. Normal source available.

2. Emergency source available.

3. Exercise mode in operation.

L. Serial Communication Port: Two twisted pairs of shielded communication cable in conduit shall daisy chain all transfer switches with a remote annunciator.

M. Remote Annunciator: A remote annunciator shall be provided that shall monitor and control the following functions for each transfer switch:

1. Load Connect to Emergency/Normal Indication

2. Source Available: Emergency/Normal Indication

3. Time Delay Indication and Key Locked Bypass Switch

4. Transfer Test Indication and Key Locked Switch

5. Remote transfer loads between normal and emergency sources with Key Locked Switch

6. Remote generator start with Key Locked Switch

7. Remote generator stop with Key Locked Switch

N. Annunciators shall be located as directed by the Owner. Extend conduit and wire as required by the manufacturer.

O. An adjustable emergency to normal pre-signal signal to elevator controller.

P. Metering Capabilities: The following metered readings shall be available at the local display. [The metering information shall also be shared by serial connection to the master control cubicle of the emergency power paralleling equipment.]

1. Current, per phase RMS and neutral

2. Current unbalance %

3. Voltage, phase-to-phase and phase-to-neutral

4. Voltage unbalance %
5. Real power (KW), per phase and 3-phase total
6. Apparent power (KVA), per phase and 3-phase total
7. Reactive power (KVAR), per phase and 3-phase total
8. Power factor, 3-phase total & per phase
9. Frequency
10. Accumulated energy, (KWH, KVAH, and KVARH)
11. Demand, (KWH, KVA)

END OF SECTION

SECTION 26 4200

CATHODIC PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies complete galvanic sacrificial anode type cathodic protection systems for underground steel tanks and piping. The section also includes devices to electrically isolate the system being protected.

B. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water Fire Protection Force, Main Gas lines, their connectors and lines under the slab or floor foundation. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing the pipe shall have a test station.

PART 2 - PRODUCTS

2.1 ANODES

A. Type: Type II, factory-packed in cloth bag or box containing prepared backfill mixture, with lead wires.

B. Construction:

1. Alloy Specifications:

Element	Percent of Weight
Aluminum	0.010 Max.
Manganese	0.50 - 1.30
Zinc	0.05 Max.
Silicon	0.50 Max.
Copper	0.02 Max.
Nickel	0.001 Max.
Iron	0.03 Max.
Other	0.30 Max.
Magnesium	Remainder

2. Core: Galvanized steel.

3. Lead Wire: Factory installed, No. 12 solid copper, 3 M (10 feet) long, with TW or THWN insulation.

4. Lead Wire Attachment to Core: Silver solder the lead wire to the anode core and seal the connection with an epoxy sealing compound. Dielectric material shall extend past the connection and cover the lead wire insulation by not less than 12 mm (1/2 inch).

5. Packaging: Permeable cloth bag or box with backfill mixture completely surrounding anode 12 mm (1/2 inch) minimum.

a. Components:

Hydrated Gypsum	75 percent
Powdered Bentonite	20 percent
Anhydrous Sodium Sulphate	5 percent

b. Center the anode in the firmly packed backfill using spacers. Overall dimensions of the bagged pound anode shall be inches by inches nominal.

2.2 INSULATED CABLE

A. Single conductor, stranded, annealed copper, Type HMWPE (high molecular weight polyethylene) insulation.

B. Construction:

1. Thickness of insulation:

AWG-SIZE	mm (inches)
No. 8	2.8 (7/64)
No. 6	2.8 (7/64)
No. 4	2.8 (7/64)
No. 2	2.8 (7/64)
No. 1	3.2 (8/64)
No. 1/0	3.2 (8/64)

2. Insulation: ASTM D1248, Type 1, Class C, Category 5, Grade E5.

3. Conductors: ASTM B8.

C. Lead wires terminating at a junction box or test station shall have a cable identification tag.

2.3 CABLE CONNECTIONS

A. Connections between cables and tank, pipes, casings, or structures shall be exothermic welding process. Connections between cables and between cables and leads shall be corrosion-resistant split bolts.

B. Insulation of Cable-to-Cable Connections: Epoxy-resin splice kits with two-part resin, mold, sealing mastic.

C. Coating of Cable Connections to Protected Structures: Field-applied coating similar to that on the protected structure.

2.4 CABLE AND WIRE IDENTIFICATION TAGS

A. Laminated plastic material with black letters on a yellow background Brass material with engraved letters. Print letters and numbers a minimum of 5 mm (316 inch) in size. Provide identifier legend in accordance with the drawings.

2.5 TEST STATIONS

A. Type: Weatherproof, located at grade, or aboveground if so shown on the drawings. Enclosed terminals for anode leads, test leads, leads attached to protected system, and connection points for test instruments.

B. Construction:

1. Housing: The unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with locking cover, terminal board, shunts, and brass or stainless steel hardware.

2. Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic. Insulated terminal boards shall have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper bus bars, shunts, and variable resistors on the terminal board as indicated.
Test station terminal connections shall be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, and reference electrodes). Conductors shall be permanently identified by means of tags to indicate termination. Each conductor shall be color coded as follows:

a. Anode lead wire - black

b. Structure lead wire – white

c. Reference electrode lead wire - red//

2.6 DIELECTRIC TAPE

A. Vinyl plastic electrical tape, 0.18 to 0.25 mm (7 - 10 mils) thick, pressure-sensitive adhesive.

2.7 WARNING TAPE

A. 50 mm (2 inches) wide, detectable with metal detector, mylar-encased aluminum, orange color, imprinted "Cathodic Protection Cable Below" or similar.

2.8 DIELECTRIC INSULATION

A. Rubber-based, 3 mm (0.125 inch) thick.

END OF SECTION

SECTION 26 5100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories

B. Lamps

C. Ballasts

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

B. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction. Provide ballast covers to separate inboard/outboard lamps when multi-level switching is indicated, so light does not spill into unlit cells.

C. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.

D. Exit Signs: Stencil single or double face, 6-inch high letters with green color, with or without directional arrows, universal mounting type as indicated on the drawings.

E. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

F. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes used in interior applications shall have a minimum color rendering

index (CRI) of 80. Color temperature of the luminaires shall be 4000 Kelvin (in accordance with the specific requirements for a given space).

B. LED luminaires shall have a minimum efficacy of 100 lumens per watt.

C. LED chip arrays specified as color changing shall have chip colors.

D. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

E. Luminaire minimum lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.

F. LED luminaires shall have a total harmonic distortion (THD) of 20% or lower.

G. LED luminaires shall have a power factor of 0.9 or above.

H. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have over heat, short-circuit, and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities.

3. Driver shall have a minimum of 50,000 hours rated life.

I. Luminaires shall conform to Title 24 lighting and lighting control standards.

J. LED luminaire shall have a minimum warranty of 5 years if available.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All light fixtures shall to be in area of easy access for maintenance. No overhead light fixtures over the raised floor if possible.

B. All selected light fixtures shall have minimum effort in luminaire repair/replacement.

END OF SECTION

SECTION 26 5200

EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency lighting units with self-test capability

B. Emergency exit signs with self-test capability

C. Emergency fluorescent lamp power supplies

D. Emergency inverters for LED and compact fluorescent

E. Emergency transfer devices

PART 2 - PRODUCTS

2.1 INCANDESCENT EMERGENCY LIGHTING UNITS

A. Emergency Lighting Unit: Self-contained unit with rechargeable storage batteries, charger, and lamps.

B. Battery: Maintenance free lead calcium type, with 1.5-hour capacity to supply the connected lamp load.

C. Charger: Dual-rate solid state current limiting charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charged within 168 hours. Low voltage disconnect to prevent deep discharge of battery.

D. Lamps: As scheduled on luminaire schedule.

E. Remote Lamps: Match lamps on unit.

F. Indicators: Provide lamps to indicate AC ON and RECHARGING. Provide voltmeter.

G. Provide test switch to transfer unit from normal supply to battery supply.

H. Accessories: _____. Time delay relay for HID lighting areas.

I. Electrical Connection: Knockout for conduit connection.

J. Unit Voltage: 120 277 volts, AC.

K. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.

L. Unit shall be programmed to exercise the battery and test emergency operation by performing a five-minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five-minute discharge/diagnostic test at any time.

M. Warranty: Emergency lighting unit shall have a full three (3) year, non-prorated warranty.

2.2 SELF-CONTAINED EMERGENCY POWER EXIT SIGNS

A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully-automatic two-rate charger.

B. Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for 10 years under normal conditions.

C. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all requirements of NFPA 101.

D. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.

E. Unit shall be programmed to exercise the battery and test emergency operation by performing a five-minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five -minute discharge/diagnostic test at any time.

2.3 ACCEPTABLE MANUFACTURERS - EMERGENCY BALLASTS AND INVERTERS

A. Philips/Bodine.

B. Dual-Lite.

C. Iota.

2.4 EMERGENCY BALLAST - FLUORESCENT LAMPS

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation.

B. Battery: Sealed, high temperature, maintenance free, field replaceable, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with solid state LED charging indicator light, test switch, electronic circuitry for use with electronic energy saving magnetic dimming ballasts.

D. Ballast to be mounted inside ballast channel of remote to luminaire shown on drawings.

E. Charging indicator LED to be mounted above fixture lens louver in corner of fixture viewable from ground level.

OR

F. Charging indicator LED to be mounted in remote test monitor plate (provided with ballast where shown on drawings.

G. Ballast capable of operating one or two lamps of a switched or unswitched luminaire with a minimum lumen output as specified below:

Lamp	*A*	*B*
F025, FB024 T8	2250	1150

F032, FB-31 T8	3000	1350
F096 T8	3000	1400

H. Unit to be provided with microprocessor based self-diagnostic capability, continually monitoring charging current and battery voltage, and testing of emergency operation a minimum of 30 seconds every 30 days and 90 minutes once per year. Provide with user-selectable audible failure feature and flashing failure indicator. Self-test routine to meet NFPA Life Safety Requirements.

I. Warranty: Emergency ballast shall have a full five (5) year, non-prorated warranty.

2.5 EMERGENCY BALLAST - COMPACT FLUORESCENT LAMPS

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory of field installation.

B. Battery: Sealed, high temperature, maintenance free, field replaceable, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use with electronic 4-pin and triple tube energy saving dimming ballasts.

D. Ballast to be mounted remote and adjacent to luminaire shown on drawings. Ballast to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test monitor plate (provided with ballast), where shown on the drawings.

F. Ballast capable of operating one or two lamps of a switched or unswitched fixture with minimum lumen output as specified below:

Lamp	Total Lumens	
	1 Lamp	2 Lamps
PL-T 32W, DULUX T/E 32	575	750
PL-T 26W, DULUX T/E 26, F26TBX	450	725
PL-T 18W, DULUX T/E 18, F18TBX	300	525
PL-C 26W, DULUX D/E 26, F26DBX	600	700
PL-C 18W, DULUX D/E 18, F18DBX	475	575
PL-C 13W, DULUX D/E 13, F13DBX	350	425
PL-L 36W, DULUX L 39, F39/36BX	575	750
PL-L 24W, DULUX L 27, F27/24BX	475	550
PL-L 18W, DULUX L 18, F18BX	350	400

G. Warranty: Emergency ballast shall have a full two (2) year, non-prorated warranty.

2.6 EMERGENCY INVERTER – LED AND COMPACT FLUORESCENT LAMPS UP TO 20 WATTS

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use with ballasts, and LED drivers. Output of inverter shall be sinusoidal with solid-state low voltage disconnect circuit.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test/monitor plate provided with inverter, where shown on the drawings.

F. Inverter capable of operating a switched, dimmed or unswitched luminaire up to 20 watts with full lumen output.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.7 EMERGENCY LED DRIVER

A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation in indoor and damp locations.

B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life expectancy.

C. Features: Integral battery charger with LED charging indicator light, test switch, and electronic circuitry for use with LED drivers.

D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from below ceiling through luminaire opening.

E. Charging indicator LED and test switch to be mounted in remote test/monitor plate, where shown on the drawings.

F. Inverter capable of operating a switched, dimmed, or unswitched luminaire up to 7 watts at a rated current of 270mA.

G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

2.8 EMERGENCY TRANSFER DEVICES

A. Loss of power on normal circuit shall switch load to emergency power source.

B. Provide suitable NEMA 1 enclosure and mounting per manufacturer specification.

C. Emergency Lighting Control Override - Single Luminaire:

1. Rated 2 amps at 120 volt incandescent and 10 amps at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD, Iota ETS, Watt Stopper ELCU-100.

D. Emergency Lighting Control Override - Branch Loads:

1. Rated 1000 watts at 120 volt incandescent and 20 amp at 277 volt fluorescent.

2. Approved Manufacturers: Bodine GTD20, Chloride Lightstar, Dual-Lite ATSD, Nine24 BLTC, Highlites HEPC.

END OF SECTION

SECTION 26 5600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Parking lighting and security walkway lighting

B. Lamps

C. Ballasts

D. Poles

PART 2 - PRODUCTS

2.1 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible location to meet depth specified.

B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.

C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.

2.2 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70 and color temperature of 4000 K.

B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.

C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

D. Luminaire minimum lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.

E. Photometry for LED luminaire to follow IES recommendations for testing.

F. LED products shall have minimum 5 years warranty.

G. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have over heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.

3. Driver shall have a minimum of 50,000 hours rated life.

2.3 ACCEPTABLE MANUFACTURERS - POLES

A. Manufacturer of Luminaire.

B. Valmont Poles.

C. U. S. Pole Company.

D. KW Industries

2.4 LIGHTING POLES

A. Metal Poles: Round straight steel lighting pole with embedded anchor base.

B. Prestressed Concrete Poles: Round straight lighting pole with embedded anchor base.

C. Wind Load: 100 MPH velocity, with 1.3 gust factor with luminaires and brackets mounted.

D. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.

E. Pole Top: Provide mast arm(s) in array as indicated.

F. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.

G. Vibration Damper: Canister or snake type second mode vibration damper internal to the pole as recommended by pole manufacturer. Provide additional pole top damper for first mode vibration on single-head poles where recommended by manufacturer.

END OF SECTION

SECTION 26 5668

EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires and accessories

B. Interior luminaires and accessories

C. Lamps

D. Ballasts

E. Blackout shutters indoor applications

F. Mounting hardware indoor applications

G. Poles outdoor applications

H. Wireless lighting control

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Outdoor

1. Musco

2. GE Sports Lighting Powerspot III New glare ‘SLOG’ with Spill/Glare control.

3. Qualite PRO-Series with Spill/Glare control.

4. Hubbell Sportsliter System SLS series with Spill/Glare control.

B. Indoor:

1. WideLite Arena Eclipse II with Shutter System.

2. Sterner Para II with motorized shade.

2.2 GENERAL

A. Manufacturer shall have a minimum of 5-years’ experience in the design, manufacturing, and installation support of their sports lighting system.

B. Sports lighting system shall be ETL or UL listed as a complete system.

C. Outdoor Fixtures and structural system shall withstand 100 mph constant wind forces with a 1.3 gust factor without misalignment to crossarms or individual fixture aiming.

D. Manufacturer shall provide a minimum of 5-year warranty, from date of Owner accepted

installation, against defects in material. All parts and labor to replace will be at no cost to the Owner. The alignment/aiming of individual fixtures shall be warranted against any movement over this same 5-year period.
Lamps shall be warranted for two years from date of Owner accepted installation. Lamps failed within this time shall be replaced and installed at no cost to the Owner by the sports lighting manufacturer.

2.3 PERFORMANCE DESIGN CRITERIA

A. Outdoor

1. Calculations for Outdoor Baseball Fields, Football Fields, Soccer Fields, and Tennis Courts:

a. Photometric analysis shall state the maintained horizontal footcandle level at 3' above playing field level using a 20' x 20' grid. Test points shall include the sidelines and endline.

b. The average maintained horizontal light level shall have a maximum to minimum ratio of 3:1 or less.

c. Calculations shall include a light loss factor in addition to any applicable tilt factor and ballast factor. The light loss factor, LLF, shall be the combination of the lamp lumen depreciation, LLD, and the luminaire dirt depreciation, LDD. For calculations, use a LDD=0.90. The LLD shall be determined by the lamp manufacturer's stated mean lumens at 40% rated life divided by the 100 hour burn in initial lumens.

For example: The new GE Lighting High Output 1500W multi-vapor universal burn 'Sportstar' has the following initial and mean lumen ratings:

	Vertical	Horizontal	45^{o}
Initial Lumens	178,000	170,000	160,000
Mean Lumens	160,000	140,000	145,000
LLD (mean/initial)	0.899	0.824	0.906
(x)LDD	0.90	0.90	0.90
LLF	0.81	0.74	0.82

d. Calculations shall state the final design lumens used per fixture. The final design lumens are calculated by multiplying the 100 HR initial lamp lumens by the light loss factor (LLF), and applicable ballast factor and tilt factor.

e. Include "spill light" calculation showing maintained horizontal and vertical footcandles at 3' above grade along the property line.

f. Calculations shall include Maximum-to-Minimum Ratio, Coefficient of Variation, and Uniformity Gradients as defined by the Illuminating Engineering Society of North America.

2. Outdoor Lighting System Levels

a. Outdoor Baseball and Softball Fields:

1) IESNA RP-6, Class: I.

2) Horizontal Illuminance:

a) Infield: 50 30 fc.

b) Outfield: 30 fc.

b. Outdoor Football Fields*:

1) IESNA RP-6, Class: I.

2) Horizontal Illuminance: 30 fc.

3) *Readings taken at grade. All other readings taken at 36".

c. Outdoor Soccer Fields:

1) IESNA RP-6, Class: II.

2) Horizontal Illuminance: 50 fc.

d. Outdoor Tennis Courts:

1) IESNA RP-6, Class: I.

2) Horizontal Illuminance: 50 fc.

B. Indoor

1. Calculations for Indoor Basketball, Soccer – Arena Football, and Volleyball:

a. Photometric analysis shall state the maintained horizontal footcandle level at 3' above playing field level using a 10' x 10' grid.

b. The average maintained horizontal light level shall have a maximum: minimum ratio of 3:1 or less.

c. Calculations shall include a light loss factor in addition to any applicable tilt factor and ballast factor. The light loss factor, LLF, shall be the combination of the lamp lumen depreciation, LLD, and the luminaire dirt depreciation, LDD. For calculations, use a LDD=0.90. The LLD shall be determined by the lamp manufacturer's stated mean lumens at 40% rated life divided by the 100 hour burn in initial lumens.

For example: The new GE Lighting High Output 1500W multi-vapor universal burn 'Sportstar' has the following initial and mean lumen ratings:

	Vertical	Horizontal	45°
Initial Lumens	178,000	170,000	160,000

	Vertical	Horizontal	45°
Mean Lumens	160,000	140,000	145,000
LLD (mean/initial)	0.899	0.824	0.906
(x)LDD	0.90	0.90	0.90
LLF	0.81	0.74	0.82

d. Calculations shall state the final design lumens used per fixture. The final design lumens are calculated by multiplying the 100 HR initial lamp lumens by the light loss factor (LLF), and applicable ballast factor and tilt factor.

e. Calculations shall include Maximum-to-Minimum Ratio, Coefficient of Variation, and Uniformity Gradients as defined by the Illuminating Engineering Society of North America.

2. Lighting System Levels:

a. Indoor Basketball:

1) IESNA RP-6, Class: I.

2) Horizontal Illuminance: 125 80 50 30 fc.

b. Indoor Volleyball:

1) IESNA RP-6, Class: II.

2) Horizontal Illuminance: 70 50 30 fc.

3. Indoor: Calculations for Work Lighting:

a. Photometric analysis for Work Lighting shall be sub-divided into three areas: the Arena floor, the north and south side of seating areas, and the west end seating area.

b. The maintained horizontal footcandle level for the seating areas shall be measured at seat level on the sloped incline using a 10'x10' calculation grid. The average maintained horizontal light level shall not be less than 15 foot-candles with a maximum: minimum ration of 4:1or less.

4. Indoor: Calculations for House Lighting:

a. Photometric analysis for House Lighting shall be sub-divided into three areas: the Arena floor, the north and south side of seating areas, and the west end seating area.

b. The maintained horizontal footcandle level for the seating areas shall be measured at seat level on the sloped incline using a 10'x10' calculation grid. The average maintained horizontal light level shall not be less than 10 footcandles with a maximum:minimum ratio of 3:1 or less.

5. Indoor: Calculations for Emergency Lighting (Portion of the House Lighting on Emergency)

   a. Photometric analysis for Emergency Lighting shall be sub-divided into three areas: The Arena floor, the north and south side of seating areas, and the west end seating area.

   b. The maintained horizontal footcandle level for seating areas shall be measured at seat level on the sloped incline using a 10'x10' calculation grid. The average maintained horizontal light level shall not be less than 3.0 foot-candles with a maximum: minimum ration of 3:1 or less. The minimum at any meter point shall not be less than 1.5 footcandles.

   c. Emergency Lighting shall be provided within 30 seconds of power failure. Duration of emergency illumination shall be not less than 15 minutes.

6. Both outdoor and indoor Luminaire Mounting Height: Comply with recommendations in IESNA RP-6, Section 3.

2.4 FIXTURES

A. Outdoor: The sports floodlights optical assembly shall be a one piece spun aluminum parabolic type reflector finished inside and out with a corrosion resistant anodized finish for maximum optical performance and lumen maintenance.

B. Indoor: The arena sports floodlights, Type A1, optical assembly shall be a multi-segmented aluminum reflector with 95% reflective specular finish. Manufacturer to determine proper optical assembly beam pattern to achieve performance criteria.

C. Outdoor: The optical assembly shall include a thermal and impact resistant glass lens in a stainless steel hinged doorframe. The doorframe shall be permanently attached to the reflector by the stainless steel hinge and held in place with stainless steel spring latches. The doorframe shall include a concentric butt-welded high temperature solid silicone gasket. The reflector shall also include a granular charcoal filter to protect the internal reflective surface from photometric degradation caused by the entry of dust and other fine particulate.

D. Indoor: The optical assembly shall include a thermal and impact resistant glass lens in an aluminum doorframe. The doorframe shall be permanently attached to the reflector by screws. The doorframe shall include a concentric butt-welded high temperature solid silicone gasket. The reflector shall also include a granular charcoal filter to protect the internal reflective surface from photometric degradation caused by the entry of dust and other fine particulate.

E. The optical assembly shall include a thermal resistant, vibration dampening lamp support positioned opposite of the lamp base so as to not interfere with light distribution. This support will dampen vibrations, which otherwise would decrease overall lamp life and maintain proper position of lamp within reflector.

F. Outdoor: All fixtures mounted on the sideline poles shall be provided with means to minimize glare and spill lighting. Use of internal louvers and/or external visors shall be securely assembled to the optical housing.

G. Indoor: All arena sports floodlights shall include a total blackout motorized shutter or shade system. This shutter/shade system shall provide no light leak when closed and maintain 100% lights output. Shutter system can remain closed indefinitely without

excessive heat build-up. Shutter shall close/open in less than three (3) seconds and include a fail-safe lamp extinguishing relay to turn off lamp if the shutter would not close to ensure a dark arena when required. Shutter shall not interfere with photometric distribution of the fixture. Power for the motorized shutter/shade via 120-volt ballast tap from the remote ballast.

H. All sports floodlights and work floodlights shall utilize the same 1500-watt metal halide lamp source for consistency in relamping and maintenance. Each fixture shall have a lockable aiming mechanism that will allow fixture to be rotated for relamping and repositioned without reaiming.

I. Outdoor: The sports floodlights shall mount to the crossarms with a fully adjustable mounting bracket to allow aiming of fixture. The ballast assembly shall be remote from the fixture in a separate enclosure mounted near the base of the pole (10 feet above grade). Wiring between the remote ballast enclosure(s) and fixtures shall be via a wiring harness located within the pole.

J. Indoor: The sports floodlights and work floodlights shall mount to the catwalk railings with a fully adjustable mounting bracket to allow aiming of fixture. The ballast assembly shall be remote from the fixture in a separate enclosure mounted to the same fixture mounting bracket supported to catwalk. Wiring between the remote ballast enclosure and fixture shall be via a cord and modular plug for both lamp and motorized shutter. Ballast also shall include 6' cord and locking plug for 277-volt operation.

K. Indoor: The Work floodlights, Type A2, are separate from the Arena sports floodlights and are controlled all on/off only for clean up or set up work mode. The work floodlights will not have a shutter/shade system and cannot be used to supplement the sports floodlights.

L. Indoor: The House floodlights, Type A3, are separate from both the Arena sports floodlights and Work floodlights and are controlled through the House dimming system. A portion of the House floodlights shall be an emergency power to yield emergency lighting of the Arena per the performance criteria.

M. Indoor: In addition to each fixture being supported from the mounting hardware, the manufacturer shall supply stainless steel safety aircraft cable to support the fixture independently to the catwalk railing.

N. All wiring on the Luminaire assembly shall meet National Electric Code and shall pass from each Luminaire on the assembly through protective enclosures to join in a common enclosure. Each luminaire shall have individual supplemental fuse protection located in remote ballast boxes. Fusing must be UL listed. In-line is not acceptable.

2.5 ACCEPTABLE MANUFACTURERS – LAMPS

A. GE Lighting

B. Venture Lighting

C. Phillips Lighting Company

D. Osram/Sylvania

2.6 LAMPS

A. Metal halide HID lamps shall be clear, high output, suitable for all burning positions with

mogul or position oriented mogul base (POMB) and BT-37 envelope size.

B. Utilize 1000-watt or 1500-watt metal halide high output lamps.

C. State manufacturer and the 100 HR initial lamp lumen rating of lamp used on photometric analysis summary and include manufacturer's technical specification cutsheet in submittal package.

D. Indoor: Quartz lamps for Arena House floodlights shall be 900 watt, T2.5 HIR type with 31,000 lumens output as manufactured by GE. Lamp shall be rated 277 volt. Use of 1500 W quartz lamps is NOT acceptable.

E. Lamps shall be supplied by the sports lighting manufacturer, including extra stock as specified, to match the basis of design calculation.

F. Provide two-year warranty which includes field replacement.

2.7 REMOTE BALLAST ENCLOSURE

A. Outdoor: Each pole shall utilize remote NEMA 3R ballast enclosure(s) as required to control the associated number of fixtures on the pole.

B. Outdoor: Enclosure shall be hot dipped galvanized sized to house up to a maximum of six (6) ballasts, a main breaker sized for load served, capacitors, and fuse blocks to individually protect each ballast.

C. Outdoor: Enclosures to be securely mounted on side of pole at approximately 10’ above grade with gasketed wire access for main power feed and manufacturer’s pre-fabricated wiring harness going to fixtures.

D. Indoor: Each Sports Floodlight, Type A1, and Work Floodlight, Type A2, shall have a remote ballast enclosure. All ballasts shall be encapsulated to minimize ballast noise with a Class H (180°C) temperature rating.

E. Indoor: Each ballast enclosure shall include 6' so cord set with locking-type plug for operation on 277-volt circuit. Electrical Contractor to provide matching locking type receptacle adjacent to fixture mounting for each fixture.

F. Indoor: Each ballast enclosure for Sports Floodlight, Type A1, fixtures shall include modular wiring and receptacles to lamp socket and to motorized shutter.

G. Indoor: Enclosures to be mounted on Z-spline bracket secured to fixture mounting hardware which is clamped to the catwalk railing. Weight of ballast to counter balance weight of cantilevered fixture and yield a deadload to railing.

H. Outdoor Voltage rating for all sports floodlighting remote ballast enclosures shall be 480 volt, 3-phase. Feed conductors shall route within pole and terminate at 3-pole main breaker within enclosure. Enclosure shall be prewired from main breaker through individual fusing to ballast.

I. Indoor Voltage rating for all sports and work floodlighting remote ballasts enclosures shall be 277 volt.

J. Supply extra stock of ballasts to Owner as specified.

2.8 HIGH INTENSITY DISCHARGE BALLASTS

A. Ballasts shall comply with ANSI C82.4, C82.6 and C92.1.

B. Ballast shall be high power factor. Lead-peaked autotransformer type for specific metal halide lamp used. The ballast design center shall not vary more than ±5% from rated lamp watts for nominal line voltage and nominal lamp voltage.

C. With a nominal voltage "reference" lamp, the wattage regulation spread shall not exceed 30% for ±10% line voltage variation for high power factor auto-regulator ballast.

D. Outdoor: The ballast much reliably start and operate the lamp in ambient temperatures down to minus-20^{o}F for the rated life of the lamp.

E. Auto-regulating type ballasts shall not exceed normal operating current and shall be capable of sustaining lamp operation with a line voltage dip or sag of 40% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.

F. For auto-regulating high-power factor ballasts, the current crest factor shall not exceed 1.8 for ±10% line voltage variation, including lamp starting or from nominal lamp voltage through rate end of life lamp voltage. The line power factor of the lamp/ballast system shall not be below 90% for ±10% line voltage variation.

G. LS-NC Rating: NEMA LE 2; equal to or less than ratings listed in Table C-1.

H. Sports lighting system manufacturer shall provide a five-year warranty on ballast replacement.

2.9 OUTDOOR: WIRING HARNESS

A. The wiring harness between the fixtures and remote ballast enclosure(s) shall be multi-conductor type cable with an overall outer PVC jacket for physical protection. Minimum conductor size shall be #14AWG with individual color-coated insulation jacket to facilitate any troubleshooting. All conductors shall be stranded copper with 600-volt insulation with 90^{o}C temperature rating.

B. In addition to the outer PVC jacket around the multiple conductors, provide rubber bumpers spaced no greater than 10’ on-center to minimize possible abrasion of outer PVC jacket on interior finish of pole.

C. Include stainless steel wire mesh strain relief at top of wiring harness and secure to inside top of pole.

D. Each end of wiring harness shall have a quick connector plug for ease of installation.

E. Each wiring harness shall be tested at the factory to verify proper operation between ballast and fixture and to minimize field installation time.

2.10 OUTDOOR POLES

A. Comply with AASHTO LTS-3 for poles or other support structures, brackets, arms, appurtenances, base, anchorage, and foundation.

B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires without failure, permanent deflection, or whipping in steady winds of 100 mph with a gust factor of 1.3.

C. Mountings, Fasteners, and Appurtenances: Corrosion resistant, compatible with support

components, and shall not cause galvanic action at contact points.

1. Steel Components: Hot-dip galvanized after fabrication, complying with ASTM A 123 / A 123M.

2. Mounting Hardware Fasteners: Hot-dip galvanized, complying with ASTM A 153 / A 153M.

D. Poles shall be sectional type hot dipped galvanized steel poles to achieve minimum fixture mounting height specified. All poles shall include grounding lug, wire access handhole, remote ballast enclosure(s) mounting brackets and wiring access, lightning terminal atop pole, and jacking brackets. Contractor/Manufacturer may use prestressed centrifugally spun concrete poles meeting all structural requirements at their discretion.

E. Pole base may either be a prestressed centrifugally spun concrete base pier or direct embedded hot dipped galvanized steel pole with black tar coating entire embedded length or a poured in place foundation concrete base.

F. The foundation for either prestressed concrete base or base plate steel pole shall be designed around standard auger sizes with concrete fill to achieve a minimum 28-day compression strength of 3000 psi or greater as required by manufacturer's structural design analysis. Crushed rock or earth backfill is not acceptable!

G. The sports lighting system manufacturer shall provide complete calculations within submittals verifying that the lighting pole meets the wind load requirements specified herein.

H. The sports lighting structure system shall be designed to withstand an Isotach wind velocity of 90 mph plus a 1.3 gust factor, including the total effective projected area and weight of the fixtures and complete assembly. The loads computed by this method shall not be less than those based on 1 90 mph wind with an exposure "B" per International Building Code 2000 and ASCE 7-98.

I. Sports lighting system manufacturer shall provide complete calculations within submittals verifying that the lighting pole meets the wind load requirements specified herein.

J. Each section of the pole shaft shall be of a single ply of steel with no welded splices and having only one longitudinal seam weld. Each slip joint shall be assembled in the field by slipping the upper section over the lower section by a minimum lap of 1.5 times the largest inside diameter of the upper section. The pole cross section shall be rounded or 16-sided with a four-inch corner radius. The pole shaft sections shall be high strength steel meeting the requirements of ASTM A595 Grade A or B or ASTM A572 Grade 65.

K. Poles shall be hot-dipped galvanized in accordance with the requirements of ASTM A123. Each component must be completely coated in a single dip. No double dipping will be allowed. All miscellaneous hardware shall be galvanized per ASTM A153.

L. Each pole shall include a ½" diameter by 48" tall solid copper lightning protection air terminal with nickel plated tip.

M. Crossarms shall be fabricated from hot dipped galvanized tubular steel. All mounting brackets and hardware shall be galvanized to ASTM A123 requirements.

N. Manufacturer of sports lighting structure shall receive soil tests from Owner to properly design pole foundations.

O. Manufacturer shall include cost to hire the services of a licensed Structural Engineer to review soil tests and design appropriate pole foundations. Include signed foundation drawings, calculations and all installation requirements in sports lighting system submittal.

P. The poles shall have a 1” diameter grommet drilled in the pole shaft, prior to galvanizing, and furnished with a rubber plug for future speaker wiring access. This grommet shall be located approximately 12” below the externally mounted cross-arm or bracket and shall be suitable for supporting up to 4 speakers.

2.11 INDOOR: MOUNTING HARDWARE

A. Manufacturer to provide complete mounting system for all arena sports lighting, work lighting and house lighting fixtures. The mounting system bracket shall be supported from a minimum of two (2) railings on the catwalk and be capable of stacking two fixtures, one above the other.

B. Mounting bracket shall utilize cantilevered arms to hold fixtures out from the catwalk railing and allow for complete tilt and rotation of fixtures even when double stacked. Spacing and length of arms shall not restrict the aiming or relamping of fixtures.

C. Mounting system shall include provisions for mounting remote ballast enclosures on a Z-spline bracket located on the catwalk side of the mounting system.

D. The mounting system hardware shall be capable of supporting up to a minimum of 500 lbs.

2.12 WIRELESS LIGHTING CONTROL

A. Manufacturer to provide wireless lighting control to manage, monitor and control all sports lighting.

END OF SECTION

SECTION 27 0000

COMMUNICATIONS SYSTEMS DESIGN CRITERIA

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Communications Systems Requirements.

1.2 DESIGN CRITERIA

A. Design team or design build team should provide a compliance letter with statement of being fully compliant with Campus standards and requirements for the campus as part of final submission documentation to the district. Design team or design build team should follow the latest District Design Guidelines and standards located on BuildLACCD's website. (http://www.build-laccd.org/contractors-bidders/standards-guidelines.

B. This district wide design standard and the accompanying specifications govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as specified herein.

C. Contractor are to provide all new materials as indicated on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.

D. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12)

E. Description of Systems include but are not limited to the following:

1. Complete Structured Cabling System including, but not limited to:

a. Voice and data backbone cabling and terminations.

b. Voice and data horizontal cabling and terminations.

c. Information outlets (IO's) including faceplates, jacks and labeling.

d. Equipment racks, cabinets, cable management and equipment.

e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.

f. Cabling pathways.

g. Grounding and Bonding

h. Testing

2. Complete Data Communications Equipment Systems.

3. Complete Voice Communications Equipment Systems.

4. Complete Audio/Visual Systems.

5. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.

6. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the “Suggested Matrix of Scope Responsibility”.

7. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

    a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling

    b. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

        1) C.1 - Commercial Building Telecommunications Standard

        2) C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard

        3) C.3 - Optical Fiber Cabling Components Standard

        4) C.4 - Broadband Coaxial Cabling and Components Standard

    c. ANSI/TIA-569-C - Telecommunications Pathways and Spaces

    d. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure

    e. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

    f. ANSI/TIA-758-B - Customer-Owned Outside Plant Telecommunications Standard

    g. ANSI/TIA-862-A - Building Automation Systems Cabling Standard

    h. ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers

    i. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

    j. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding

    k. NFPA 70 (NEC) - National Electrical Code (Current Edition)

    l. UL 444 - Standard for Safety for Communications Cable

m. LACCD facilities Design standards cabling Telecommunications Ver2-Febuary 2017

F. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

G. Definitions:

1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of the Specification.

2. “Electrical Contractor” shall also refer to the Contractor listed in Division 27 of the specification when the “Suggested Matrix of Scope Responsibility” indicates the work shall be provided by the EC. Refer to the Contract Documents for the “Suggested Matrix of Scope Responsibility”.

3. “Communications Contractor” as referred to herein refers to the Contractors listed in Division 27 of the Specification.

4. Low Voltage Communications Wiring: The wiring (less than 120VAC) associated with the Communications Systems, used for analog and/or digital signals between equipment.

5. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications information outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling the nearest cable tray. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling the bottom of the exposed structural joists the nearest cable tray.

H. General:

1. The purpose of these standards is to outline typical Electrical and Communications Contractor's work responsibilities as related to Communications Systems including Telecommunications rough-in, conduit, cable tray, power wiring and Low Voltage Communications Wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Communications Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Communications Drawings but required for the successful operation of the systems shall be the responsibility of the Communications Contractor and included in the Contractor’s bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Communications systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Communications Contractor has convened to determine the exact location and requirements of the installation.

4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Communications Wiring, the installation shall not begin until the Communications Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Communications utility elevations prior to fabrication and installation. The Communications Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

    a. Lighting Fixtures

    b. Gravity Flow Piping, including Steam and Condensate

    c. Sheet Metal

    d. Electrical Busduct

    e. Cable Trays, including 12” access space

    f. Sprinkler Piping and other Piping

    g. Conduit and Wireway

    h. Open Cabling

I. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the “Suggested Matrix of Scope Responsibility” to be provided by the Electrical Contractor.

2. Assumes all responsibility for providing and installing cable tray.

3. Responsible for Communications Systems grounding and bonding.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

J. Communications Contractor’s Responsibility:

1. Assumes all responsibility for the Low Voltage Communications Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the “Suggested Matrix of Scope Responsibility.”

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Communications equipment which is required to be bonded to the Communications ground system.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

K. Coordination Drawings General Requirements:

1. Coordination drawing files shall be made available to the A/E and Owner’s Representative for approval prior to stat of work. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such. Design team or design build team shall be responsible to produce and submit shop drawings for approval from the campus and/or A/E.

4. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

5. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

6. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

7. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

8. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

e. When additional access panels are required, they shall be provided without additional cost to the Owner.

9. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

10. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

11. Updated coordination drawings that reflect as-built conditions may be used as record documents.

L. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.

2. The installing Contractor shall have at a minimum a C-10 License and be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.

3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.

4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

6. The Contractor must have an active RCDD (Registered Communications Distribution Designer) on-staff serving as a project manager. Project shop drawings and test reports shall be stamped by the RCDD.

7. The Contractor shall have certified BICSI installation technicians on staff to perform the following tasks on the project:

a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.

b. Oversee all testing and termination of cabling.

8. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

    a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.

    b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.

    c. A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic systems on the project.

    d. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.

    e. Resume and certification of the RCDD for the project as required by the form at the end of this specification section.

    f. Resume and certification of the BICSI installation technician for the project.

M. Compliance with Codes, Laws, Ordinances:

1. The Contractor shall conform to all requirements of the Building Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. The Contractor shall also conform to all published standards of the Los Angeles Community College, as related to this installation.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used, otherwise contractor shall be responsible to provide products specified where required.

4. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.

5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

N. Warranty requirements at a minimum shall provide a five (5) year service warranty for all equipment, materials, and workmanship. Individual specifications sections may require additional warranty requirements for specific equipment or systems.

O. Warranty requirements for CAT-6A and Fiber cabling shall be at a minimum of twenty-five (25) years. Cabling manufacturers shall not be mixed in order to maintain warranty.

P. Contractor shall be responsible to provide at a maximum a 4-hour response time for servicing or replacing any equipment or devices installed for the project.

Q. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

R. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

S. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used per the contract.

T. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall be responsible to provide a side by side comparison chart for approval, this will not constitute replacement of specified items. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

U. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

V. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

W. Installation requirements shall be adhered to as follows. Installation of all conduit and cabling shall comply with Div. 26 specifications as required. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

X. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

Y. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

Z. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

1. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

2. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

3. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

4. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

AA. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review and final approval. The contractor will be responsible to provide any additional forms or documentation required by the District as applicable to the project

2. Submitted bound copies of approved shop drawings for district record keeping. Such drawings shall be provided in original condition as to when they were approved.

3. A clean set of record documents including edited drawings and specifications accurately reflecting field conditions, inclusive of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein in native and electronic PDF format and provide manufacturer software.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site insert address here; submit receipt to Architect/Engineer prior to final payment being approved.

BB. Provide adequate instructions to the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

CC. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

DD. (3) hard copies of all deliverables shall be provided in 3-ring binder. Soft copies of all deliverables shall be provided on MP4 USB thumb drive. Must provide (2) thumb drives. Contractor where required shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

EE. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

FF. At a minimum the contractor shall provide (4) hours of instruction time for each system or as specified and requested by owner. Verbal requests shall not constitute minimum time required for instruction. A written statement shall be provided to document time of instruction.

1. The Contractor is responsible for all instructions to the Owner and/or Owner’s operating staff on the Communications Systems.

2. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

GG. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

HH. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

II. This Contractor shall maintain at the job site, a separate and complete set of Communications Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Communications Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

JJ. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

KK. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

END OF SECTION

SECTION 27 0503

THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section includes firestopping for through-penetrations and joints in or between the following fire-resistance rated assemblies, including both blank openings, linear openings, and openings containing penetrating items:

1. Floor-ceiling assemblies.

2. Roof-ceiling assemblies.

3. Walls and partitions.

4. Smoke barriers.

5. Construction enclosing compartmentalized areas.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.

1. Through Penetration Firestop Systems (XHEZ)

2. Joint Systems (XHBN)

3. Perimeter Fire Containment Systems (XHDG)

4. Continuity Head-of-Wall Joint Systems (XHBO)

5. Fill, Void or Cavity Materials (XHHW)

6. Firestop Devices (XHJI)

7. Forming Materials (XHKU)

8. Wall Opening Protective Materials (CLIV)

B. All major building codes:

1. International Building Code published by ICC.

2. (Note to specifier: Retain or delete the building codes listed above as applicable).

C. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.

D. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 70: National Electrical Code”.

E. Factory Mutual Approvals (FM) of Norwood, MA “FM 4991: Standard for Approval of Firestop Contractors”.

F. Underwriters Laboratories (UL) of Northbrook, IL “UL Qualified Firestop Contractor Program”

1.4 PERFORMANCE REQUIREMENTS

A. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.

B. When intumescent products are used, provide products that do not contain sodium silicate or any other water soluble intumescent ingredient in the formulation.

C. Provide firestop products that do not contain ethylene glycol.

D. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.

E. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.

F. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall be:

1. Capable of retrofit around existing cables

2. Designed such that two or more devices can be ganged together

3. Maintenance free such that no action is required to activate the smoke and fire sealing mechanism

G. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

H. Provide fire-resistive joint sealants sufficiently flexible to accommodate movement such as thermal expansion and other normal building movement without damage to the seal.

I. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E1966, or ANSI/ UL 2079.

J. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/ UL1479 for penetrations and ANSI/UL2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.

K. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

L. Provide a fire-rated grommet for all individual or small grouped cable applications up to 0.53 in. (14 mm).

M. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.

1.5 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.6 WARRANTY

A. Provide one-year warranty on parts and labor at a minimum. Contractor should provide added warranty to district based on inspection frequency.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) and/or wall opening protective materials (CLIV) and/or joint systems (XHBN) and/or perimeter fire containment systems (XHDG) and/or continuity head-of-wall joint systems (XHBO) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Acceptable Manufacturer: Specified Technologies Inc., 210 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

2. Hilti, Inc., Tulsa, Oklahoma
800-879-8000
www.us.hilti.com

3. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

4. 3M Products

5. Or approved equal

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. General: LACCD standards should be to provide Kit Style assembly system and putty style fire blocking materials where possible. Use only firestopping products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type or joint opening width and movement capabilities, annular space requirements, and fire-rating involved for each separate instance.

B. Intumescent Sealants: Single component intumescent latex formulations containing no water soluble intumescent ingredients capable of expanding a minimum 8 times, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant

2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant

C. Endothermic Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series LC Endothermic Sealant

D. Elastomeric Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture and accommodate minimum ±25 percent movement, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series AS Elastomeric Spray

2. Specified Technologies, Inc. (STI) SpecSeal Series ES Elastomeric Sealant

E. Firestop Devices: Factory-assembled steel collars lined with intumescent material capable of expanding a minimum 30 times sized to fit specific outside diameter of penetrating item, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSC Firestop Collars

2. Specified Technologies, Inc. (STI) SpecSeal Series LCC Firestop Collars

F. Fire Rated Cable Pathways: Gangable device modules capable of being retrofitted around existing cables and comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill and requiring no additional action in the form of plugs, twisting closure, putty, pillow, or sealant to achieve fire and leakage ratings, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-Path Fire Rated Pathway

G. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24” (610 mm), the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty Pads

2. Specified Technologies, Inc. (STI) SpecSeal Series EP PowerShield Insert Pads

H. Firestop Putty: Intumescent, 100% solids, non-hardening, water resistant, butyl rubber based putties containing no solvents or silicone compounds, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty

I. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film and capable of expanding a minimum 30 times, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series RED2 Wrap Strip

2. Specified Technologies, Inc. (STI) SpecSeal Series BLU2 Wrap Strip

J. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides contained in a flame retardant poly bag, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows

K. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSM Firestop Mortar

L. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag), the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal SIL300 Silicone Firestop Sealant

2. Specified Technologies, Inc. (STI) SpecSeal SIL300 SL Self-Leveling Silicone Firestop Sealant’

M. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coatings for horizontal surfaces where greater water resistance is required or inclement weather is anticipated, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal FT305 Firestop Spray

N. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:

1. Specified Technologies, Inc. (STI) Pensil 200 Silicone Foam

O. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil capable of sustaining a minimum 2,500 lbs (1,134 kg) when subjected to load testing, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal CS Composite Sheet

P. Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal CD Cast-In Firestop Device

Q. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use on steel HVAC ducts, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal FyreFlange Firestop Angles

R. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material capable of expanding minimum 10 times with expansion beginning at 350°F (177°C) for use in blank openings and cable sleeves, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series FP Firestop Plug

S. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal T-Collar Device

T. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing cable penetrations up to 0.53 in. (14 mm) diameter, the following products are acceptable:

1. Specified Technologies, Inc. (STI) EZ-Firestop Grommet (RFG1 or RFG2)

U. Fire-Rated Closet Flange Gasket: Molded, single-component, intumescent gasket for use beneath a closet flange in floor applications, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series CF34 Closet Flange Firestop Gasket

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.

C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General Requirements: Install through-penetration firestop systems and fire-resistive joint systems in accordance with “Performance Criteria” Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of firestopping products.

1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.

2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of through-penetration firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

3. Protect materials from damage on surfaces subjected to traffic.

4. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition might occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

5. Where joint application is exposed to the elements, fire-resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C-920, “Specification for Elastomeric Joint Sealants”.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage. Contractor shall be responsible to provide visual inspection at end of project and shall be responsible to correct any deficiencies prior to owner’s visual verification. Where owner find enough repairs are needed, contractor shall make repair at no addition cost.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 27 0526

COMMUNICATIONS BONDING

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. Bonding Conductors

B. Bonding Connectors

C. Grounding Busbar (TMGB and TGB)

D. Rack-mount Telecommunications Grounding Busbar

1.2 RELATED WORK

A. Refer to Division 26 XX XX for Raceways and Boxes for Electrical Systems, Grounding and Bonding for Electrical Systems.

B. Refer to 270 XX XX for Basic Communications Systems Requirements, Through Penetration Firestopping, Communication Equipment Rooms, Interior Communications Pathways and Identification and Administration.

1.3 QUALITY ASSURANCE

A. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.

B. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be Underwriters' Laboratories, Inc. Listed.

1.4 REFERENCES

A. ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

B. ANSI/TIA/EIA 568-C – Commercial Building Telecommunications Cabling Standard

C. ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways

and Spaces

D. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

E. ANSI/TIA/EIA 758 – Customer Owned Outside Plant

F. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

G. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

H. IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

I. NFPA 70 – National Electrical Code

J. NFPA 780 – Standard for the Installation of Lightning Protection Systems

K. UL 96 – Lightning Protection Components

L. UL 96A – Installation Requirements for Lightning Protection Systems

M. UL 467 – Grounding and Bonding Equipment

1.5 SYSTEM DESCRIPTION

A. The system described her-in shall meet or exceed LACCD district standards and shall meet at a minimum the work listed below.

B. Contractor to be responsible for the furnishing, installation, adjusting, and testing of a complete turnkey communication bonding system, including connection to the electrical ground grid.

C. Performance Statement: Contractor will be responsible top provide proper shop drawings describing the material quality, required features, operational requirements, and performance of the system. The Contractor will be solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

D. The major components of the system shall be as per below per LACCD districtwide standards. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor with minimal or no impact to owner cost.

E. Basic System Requirements:

1. A complete communications bonding infrastructure is required. Refer to the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

2. The bonding system shall include, but not be limited to, the following major components:

a. Bonding Conductor for Telecommunications (BCT)

b. Telecommunications Main Grounding Busbar (TMGB)

c. Telecommunications Bonding Backbone (TBB)

d. Telecommunications Grounding Busbar(s) (TGB)

e. Rack mount Telecommunications Grounding Busbar(s)

f. Bonding Conductor(s) (BC)

g. Bonding Connectors

h. Bonding system labeling, and administration see division 27 XX XX where required.

3. LACCD Bonding and Grounding Standards:

a. BDF/IDF rooms shall be provided with a copper Telecommunications ground busbar in each room. The grounding conductor shall be a 1/0 copper wire, cad-welded directly to the Ufer ground, or main entrance ground, or building steel.

b. Racks and ladder racks shall be bonded to the Telecommunications ground busbar with a minimum of a # 6 AWG stranded wire.

c. Cable tray shall be bonded to Telecommunications ground busbar in the BDF/IDF rooms on the same floor as the tray. All non-contiguous segments of cable tray shall bond together using a minimum of a # 6 AWG copper wire, with crimp-on lugs bolted to each segment of cable tray to ensure electrical continuity throughout the length of cable tray system.

d. Each BDF shall be provided with copper signal grounding busbar. The grounding conductor shall be 1/0 copper cable, cad-welded directly to the Ground busbar or Main Building Entrance Ground or building Steel.

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.

2. Minimum size 1-0 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.

2. Insulation:

a. PVC insulation with nylon outer jacket.

b. Rated ≥ 600 volts.

c. Green.

3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing

1. All Communications bonding system conductors shall be sized by length as follows:

Length Linear ft. (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
Greater than 66 (20)	3/0

2. The BCT shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

A. Acceptable Types: Mechanical connector bonding lugs shall be prohibited.

1. Two-hole compression lug

2. Exothermic weld

3. Irreversible compression

B. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (TMGB AND TGB)

A. Features:

1. Busbar to be Wall-mount configuration.

2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.

3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.

4. Busbar shall be provided with stainless steel offset mounting brackets.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating. Minimum Dimensions: 1/4” thick x 4” high x 12” long.

a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

2. Hole pattern shall include:

a. A minimum of 15 sets of 5/16” holes, 5/8” on center, to accommodate “A” spaced 2-hole compression lugs.

b. A minimum of three (3) sets of 7/16” holes, 1” on center, to accommodate “C” spaced 2-hole compression lugs.

2.4 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR

A. General: each telecommunication rack shall a separate TBB to the TGB as required per district.

1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.

2. Mounts in a standard 19” 23” equipment rack.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating. Minimum Dimensions: 3/16” thick x 3/4” high x 19” long.

a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

2. Hole pattern shall include:

a. A minimum of eight (8) 6-32 tapped lug mounting holes on 1” centers.

b. A minimum of two (2) pairs of 5/16” diameter holes spaced 3/4” apart.

2.5 ADJUSTING

A. All work must be adjusted and completely secured prior to completion.

B. Contractor will be required make all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

2.6 TESTING

A. Test installed system.

B. Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical distribution panel bonded to the TMGB or a TGB.

1. Measurements shall be made 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.

2. Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 5 ohms.

3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

C. Measure and document voltage between screen of installed and terminated ScTP, FTP, and/or SSTP horizontal cables and electrical ground of electrical outlet(s) serving the information outlet location area.

1. The voltage between the screen and the ground wire shall not exceed 1.0 V rms, and 1.0 V dc for any installed and terminated ScTP, FTP, and/or SSTP horizontal cables.

D. Include measurement documentation in test data submitted at completion of project as required per LACCD district standards.

2.7 SYSTEM TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.

1. Provide two week's advanced notice of training to the Owner and Architect/Engineer.

2. The Architect/Engineer shall be presented with the option to attend the training.

3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

B. At a minimum, the following training shall be conducted:

1. A course detailing the system functions and operations that a technical user will encounter. Provide training on all aspects of using the system, including making new bonding connections to the TMGB, TGB, or RTGB. Provide training on all

recommended inspection, maintenance, and repair procedures for the system.

C. Minimum on-site training times shall be:

1. Technical user: Four hours.

END OF SECTION

SECTION 27 0528

COMMUNICATIONS RACEWAY

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. The work covered under this section per LACCD districtwide standards shall consist of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant. Contractor will be responsible to provide complete shop drawings for approval by the District, EOR or architect prior to installation and shall comply to the set standards as required. Where contractor installation is provided without approval, said contractor will be responsible to remove and reinstall any and all equipment or devices to meet district standards at no cost to owner/district.

B. Contractor will be responsible to refer to the District Facilities Standards for additional information required to provide proper raceway installation per LACCD's referenced drawings. See http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=8. Facilities Design Standards Cabling Telecommunications_ver_2-February 2017.

C. Wire mesh support systems are defined to include but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

1.2 RELATED WORK

A. Conduit

B. Basic Communications Systems Requirements

C. Communications Bonding

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

B. NEMA VE 2-2000 - Cable Tray Installation Guidelines

PART 2 - PRODUCTS

2.1 CONDUIT

A. Refer to other Sections for conduit requirements.

B. Provide communication cable conduit in locations where access to cable tray is unavailable or where portions of the pathway span are inaccessible (i.e. embedded in walls or inaccessible ceilings). Provide conduit for small quantities of cable where cable tray is impractical. Conduit materials may be used to house non-rated cables between end points to ensure NEC Code compliance. Conduits serving individual workstation outlets shall be a minimum of 1 inch. The 1-inch conduits shall be connected to double gang, deep device boxes (2 1/2-inch deep), equipped with a single gang mud ring at the outlet location. Individual workstation conduits are to be dedicated to only one outlet box each and shall not be “daisy-chained” together.

C. Acceptable Conduit Manufacturers:

1. Appleton.

2. Crouse-Hinds.

3. Or approved equal

D. Acceptable Conduit Support Manufacturers

1. Kindorf.

2. Unistrut.

3. Thomas & Betts.

2.2 CABLE TRAY – LADDER RACK

A. Acceptable Manufacturers:

1. Cable tray, Chatsworth or APC

2. Ladder Rack, Chatsworth or APC

3. Or approved equal. Approved equal must be accompanied with a comparison chart and will only be taken into consideration. Owner shall provide final approval prior to installation.

B. General: Provide wire mesh per LACCD with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Provide drop-out fittings where cable tray is installed over equipment racks. Two drop-out fittings shall be installed over each rack so that a controlled radius is maintained into each side of every equipment rack that cable tray passes over. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.

C. Wire mesh shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire mesh sides (flanges) shall be rounded during manufacturing for safety of cables and installers.

D. Materials and Finishes: Material and finish specifications for each wire mesh type are as follows:

1. Electro-Galvanized Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633 SC2.

2. Accessories:

a. Underfloor cable tray shall be provided with bend radius control fittings at all inside corners.

E. Type of Overhead Wire Mesh Support System:

1. All straight section longitudinal wires shall be straight (with no bends).

2. Wire mesh supports shall be trapeze hangers or wall brackets.

3. Trapeze hangers are to be supported by 1/4 inch or 3/8 inch diameter rods.

4. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.

2.3 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8”. Hooks shall have 90-degree radius edges.

2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.

3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use zinc plated steel, ASTM B633 SC3 suitable for heavy duty use. Provide stainless steel AISI Type 304 hooks for corrosive locations.

C. Cable Hangers:

1. Adjustable, non-continuous cable support slings for use with low voltage cabling.

2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.

3. Sling length shall be adjustable to a capacity of between 200 and 300 or of UTP, and FTP Cat 6A cables.

4. Cabling hanger load limit shall be 100 lbs per foot.

5. Manufacturer: Erico Caddy, Chatsworth Products, Cooper B-Line, Mono or approved equal.

2.4 OPTICAL FIBER SYSTEM

A. Acceptable Manufacturers:

1. **Sumitomo** Electric FutureFlex.

2. Corning

2.5 OPTICAL TERMINAL ADAPTERS AND CONNECTORS

A. Acceptable Manufacturers:

1. Sumitomo Electric FutureFlex.

2. Siemon

3. Corning

4. Or approved equal. Approved equal must be accompanied with a comparison chart and will only be taken into consideration. Owner shall provide final approval prior to installation.

2.6 PULL BOXES AND CABINETS

A. Acceptable Manufacturers:

1. Hoffman Enclosures.

2. Wire Guard.

2.7 METAL OUTLET BOXES – SINGLE GANG FOUR PLEX OR DOUBLE GANG, EXTRA DEEP

A. Acceptable Manufacturers:

1. Appleton.

2. Raco.

3. Steel city.

2.8 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer’s requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer’s instructions with a minimum 3/8” rod. In no case shall the side-to-side travel of any cable hook exceed 6”.

D. Cable hooks shall be selected based on the contractors cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. Support spans shall be based on the manufacturer's load ratings. In no case shall a 4 foot span be exceeded.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

2.9 CONDUIT AND CABLE ROUTING

A. All conduits shall be reamed and shall be installed with a nylon bushing.

B. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

C. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

D. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.

1. A separate pull box is required for each 90' (or greater) length section.

2. A separate pull box is required after any two (2) consecutive 90-degree bends.

3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

E. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

F. Provide conduit in locations where access to cable tray is unavailable or where portions of the pathway spans are inaccessible (i.e. embedded in wall or inaccessible ceilings).

G. Provide conduit for small quantities of cables where cable tray is not practical.

H. Minimum conduit size for communications cabling serving individual workstations shall be 1" and be connected to double gang backbox with a minimum depth of 2 1/2" and provide a single gang plaster ring. Individual workstations conduits are to be dedicated to one information outlet location, no daisy chaining of conduit between backboxes will be accepted.

I. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

2.10 WIRE MESH TRAY STANDARD REQUIREMENTS

A. The wire mesh cable tray system shall be only for telecommunications.

B. Install wire mesh as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC,

and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.

C. Cable tray sections shall be grounded in accordance with manufacturer's recommendations using manufacturer approved hardware. Painted sections shall have paint removed at each grounding attachment point.

D. Test wire mesh support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA 70B, Chapter 18, for testing and test methods.

E. Provide sufficient space encompassing wire mesh to permit access for installing and maintaining cables.

F. Tray shall be continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without 2" x 4" mesh support.

G. Overhead and Underfloor Tray shall be field cut using only manufacturer approved cutting device and methods. Cutting device shall be an offset blade bolt cutter; standard bolt cutters are specifically not permitted. Drop-in tray sections shall not be field cut or field modified in any way.

H. Bends in overhead and underfloor tray shall be accomplished by utilizing manufacturer's cutting guides.

I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

2.11 OPTICAL FIBER ROUTING

A. Optical fiber shall be air-blown in a tube system in which the fiber and tube are a unified air-blown fiber solution.

B. The tube system shall be plenum rated when used indoors.

C. The tube system shall be sized to meet the fiber strand count shown on the drawings plus 100% spare capacity.

D. Traditional fiber cabling to used where required in existing projects where blown fiber is not used.

2.12 ATTACHMENT TO METAL DECKING

A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25 lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

B. Cabling conditions:

1. Horizontal cable length maximum 90 meters or 295'

2. Tie wraps that distort the cable jacket will affect cable performance.

3. Velcro strap shall be utilized to organize cabling
4. 4 pair horizontal cable: 25 lbs. of force maximum pull tension
5. UTP Bend Radius = 4 X Cable OD
6. FTP Bend Radius = 8 X Cable OD

C. Horizontal Pathways in Conduit

1. Two 90 degree bends maximum between pull points
2. 30 meters (100ft) max
3. Maximum of three work areas served by a single conduit
4. Flexible Conduit 5 meters max / increase one trade size

D. Conduit Fill Requirements

1. Maximum 40% fill in conduit
2. Trade Size 1 = 4 CAT 6A UTP Cables
3. Trade Size 1.25 = 7 CAT 6A UTP Cables
4. Trade Size 1.5 = 10 CAT 6A UTP Cables
5. Trade Size 2 = 18 CAT 6A UTP Cables

END OF SECTION

SECTION 27 0543

EXTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. Exterior communication pathway standards below are listed per LACCD and shall be adhered to with minimal disruption to existing facility pathways and underground topology. Contractors shall be responsible to provide and install any underground and exterior conduit and pull boxes without disruption to existing systems throughout the campus where work will be performed.

B. This section describes the products and execution requirements relating to furnishing and installing exterior cabinets/racks, ladders, conduits, sleeves, innerduct, etc. for an exterior cabling plant or parking structures that will required such work to be performed.

1.2 QUALITY ASSURANCE

A. Precast Manufacturer (if applicable): Company specializing in precast concrete structures with three (3) years documented experience.

B. Contractor will be responsible for coordinating with other trades, the proper installation of Exterior Trenching, Conduit, Boxes and Manholes, Aerial Entrance Masts, Service Cabinets, Bonding and Grounding, Etc. per LACCD and industry standards and requirements.

1.3 REFERENCES

A. Basic Communications Systems Requirements.

B. ANSI/TIA 758-B – Customer Owned Outside Plant Telecommunications Infrastructure Standard.

C. ANSI/TIA 607-B - Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises

D. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.

F. ASTM A48 - Gray Iron Castings.

G. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.4 REGULATORY REQUIREMENTS

A. Equipment and material shall be UL (Underwriters Laboratory) listed and labeled.

PART 2 - PRODUCTS

2.1 OUTSIDE PLANT CONDUIT

A. Rigid Metallic Conduit (RMC) and Fittings:

1. Rigid steel conduit hot-dipped galvanized inside and out with threaded ends meeting ANSI C80.1.

2. Fittings and Conduit Bodies:

a. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

b. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

c. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

d. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.

e. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

3. Acceptable Manufacturers:

a. Allied, LTV, Steel duct, Wheatland Tube Co, O-Z Gedney, or pre-approved equal.

B. Rigid Non-Metallic Conduit (RNC) and Fittings:

1. UL listed, NEMA TC2 and TC6 Schedule 40 or 80 rigid polyvinyl chloride (PVC) approved for direct burial without concrete encasement.

2. Fittings: NEMA TC3 and TC9, sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

3. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

4. Acceptable Manufacturers:

   a. Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or pre-approved equal.

C. High-Density Polyethylene (HDPE) Conduit:

1. Minimum Size: 2 inches, unless noted otherwise.

2. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or pre-approved equal.

3. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	< .941
D-1238	Melt Index, g/10 min Condition E	> .55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.
D-790	Flexural Modulus, MPa (psi)	< 80,000
D-746	Brittleness Temperature	-75°C Max

4. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

5. Fitting and Conduit Bodies:

   a. Directional Bore and Plow Type Installation: Electrofusion or universal aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.

   b. For All Other Types of Installation: Coupler must provide a watertight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.

   c. E-loc type couplings are not acceptable in any situations.

   d. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

D. Fittings:

1. Sweeps: Factory manufactured RMC wrapped with 4 mil vinyl tape with a bend radius as follows:

    a. Conduit internal diameter of 2” or less is 6 times the internal conduit diameter.

    b. Conduit internal diameter of more than 2” is 10 times the internal conduit diameter.

2. End Caps (Plugs): Pre-manufactured and watertight. Tape is not an acceptable end cap or cover.

2.2 HAND-HOLES

A. Type:

1. Polymer concrete

B. Dimensions:

1. As indicated on the drawings.

C. Requirements:

1. Includes polymer concrete cover cast iron cover steel checker plate covers.

D. Acceptable Manufacturers

1. Jensen

2. Old Castle Precast Christy®

3. Brooks.

2.3 TEXTILE INNERDUCT

A. Contractor shall provide and install innerduct in each conduit identified to have copper and fiber optic cable installed.

B. Innerduct shall have an 18 gauge solid copper core tracer wire installed into each cell to allow for detection by industry standard toning equipment.

C. Each innerduct cell shall have a pull tape installed.

D. Acceptable Manufacturers:

1. Maxcell or pre-approved equal.

2.4 HEAVYWALL INNERDUCT

A. General Requirements:

1. Innerduct shall be produced from a suitable thermoplastic polymer conforming to the minimum standards for polyethylene as defined by ASTM.

2. Innerduct shall be high density, high impact resistant, abrasion resistant, and flexible with a low friction factor and light weight.

B. Mechanical Requirements:

1. Innerduct shall have corrugated walls and shall be free from holes, splits, blisters, inclusions, and other performance-affecting imperfections.

2. Innerduct bore shall be free from dimensional non-uniformities, and wall thickness shall be concentric.

C. Dimensions and Tolerances:

1. Innerduct shall conform to IPS dimensions as defined in NEMA TC-2.

SIZE	OD	ID
1”	1.375” (Max.)	1.0” (Min.)
1-1/4”	1.67” (Max.)	1,25” (Min.)
1-1/2”	2.0” (Max.)	1.5” (Min.)

2.5 UNDERGROUND WARNING TAPE

A. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.

B. Overall Thickness: 5 mils (0.125 mm).

C. Foil Core Thickness: 0.35 mil (0.00889 mm).

D. Orange colored tape 3-wide with 1-inch high black letters permanently imprinted with “CAUTION – BURIED COMMUNICATIONS LINE BELOW”. Printing on tape shall be permanent and shall not be damaged by burial operations.

E. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

F. Comply with ANSI Z535.1 through ANSI Z535.5.

G. Acceptable Manufacture: CARLON

2.6 UNDERGROUND PULL BOX AND RACEWAY COMPONENTS AND ACCEPTABLE MANUFACTURERS:

A. Pull Rope 1700lb tensile strength by Carlon.

B. Bonding ribbon (in Vaults) by INWESCO Cat 12A55.

C. Bonding ribbon clamps (in Vaults) by INWESCO Cat 12A56.

D. Fargo Clamp by INWESCO Cat 12A57.

E. Ground Rod by INWESCO Cat 12A60.

F. Ground Inserts (Cast Bronze) by INWESCO Cat 12H69.

G. Manhole and Pull Boxes hardware by INWESCO products.

H. Manholes by Utility Vault (Oldcastle); Jensen, Brooks.

I. Manhole lids by Alhambra Foundry, OPW Manhole.

J. Manhole Ladders by Alhambra Foundry – Model A – 3382 w/A3383 Support Bar.

2.7 DUCTBANK MINIMUM REQUIREMENTS

A. Make duct bank installations and penetrations through foundation walls watertight.

B. Top of duct banks shall be a minimum of 24 inches below grade, unless otherwise indicated on drawings.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 3-inch minimum separation between the outer surfaces of the ducts.

D. Transition from non-metallic to galvanized rigid steel conduit where duct banks enter buildings, manholes, and handholes.

E. Where ducts enter structures such as manholes, handholes, pullboxes and buildings, terminate the ducts in suitable end bells.

F. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3-inches per 100 feet.

G. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand, or gravel have been left in the duct.

H. Plug and seal empty spare ducts entering buildings and structures. Seal watertight all ducts in use entering buildings and structures.

2.8 TEXTILE INNERDUCT

A. Provide two (2) 3-cell innerducts per 4" conduit or as recommended by the manufacturer.

B. Install innerduct per manufacturer's guidelines.

C. Cut and tie off innerduct and pull tape inside each communications vault or Entrance Room.

2.9 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with their work.

B. Excavation:

1. Excavations for trenches shall be excavated to proper dimensions to permit installation and inspection of work.

2. Where excavations are carried in error below indicated levels, thoroughly compacted sand-gravel fill, shall be placed in such excess excavations.

3. Excavations shall be protected against frost action and freezing.

4. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation be undermined.

5. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc., shall be borne by the bidder.

6. In the case where the trench is excavated in rock, a compacted bed with a depth of 3” (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

7. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.

8. Mechanical excavation of the trench to line and grade of the conduit, unless otherwise indicated on the drawings.

C. Underground Obstructions:

1. Contractor is responsible for obtaining all utility locates for all trades on the project to determine obstructions indicated. The Contractor shall use great care in installing in the vicinity of underground obstruction.

D. Fill and Backfilling:

1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.

2. The Contractor shall provide the necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials, frozen earth, debris or earth with an exceptionally high void content, and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed.

5. All trenches shall be backfilled immediately after installation of conduit, unless other protection is directed.

6. All conduit shall be laid on a compacted bed of sand at least 3” deep. Backfill around the conduit with sand, spread in 6” layers, then compact each layer.

7. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. All other conduit shall have sand backfill to 6” above the top of the conduit.

8. The backfilling above the sand shall be placed in uniform layers not exceeding 6” in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.

9. Install a warning tape approximately 12 inches below finished grade over all underground duct banks. The identifying warning tape shall be as specified above.

10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.

2.10 RESTORATION REQUIREMENTS

A. Where soil and sod has been removed, it shall be replaced as soon as possible after backfilling is completed. All areas disturbed by work shall be restored to their original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, or mulching,

END OF SECTION

SECTION 27 0553

IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section describes the execution and administration requirements set forth by LACCD standards relating to the structured cabling system and its termination components and related subsystems.

B. Contractor shall Obtain facilities IT Approval for labeling prior to installation. Where Labeling is found to be deficient or not installed per said documents, contractor will be responsible to reinstall proper labels at no cost to owner and shall be responsible for time delay where occurs.

1.2 RELATED WORK

A. Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to other sections for relevant standards. See BuildLACCD web site for any additional labeling requirements not listed here-in. refer to Structural Cabling Systems R2(11.8.2013) http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=8#.

B. Refer to DW cabling Standards located in http://az776130.vo.msecnd.net/media/docs/default-source/contractors-and-bidders-library/standards-guidelines/District-Facility-Standards/laccd-facilities-design-standards-cabling-telecommunications_ver2---February-2017.pdf?sfvrsn=0

PART 2 - PRODUCTS

2.1 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface an attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.

1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum “quite zone” of 0.25” on each side of the bar code.

2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:

1. Labels on each end of a cable shall be the same color for each termination.

2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.

3. Orange (Pantone 15C) shall be used for the demarcation point.

4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.

5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)

6. White shall be used to identify the first-level backbone termination in the main cross-connect.

7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.

8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.

9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.

10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.

11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.

F. Tag all CAT6A and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system. All copper horizontal cables are to be labeled using a machine printed label at each end of the cable at approximately 4 to 12 inches of the termination point. Handwritten labels shall not be used.

1. (Telecom Room Number) – (Room Number) - (Patch Panel Letter) – (Patch Panel Port Number).

2. “Telecom Room Number”

3. “Room Number”

4. “Patch Panel Letter” shall start with ‘A’ for the top modular patch panel, increasing sequentially from top to bottom across the equipment rack.

5. “Patch Panel Port Number” shall start with ‘1’ for the upper left port in each modular patch panel, increasing sequentially from left to right and top to bottom across the modular patch panel face.

6. Example: BDF1001 1023 A 1-2 indicates the first and second modular patch panel port in modular patch panel ‘A’ in Building Distribution Frame (BDF) 1001 room 1023.

7. Contractor shall utilize the blank designation inserts which accompany the manufacturer’s Patch Panel hardware to label the hardware. Contractor shall remove the Inserts and input LACCD’s labeling scheme. All information shall be laser printed, no handwritten labeling shall be permitted or approved.

G. Tag each individual 900 micron buffered fiber 3” from the connector with a polyester film marker tape as a “flag”, designated in a numerical sequence.

H. Label fiber optic innerduct every 4’ with a 1” by 3 1/2” “Fiber Optic Caution” label.

I. Contractor shall furnish and install self-laminating type labels to the utilized spur cable’s overall jacket, six (6) inches from the fiber storage panel strain relief, with the EF/IDF number and fiber number in numerical sequence.

J. Label the front of each fiber termination shelf with the labels furnished with such shelf, using LACCD’s approved scheme.

K. No handwritten labels will be accepted.

2.2 IDENTIFICATION AND LABELING

A. Cable Labeling: Backbone and horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each manhole and pull box.

2. Fiber innerduct labeling shall be provided at both ends using machined-produced labels with Black typeface on Yellow Background, a minimum of 2 inches wide.

3. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.

4. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

2. Contractor shall label the cross connect blocks using the appropriate manufacturer's labels. The labels shall be designed every four (4) and/or five (5) pairs as determined by IT. The label designations shall be printed with machine-produced type. Handwritten designations shall not be acceptable. Where handwritten labels are used, contractor shall be responsible to remove and install proper labeling as required and shall be responsible for time and material.

D. Grounding/Bonding Labeling:

1. The TMGB shall be labeled "TMGB." There shall be only one TMGB in the facility.

2. Label all TBB conductors connecting to the TMGB with a unique label, located at both ends of the TBB.

3. Each TGB shall be labeled with a unique label.

4. All TBB conductors connecting to the TGB shall be labeled uniquely at each end of the cable.

E. Cable Plant labeling:

1. Contractor shall; label splice cases to match the existing labels, using letters with \machine-produced black typeface on an Orange Background. Contractor shall identify all binder groups utilizing color Zipp Ties. Contractor shall furnish and install stamped metal band labels on all feed cables indicating cable size, gauge and plant pair counts.

2.3 CABLE TAGS & SPLICE LABELS

A. Manufacturers:

1. 3M

2. Panduit

3. Siemen

2.4 CABLE LABEL SCHEME PER LACCD

A. Contractor to present a mockup of a faceplate to facilities IT for verification and approval of labeling scheme to match campus standards. The following is an example to be followed and approved.

B. All patch panel ports and telecommunication outlet ports shall be labeled with the cable identifier. Owner may provide specific labeling requirements coordinate with owner.

C. All fiber cabling shall be labeled in the front of each fiber termination shelf with the labels furnished with such shelf, using LACCD's approved scheme.

D. See Attachment A below, Faceplate – Patch Panel – Cable Labeling.

E. See Attachment B below, Fiber Labeling Layout

END OF SECTION

SECTION 27 1100

COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12 and http://az776130.vo.msecnd.net/media/docs/default-source/contractors-and-bidders-library/standards-guidelines/District-Facility-Standards/laccd-facilities-design-standards-cabling-telecommunications_ver2---February-2017.pdf?sfvrsn=0). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for Communication Equipment Rooms. Communication Equipment Rooms include rooms for the Building Distribution Frame (BDF), Intermediate Distribution Frame (IDF), and Server Room (such as data centers and main computer rooms housing servers, mainframes and other central equipment).

B. Definitions:

1. Building Distribution Frame (BDF): Allows single point administration of technology components for cross-connect of first level backbone cables, entrance cables and equipment cables.

2. Intermediate Distribution Frame (IDF): Cross connect location between the horizontal cabling and the backbone cabling.

3. Server Room: Accommodates a single location for incoming services to terminate and indicates an interface point and division of responsibility between the building cabling system and the service provider (herein referred to as the demarc) and location of servers.

C. Refer to Specification Section 27 05 28 for cable pathway and support requirements.

1.2 RELATED WORK

A. Basic Communications Systems Requirements

B. Communications Bonding

C. Interior Communication Pathways

D. Horizontal Cabling Requirements

PART 2 - PRODUCTS

2.1 EQUIPMENT GROUNDING

A. Refer to other sections for grounding requirements.

B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.2 EQUIPMENT RACKS AND CABINETS

A. Where identified on the drawings in Communication Equipment Rooms, equipment racks and/or equipment cabinets shall be furnished and installed by the Contractor to house cable termination components (e.g., copper, optical fiber, coax) and network electronics.

B. The equipment rack shall conform to the following requirements: Contractor to follow the latest LACCD facilities design standards cabling and telecommunications ver 2 – February 2017 racks shall be 4 port unless directed and approved otherwise by owner only.

1. Standard TIA/EIA 19" Floor Rack:

a. Equipment rack shall be 84" in height, self-supporting and provide a useable mounting height of 44 rack units (RU) (1 RU = 1 ¾").

b. Channel uprights shall be spaced to accommodate industry standard 19" mounting.

c. Equipment rack shall be double side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per TIA/EIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.

d. Equipment racks shall be provided with a supply of spare screws (minimum of 24).

e. Equipment racks shall be provided with a ground bar and #6 AWG ground lug.

f. Provide all mounting hardware and accessories as required for a complete installation.

2. Standard TIA/EIA 19" Floor Cabinet: Contractor to follow the latest LACCD facilities design standards cabling and telecommunications ver 2 – February 2017 racks shall be 4 port unless directed and approved otherwise by owner only.

a. The equipment cabinets shall be constructed of painted steel or aluminum and offer a usable mounting height of 42 RU. Rack shall be a minimum of 36 inches deep.

b. The equipment cabinet shall be equipped with a lockable steel front door and furnished with two (2) keys that shall be usable on all cabinets furnished under this Contract.

c. The equipment cabinet shall be configured to allow for adjustment of the channel uprights (front to rear) in 1-inch increments and be spaced to accommodate industry standard 19-inch mounting. Cabinet shall be tapped to accept 12-24 screws.

d. The equipment cabinet shall be vented to allow for airflow through the cabinet.

2.3 CABLE MANAGEMENT – VERTICAL AND HORIZONTAL

A. Equipment Racks:

1. Equipment racks shall be equipped with vertical and horizontal cable management hardware in the form of rings and guides. Racks shall incorporate vertical and horizontal covers, to allow an orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular patch panels and/or 110-type termination blocks to the customer provided network electronics. Vertical and horizontal cable management hardware shall be as follows:

a. Horizontal cable management hardware shall be 16 gauge cold rolled steel construction with six (6) pass-thru holes and seven (7) front-mounted 3.5” steel rod D-rings. Provide with cover designed to conceal and protect cable. Recommend using Front/Back with metal covers preferred 2U min. X2 per each patch panel to accommodate patch panel and switch. Vertical min 6" on end, and min. 10" between racks.

b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels. Recommend using Front/Back with metal covers min 6" on end, and min. 12" between racks.

c. Vertical cable management hardware shall provide for cable routing on front and rear of each rack and be 14” deep x 6” wide (minimum). Where multiple equipment racks are to be installed, this hardware shall be mounted between the uprights of adjacent equipment racks. Equipment rack uprights and the spacers shall be secured together per manufacturer’s recommendations. Provide with cover designed to conceal and protect cable.

2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., “hook and loop”) cable support ties.

3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is not acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Architect/Engineer prior to installation.

4. Vertical Cable Managers:

a. Chatsworth products 10” or 12” Evolution Series at minimum.

b. APC

c. EATON

5. Horizontal Cable Managers:

a. Siemon WM 145-S

b. Chatsworth Products

c. Ortronix

d. APC

e. Panduit

B. Equipment Cabinets

1. Equipment cabinets shall be equipped with vertical and horizontal cable management hardware, in the form of rings and guides, to allow an orderly routing of optical fiber and copper jumpers from the modular patch panel and/or 110-type termination blocks to the customer provided network electronics. At a minimum, one such horizontal cable management panel shall be provided with each equipment cabinet. Horizontal cable management panels shall be 3.5" in height and have a minimum of five (5) jumper distribution rings. Horizontal cable managers should be Front/Back with metal covers 2U minim. X2 per each patch panel to accommodate patch panel and switch. Vertical cable managers should be with metal covers minim 6" at the end of the rack/ cabinet, and min. 12" between racks.

C. 110-type Termination Blocks:

1. Horizontal troughs incorporating plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Horizontal troughs shall be positioned at the top of each column of 110-type termination blocks and between each 100-pair 110-type termination block.

2. Vertical troughs incorporating metal distribution rings shall be provided for vertical routing of jumper and/or cross-connect wire.

2.4 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00. On wall-mounted panels, this interface shall be accessible from the front of the panel.

C. Wall-mounted modular patch panels shall incorporate a standoff bracket to allow copper cabling to be routed behind the modular patch panel.

D. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

E. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

F. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.5 OPTICAL FIBER PANELS

A. All terminated optical fibers shall be mated to simplex LC type couplings mounted on enclosed fiber distribution cabinets. Couplings shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types including SC, ST, Fixed Shroud Duplex (e.g., "FDDI Connector"), Biconic, FC, and MT-RJ by changing panels on which connector couplings are mounted. Refer to Section 27 15 00 for coupling requirements.

B. The fiber distribution cabinet shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and drawings, including those not terminated (if applicable). Connector panels and connector couplings (sleeves, bulkheads, etc.) adequate to accommodate the number of fibers to be terminated shall be furnished and installed by the Contractor.

C. The fiber distribution cabinet shall be an enclosed assembly affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to conceal and protect the optical fiber couplings, connectors, and cable.

D. Access to the inside of the fiber distribution cabinet's enclosure during installation shall be from the front and/or rear. Panels that require any disassembly of the fiber distribution cabinet to gain entry will not be accepted.

E. The fiber distribution cabinet's enclosure shall provide for strain relief of incoming optical fiber cables and shall incorporate radius control mechanisms to limit bending of the optical fiber to the manufacturer's recommended minimums or ½", whichever is larger.

F. All fiber distribution cabinets shall provide protection to both the "facilities" and "user" side of the coupling. The fiber distribution cabinet's enclosure shall be configured to require front access only when patching. The incoming optical fiber cables (e.g., backbone, riser, horizontal, etc.) shall not be accessible from the patching area of the panel. The fiber distribution cabinet's enclosure shall provide a physical barrier to access such optical fiber cables.

G. Where "Loose Buffered" cables are installed, the 250 µm coated optical fibers contained in these cables may be terminated either by (1) splicing of factory-terminated cable assemblies ("pigtails") or (2) the use of a "fan-out" kit. In the latter approach, individual

fibers are to be secured in a protective covering, an Aramid (e.g., Kevlar™) reinforced tube for example, with connectors mated to the resulting assembly. In both instances, the proposed termination hardware shall incorporate a mechanism by which cable and subassemblies are secured to prevent damage. Splicing shall be by the “fusion” method. Individual splice loss shall not exceed 0.3 dB for multi-mode fibers. Direct termination of 250 µm coated optical fibers shall not be permitted.

H. Fiber distribution cabinets for horizontal cabling: Where optical fiber horizontal cabling is to be terminated, the enclosure shall be compliant to all of the above requirements plus the enclosure shall incorporate a storage mechanism designed to allow simplified identification, access to and termination of individual optical fibers. This may be in the form of a storage cassette, tray or other appropriate mechanism.

2.6 TERMINATION BLOCKS

A. Where identified on the drawings in Communication Equipment Rooms, 110-type termination blocks shall be furnished and installed by the Contractor for termination of copper cable.

B. Each horizontal row of the 110-type termination block must be capable of terminating one (1) 25-pair binder group (backbone cables) or six (6) 4-pair groups (horizontal cables). Backbone and horizontal 110-type termination blocks shall be segregated, clearly identifying their function.

C. The Mechanical Termination Shall:

1. Have the ability of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.

2. Provide a direct connection between the cable and jumper wires.

3. Have less than 0.2 dB of attenuation from 1-16 MHz.

4. Have less than 100 mW of DC resistance.

5. Have less than 5 mw of resistance imbalance.

6. Have minimal signal impairments at all frequencies up to 16 MHz.

D. The 110-type termination block shall identify pair position by a color designation - Blue, Orange, Green, Brown and Slate (backbone only).

E. The 110-type termination block shall be designed to maintain the cables’ pair twists as closely as possible to the point of mechanical termination.

2.7 LADDER RACK, CABLE TRAY

A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware and other miscellaneous materials as required for a complete installation per manufacturer’s recommendations.

B. Per district standards Contractor should provide Minimum 18” to 24” wide cable tray where provided. At times where obstructions do not allow for 24” cable tray, 2 levels may be required. This will be dependent on cable volume in IDF/BDF/Server rooms. Contractor will

be responsible to coordinate and obtain district approval prior to any installation

C. Steel C-Channel Stringer Style Ladder Rack:

1. Rolled steel siderail stringer, 2” stringer height, 9” spaced welded rungs.

2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.

3. Loading limits shall be 292 lbs/ft. for 4 ft. spans.

D. Aluminum C-Channel Stringer Style Ladder Rack:

1. Lightweight 6063-T6 aluminum, 2” stringer height, 9” rung spacing.

2. Loading limits shall be 118 lbs/ft. for 4 ft. spans.

E. Ladder rack finish shall be flat black powder coat standard ASTM B633 SC3 yellow zinc dichromate Telco gray powder coat computer white powder coat.

F. Acceptable Ladder Rack Manufacturers:

1. Chatsworth Products

2. B-LINE

3. APC

G. Acceptable Cable tray Manufacturers

1. Chatsworth Products

2. B-line

3. APC

2.8 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide ¼” screw holes for wall mounting.

2.9 POWER STRIPS

A. Provide power strips on all equipment racks, unless noted otherwise. These power strips shall have the following characteristics:

1. Standard Rack Mount:

a. TIA/EIA 19” equipment rack mountable.

b. Compliant with UL-1449 Third Edition and UL-497A.

c. Provide transient suppression to 12,000-A. Protection shall be in all three

modes (line-neutral, line-ground and neutral-ground).

d. Shall meet or exceed ANSI C62 Category A3 requirements.

e. Provide high-frequency noise suppression as follows:

1) >20-dB @ 50 kHz

2) >40-dB @ 150 kHz

3) >80-dB @ 1 MHz

4) >30-dB @ 6 to 1000 MHz

f. Protection Modes and UL 1449 Clamping Voltage: 475 volt L-N, L-G, and N-G.

g. Components: Nonmodular units composed of 20mm metal oxide varistors (MOV). Series inductors, SAD, or selenium cells may be used in addition to MOVs.

h. Be equipped with a 10-foot power cord.

i. Provide with raised floor twistlock compatible.

2.10 COPPER PATCH CORDS AND COPPER PATCH PANELS

A. Modular Patch Panel:

1. Provide Category Cat 6A UTP, GT UTP & FTP. and the Cat 6A specification for GT UTP copper patch cords for 50% of all assigned ports on the modular patch panel. Of these cords, 60% shall be 2’ in length and 40% shall be 3’ in length. These patch cords shall be the cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 4-pair RJ-45 connector on each end.

2. Refer to Section 27 15 00 for cable and connector performance requirements.

3. Patch cords shall not be made-up in the field.

a. Siemon

2.11 MM FIBER PATCH PANELS AND FIBER PATCH CORDS

A. Optical Fiber Patch Cords (Multimode):

1. Provide 50/125 μm multimode (MM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Owner’s network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped ST SC MT-RJ-type connector on each end and shall be a minimum of 5 feet (1.5m) in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans. MM Fiber Patch cords shall be OM4. Connector

should be LC per district as required for any new projects at all campuses.

2. Call MM fiber cables should be OM4.

3. Channels shall be of equal length.

4. Refer to Section 27 15 00 for cable and connector performance requirements.

a. Siemon

B. Optical Fiber Patch Cords SM Fiber patch panels and Patch cords.

1. Patch cords shall be Single-mode OS 2 as required per district on all new projects. The optical fiber patch cord shall be 8.3/3 μm singlemode (SM) optical fiber, utilizing tight buffer construction. The optical fiber patch cords shall be a minimum of 5 feet (1.5m) in length.

2. Provide 8.3/3 μm singlemode (SM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Owner's network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped LC-type connector on each end and shall be a minimum of 5 feet (1.5m) in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans.

3. Channels shall be of equal length.

4. Refer to Section 27 15 00 for cable and connector performance requirements.

a. Siemon

2.12 ARCHITECTURAL BDF ROOM REQUIREMENTS

A. The minimum space allocated to the BDF shall be 150 sq. ft. with a minimum dimension of 15 ft. in one direction. (Any space reduction requests by designers need to be presented and determined by college representatives).

B. Do not locate BDFs in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions.

C. BDFs and IDFs shall be stacked in multistory buildings.

D. Locate the BDF far enough away from sources of EMI to reduce interference with telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, radio transmitters, radar transmitters, and induction heating devices.

E. Minimum ceiling height shall be 10'.

F. BDF doors shall be lockable that at least 3' – 6" wide.

G. Provide AC grade ¾" thick fire-rated plywood 6" AFF on each wall with stamp visible.

H. Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Maintain positive pressure with a minimum of one air change per hour in the IDF. Provide:

1. Temperature 70 degrees F +/- 10 degrees

2. Relative humidity 50% +/- 20%

I. Provide adequate and uniform LED lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Coordinate lighting layout with the equipment cabinet layout, especially overhead cable trays, to ensure that light is not obstructed.

J. Provide (1) 120V, 20A NEMA 5-20R Dedicated Circuit With One Duplex Receptacle Per Circuit Per Rack And (1) 208V, 30A NEMA L6-30R Dedicated Circuit Mounted At The Side Of The Cable Runway.

K. Provide separate duplex 120 V, 15A convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such.

L. 4 post racks shall be constructed of steel, include adjustable depths, and include cage nut mounting rails. Must meet 2000lb static load rating, evenly distributed. Aluminum racks are not acceptable. Threaded rails are not acceptable.

M. BDFs shall have a connection to a backup generator if included as part of the scope of the project.

N. Provide a copper signal ground busbar in each BDF. The ground conductor shall be a 1/0 copper cable, cad- welded directly to the Ufer Ground or Main Building Entrance Ground, or building steel.

O. Fire Suppression: Provide a pre-action system.

P. Rack layouts require signoff from IT Managers in design phase and secondary signoff prior to installation.

1. Patch cables shall be augmented category 6 component compliant out to 250MHz with operational bandwidth to 500 MHz

2. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 500MHz

3. Manufacturer will be able to supply any length patch required (custom) from 6” – 20’ at no additional charge.

Q. A laminated floorplan shall be mounted in each BDF/IDF identifying all outlets being served.

R. See Attachment A for floor plan layout (BDF Rack Elevation Top View).

S. See Attachment A for Rack Elevation (BDF Rack Elevation Front View)

2.13 ARCHITECTIURAL IDF ROOM REQUIREMENTS

A. At a minimum, the IDFs shall be 8’ X 10’, with a minimum clear dimension of 8 ft. in one direction. (Any space reduction requests by designers need to be presented and determined by college representatives).

B. Do not locate IDFs in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions.

C. BDFs and IDFs shall be stacked in multistory buildings.

D. Locate the IDF far enough away from sources of EMI to reduce interference with telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, radio transmitters, radar transmitters, and induction heating devices.

E. The minimum ceiling height shall be 10' above the finished floor.

F. IDFs shall have lockable doors that are at least 3.0 ft. wide.

G. Provide AC grade ¾” thick fire-rated plywood 6” AFF on each wall with stamp visible.

H. Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Maintain positive pressure with a minimum of one air change per hour in the IDF. Provide:

1. Temperature 70 degrees F +/- 10 degrees

2. Relative humidity 50% +/- 20%

I. Provide adequate and uniform LED lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Coordinate lighting layout with the equipment cabinet layout, especially overhead cable trays, to ensure that light is not obstructed.

J. Provide (1) 120V, 20A NEMA 5-20R Dedicated Circuit With One Duplex Receptacle Per Circuit Per Rack And (1) 208V, 30A NEMA L6-30R Dedicated Circuit Mounted At The Side Of The Cable Runway.

K. Provide separate duplex 120 V, 15A convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such.

L. 4 post racks shall be constructed of steel, include adjustable depths, and include cage nut mounting rails. Must meet 2000lb static load rating, evenly distributed. Aluminum racks are not acceptable. Threaded rails are not acceptable.

M. IDFs shall have a connection to a backup generator if included as part of the scope of the project.

N. Provide a copper signal ground busbar in each BDF. The ground conductor shall be a 1/0 copper cable, cad- welded directly to the Ufer Ground or Main Building Entrance Ground, or building steel.

O. Fire Suppression: Provide a pre-action system.

P. Rack layouts require signoff from IT Managers in design phase and secondary signoff prior to installation.

Q. Patch cables shall be augmented category 6 component compliant out to 250MHz with operational bandwidth to 500MHz

1. Be factory assembled and 100% transmission tested with laboratory grade network analyzers for proper performance up to 500MHz

2. Manufacturer will be able to supply any length patch required (custom) from 6" – 20' at no additional charge.

R. A laminated floorplan shall be mounted in each BDF/IDF identifying all outlets being served.

S. See Attachment B for floor plan layout (IDF Rack Elevation Top View).

T. See Attachment B for Rack Elevation (IDF Rack Elevation Front View)

2.14 LIGHTNING PROTECTION

A. Contractor shall provide multipair protector panel(s), including mounting and termination hardware. The multipair protector panel(s) shall be UL listed.

B. For small pair count applications (less than or equal to 200-pairs), the multipair protector panel shall consist of a mounting panel for a series of solid-state gas-tube protector units, 710-type connector for input, and 110-type termination blocks for output. Insertion of the protector units into the mounting panel will complete the circuit. The multipair protector panel(s) shall be available in 25-, 50-, 100-, and 200-pair counts.

C. For large pair count applications (greater than 200 pairs) or when the multipair protector panel is separated from the cross-connect field, the multipair protector panel shall consist of a metal housing containing mountings for a series of solid-state gas-tube protector units. The protector units shall include a 25 foot, 26 AWG stub cable that serves as a fusible link, a 24 AWG terminating cable, and two connectors for external ground connections. The protection devices shall be available in 50- and 100-pair counts.

D. Gas-tube Protection Units:

1. DC Breakdown Voltage (at 2 KV/sec): 265-425V.

2. Surger Breakdown Voltage (at 100 V/μsec): 200-800V.

3. Insulation Resistance: 100 Mohms.

4. Vented Breakdown Voltage: Less than 1,000V.

5. DC Arc Voltage: 20V (typical).

6. Capacitance: Less than 100 pf.

7. Rated Impulse Discharge: 200A.

8. AC Discharge: 65A (11 cycles at 60 Hz).

9. Maximum Impulse Discharge: 20 KA.

2.15 DEMARCATION REQUIREMENTS

A. Contractor shall coordinate all requirements for the demarcation point with the owner's selected service provider.

B. The Contractor shall not proceed with any installation without written communication with the Architect/Engineer should the service provider's requirements differ from the work shown on the contract documents.

C. Refer to the drawings for further requirements.

2.16 FIRE RETARDANT PAINT

A. Manufacturers: Flamort Co., Inc., FireNoMore International, International Fire Retardants, Inc. or Equal.

END OF SECTION

SECTION 27 1300

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements per LACCD relating to furnishing and installing backbone communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of both optical fiber and/or copper cabling.

1.2 RELATED WORK

A. Basic Technology Systems Requirements.

B. Horizontal Cabling Requirements.

PART 2 - PRODUCTS

2.1 OPTICAL FIBER BACKBONE – INSIDE PLANT (PLENUM)

A. Multimode (MM)/Single Mode (SM):

1. This optical fiber backbone cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.

2. Optical fiber cable shall be Air-Blown Fiber.

3. Temperature Range:

a. Storage: -40°C to +70°C (no irreversible change in attenuation).

b. Operating: -40°C to +70°C.

4. Humidity Range: 0% to 100%.

5. Maximum Tensile Strength (≥ 12 fibers):

a. During Installation: 1332 Newton (300 lb. force) (no irreversible change in attenuation).

b. Long-Term: 600 N (135 lb. force).

6. Maximum Tensile Strength (≤ 6 fibers):

a. During Installation: 1000 Newton (225 lb. force) (no irreversible change in attenuation).

b. Long-Term: 100 N (67 lb. force).

7. Bending Radius:

a. During Installation: 20 times cable diameter.

b. No Load: 10 times cable diameter.

B. Optical fiber cables suitable for installation in multiple environments (e.g., underground duct and building risers) may be used at the Contractor's option. Such optical fiber cables shall meet all specifications noted above for cables designated for each environment through which the optical fiber cable shall pass.

C. Basis of Design (OM4 Multimode):

1. Sumitomo Electric FutureFlex FB24GS5.

D. Basis of Design (OS2 Single Mode)

1. Sumitomo Electric FutureFlex FB24SX.

2.2 COPPER BACKBONE – INSIDE PLANT

A. Copper cabling shall only be installed for existing campuses where VOIP Systems are not installed. CAT 3 Backbone Cable:

1. The CAT 3 backbone cable shall link Communication Equipment Rooms serving the building. These CAT 3 backbone cables shall be terminated on rack-mounted RJ-45 Category 6A patch panels.

2. CAT 3 backbone cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride (PVC) CMR thermoplastic CMP plenum rated skin. Conductors shall be twisted to form pairs and be fully color-coded.

3. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of 10 distinctive colors to identify 25-pairs in accordance with ICEA publication S-80-576-1988. Marking of each mate of the primary conductor in a pair with the color of that primary conductor is optional.

4. CAT 3 backbone cable shall meet the TIA/EIA 3 performance requirements.

5. When CAT 3 backbone cables of larger than 25-pairs are required, the core shall be assembled into 25-pair sub-units, each color-coded in accordance with ICEA publication S-80-576-1988. CAT 3 backbone cables with over 600-pair shall have 25-pair binder groups combined into super units. These super units shall be

wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

6. CAT 3 backbone cables shall contain an overall corrugated, coated aluminum shield that is electrically continuous over its entire length.

7. CAT 3 backbone cables shall be Air Core with an 8-mil ALVYN Sheath.

8. Acceptable Manufacturers:

   a. General Cable

   b. Superior Essex

   c. CommScope

      1) at 1000-MHz: 4.23 dB.

2.3 OPTICAL FIBER BACKBONE PERFORMANCE

A. OM4 Multimode (MM):

1. Fiber Type: Multimode; doped silica core surrounded by a concentric glass cladding.

2. Index Profile: Graded Index.

3. Transmission Windows: 850-nm and 1300-nm.

4. Core Diameter (nom): 50-ηm (microns) ± 2.5.

5. Cladding Diameter: 125-ηm ± 1.

6. Core-clad Concentricity: ≤ 1.0-ηm.

7. Cladding Non-circularity: ≤ 1.0%.

8. Fiber Coating Diameter:

   a. 245-ηm ± 10 (primary coating).

   b. 900-ηm (nominal) secondary coating (tight buffer)

   c. All coatings shall be mechanically strippable without damaging the optical fiber.

9. Attenuation (maximum @ 23 ± 5°C; backbone):

   a. @ 850-nm: 3.5 dB/km.

   b. @ 1300-nm: 1.0 dB/km.

10. When tested in accordance with FOTP-3, “Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic

Components," the average change in attenuation over the rated temperature range of the optical cable shall not exceed 0.50 dB/km with 80% of the measured fibers not exceeding 0.25 dB/km.

11. Bandwidth (minimum):

    a. @ 850-nm: 3500 MHz*km.

    b. @ 1300-nm: 500 MHz*km.

12. No optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

B. Singlemode (SM):

1. Fiber Type: Singlemode; doped silica core surrounded by a concentric glass cladding.

2. Core Diameter: 8 to 9 µm. All optical fibers shall be of the same nominal core diameter and profile.

3. Cladding Diameter: 125 ± 1.0µm.

4. Cladding Non-circularity: ≤ 1%.

5. Core to Cladding Offset: ≤ 0.8 µm.

6. Fiber Coating Diameter:

    a. 245 ± 15µm (primary coating).

    b. 900-nm (nominal) secondary coating (tight buffer).

    c. All coatings shall be mechanically strippable without damaging the optical fiber.

7. Cut-off Wavelength (cabled fiber; λ_{ccf}) $\leq$ 1260-nm.

8. Mode Field Diameter: 8.3 to 9.8 m at 1300-nm; 10.5 ± 1.0 µm at 1550-nm.

9. Zero Dispersion Wavelength (λ_0): 1301.5 nm $\leq l_0 \leq$ 1321.5 nm.

10. Zero Dispersion Slope (S_0): $\leq$ 0.092 ps/nm^2*km.

11. Fiber Attenuation (maximum @ 23 ± 5°C; Backbone):

    a. @ 1300-nm: 2.0 dB/km

    b. @ 1550-nm: 1.75 dB/km

12. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic

Components," the average change in attenuation over the rated temperature range of the optical fiber cable shall not exceed 0.05 dB/km at 1550-nm. The magnitude of the maximum attenuation change of each individual optical fiber shall not be greater than 0.15 dB/km at 1550-nm.

13. Fiber Dispersion (maximum):

a. @ 1285 to 1330-nm: 3.2-ps/nm*km

b. @ 1550-nm: 18-ps/nm*km

C. No optical fiber shall show a point discontinuity greater than 0.1 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

2.4 FIBER TUBE CABLE (OSP AND RISER & ABF TUBE CLIPS

A. Sumitomo Electric Future Flex or Equal

2.5 CABLE INSTALLATION REQUIREMENTS

A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

B. A minimum of 5 meters (approximately 15 feet) of slack cable (each cable if applicable) shall be coiled and secured at both ends located in the entrance room, Telecommunications Room or main equipment room, for backbone and intra-building cable.

C. Where exposed, all backbone fiber optic cable shall be installed in protective inner duct. This includes areas where the cable is routed in cable tray and where making a transition between paths (e.g., between conduit and cable tray or into equipment racks). The inner duct should extend into the termination and/or storage enclosure(s) at system endpoints.

2.6 CROSS-CONNECTS

A. The Owner will be responsible for all cross-connects between the data backbone cabling and network electronics and between the data network electronics and horizontal cabling.

B. The Owner shall be responsible for the cross-connect wiring between the horizontal and backbone voice cabling.

C. This Contractor shall not be responsible for cross-connects between the cabling terminations at the Entrance Room and the telephone utility network point-of-presence. It shall be the responsibility of the Contractor, to work with the Owner and provide the necessary assistance to allow Owner and/or telephone company personnel to make the necessary connections to establish service on the new cable system. These activities include, but are not limited to cross-connect documentation, general wiring overview and cable pair identification.

END OF SECTION

SECTION 27 1500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements per LACCD relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper and optical fiber cabling.

1. Copper Horizontal Cable.

2. Station Outlets.

3. Faceplates

4. Emergency Phones

5. Classroom VoIP Intercoms, IP Paging

6. Wireless Access Points

1.2 APPLICABLE PUBLICATIONS

A. Telecommunications Structured Cabling System Standards:

1. The cabling system shall include high performance copper Category 6A (UTP, STP, FTP) and optical fiber (MM OM4 and SM) cabling where appropriate and as defined by LACCD. Cables may be routed through conduit, cable trays, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile, and through plenum air-handling spaces above ceiling tile. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

2. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

a. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer

Premises

b. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard

c. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard

d. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard

e. ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard

f. ANSI/TIA-569-C, Telecommunications Pathways and Spaces

g. ANSI/TIA-598-C, Optical Fiber Cable Color Coding

h. ANSI/TIA-606-B, Administration Standard for Telecommunications Infrastructure

i. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises

j. ANSI/TIA-758-B, Customer-Owned Outside Plant Telecommunications Infrastructure Standard

k. ANSI/TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode fiber Cable Plant

l. ANSI/TIA -526-14, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

m. ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers

n. ASHRAE 9.9, Thermal Guidelines for Data Processing Environments

PART 2 - MATERIALS

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used on the project.

B. Equivalent equipment manufactured by the other named manufacturers may be used only as approved by owner/district. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the project specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent. Contractor must Submit a comparison chart when submitting an approved equal product, where such comparison chart is not provided Architect/Engineer reserves the right to require the contractor to provide specified manufacturers after Bid is accepted by contractor.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

E. The Contractor shall install cables and equipment as part of a Structured Cabling System (SCS). The various sections of this specification pertain to specific products and/or installation requirements that must conform to the warranty requirements of the Structured Cabling System manufacturer. The College prefers a Structured Cabling System throughout their buildings. The SCS to be used is Siemon 10Gig Category 6A F/UTP or equal.

2.2 COPPER HORIZONTAL CABLE (CATEGORY 6A, F/UTP (PLENUM)

A. Material

1. Use for voice and data applications to interconnect services from workstation to the wiring closet in a plenum or non-plenum rated space.

2. CMP rated only, except where cabling is routed under slab on grade, then use OSP rated cable.

3. Four pair, 23 AWG, Category 6A, F/UTP, as defined by the EIA/TIA standards intended for use with transmission rates up to and including 10 Gbps. Cabling shall be tested up to 750 MHz. Cable shall exceed transmission requirements listed in ANSI/TIA/EIA-568-C.2. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.

4. The horizontal cable requirements must be met, as well as the following channel requirements.

5. CAT 6A cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.

6. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.

7. Performance data shall be provided by third-party independent testing laboratories only. Testing data shall be submitted on the third-party testing laboratory letterhead. Test data will only be accepted if it displays testing as a channel. Electrical characteristics of the performance of the cable itself will not satisfy this requirement.

8. The structured cabling and connectivity may be provided by the same company. For the purpose of this document that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed as an acceptable manufacturer.

   Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.

9. The 4-connector channel performance margins in the table below shall be guaranteed margins above ANSI/TIA/EIA-568-C.2:

Electrical Value (1 - 500 MHz)	Minimum Margin
Insertion Loss:	3%
NEXT:	2 dB
PS NEXT:	3 dB
PSA NEXT:	3dB
PSA NEXT (Average):	
ACR-F:	2 dB
PS ACR-F:	3 dB
PSA ACR-F:	3 dB
PSA ACR-F (Average):	3 dB
Return Loss:	2 dB

10. The jacket color for CAT 6A cable shall be white for voice applications and blue for data applications.

B. Manufacturer:

1. Siemon

   a. Plenum Rated Part #: 9A6P4-A5-06-R1A (Data Blue, Phone white)

   b. OSP Rated Part #: 9A6O4-A5-01-R1A (Black)

2. Panduit as approved equal

   a. Indoor Plenum Rated (Data Blue, Phone white)

b. Outdoor OSP Rated (Black)

2.3 OUTLET LABELS

A. Materials:

1. All labels shall be made using a label maker that produces clear adhesive labels with black typeset characters. The labels must have a strong adhesive that will not come off unless it is forced off. The label size will be 3/16 inch wide with a typeset font no smaller than 10 point. The Contractor shall utilize the label maker and labels that are recommended for the selected Structured Cabling System.

2. There shall be no difference, in numbering, between a voice jack and a data jack. Voice and data will be punched down side-by side on the same patch panel, the campus standard is for all Cat 6A jacks to be identified as D01, D02, D03, etc. The number indicating the position on the patch panel. So D186 is the 186th position on the patch panel in the telecom room.

3. The Contractor must submit a sample label to the District for approval prior to labeling the new outlets.

2.4 STATION OUTLETS

A. Metal Outlet Boxes

1. Metal outlet boxes shall be installed as receptacles for the information outlets in the following locations: new interior wall construction, exterior locations, locations with special vapor proof or explosion proof applications, and floor mounted outlets. Outlet boxes shall be galvanized steel, double-gang and extra deep (2 1/8"). Boxes installed in any exterior location where exposed to rain or moisture laden atmosphere shall be cast screw hub type with gaskets and weatherproof covers. Boxes for vapor proof or explosion proof applications shall be designed specifically for such use.

2. In new wall construction, each box shall be flush mounted and equipped with a 1 1/4" conduit stubbed into the ceiling area at least 9 ".

3. In walls that are not fishable and exterior locations, the outlet box will be surface mounted. Locations of surface mounted outlets must be approved by the Inspector of Record prior to installation. All floor boxes shall be recessed.

4. All boxes shall be equipped with single (one) gang ring in locations with one voice or one data cable. All boxes shall be equipped with a dual (two) gang ring in locations with a total of two to eight copper and fiber station cables.

B. Manufacturers: Appleton, Raco, or Steel City.

C. Data Outlets

1. The standard data outlet shall consist of four (4) Category 6A Shielded four-pair cables, each terminated on a separate Category 6A Shielded rated RJ45 8-position jack following EIA/TIA T568B wiring standards. Jacks colors shall be as follows in order one through four: White (used for voice), red, blue and green. If

an outlet needs to have six ports, the fifth and sixth jack colors shall be yellow and black in that order.

2. The modular jacks shall be rated for Category 6A performance in the configuration installed. Manufacturer: SIEMON Z-MAX 6A Shielded.

3. The faceplate will be clearly labeled with outlet number, and each jack will be labeled with jack number. All labels will be typed or preprinted and shall be securely affixed to the faceplate.

4. Dust covers shall be placed in the vacant slots. Manufacturer: SIEMON Faceplates or equal.

D. Voice Only Outlets

1. Voice only outlets shall consist of a single four-pair Category 6A Shielded cable connected to a wire modular jack assembly with a metal cover plate suitable for securing a wall mounted telephone. The color of the jack will be white designated for voice.

2. All wall phone outlets shall be placed at 44 inches above the finished floor unless otherwise noted to make the maximum height to the top of the telephone 48 inches above the finished floor.

3. Wall phone outlets shall be equipped with a duplex mud-ring around the standard dual gang outlet box recessed in the wall where possible.

4. Wall phone outlets shall consist of a stainless steel duplex faceplate equipped with a single RJ45 jack.

5. Manufacturer: SIEMON 10GMX Z-MAX Cat 6A Shielded jack and SIEMON Faceplate or equal.

E. Floor-Mount Voice/Data/Data Outlets

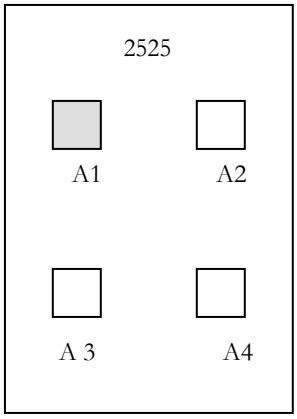
1. The data floor-mount outlet shall consist of four (4) Category 6A Shielded four-pair cables, each terminated on a separate CAT 6A Shielded RJ45 8- position jack following EIA/TIA T568B wiring standards. Jacks shall be white, red, blue and green, in that exact order, one through 4. The floor boxes are provided on the electrical drawings.

2. The communications portion of the floor box outlet shall be equipped with a Hubbell Style Line (Part # LCFBP26) for each gang. For Poke Thru Floor outlets, the cover sub plate shall be a Hubbell Duplex/Style Line cover.

3. Manufacturer: Hubbell, FSR or equal

F. Floor-Mount Furniture Feeds

1. The data furniture outlet shall consist of four Category 6A Shielded four-pair cables or more if indicated in the drawings, each terminated on a separate Cat 6A Shielded RJ45 8-position jack following EIA/TIA T568A wiring standards color



coded white, red, blue and green, in that exact order. Where indicated on the drawings, leave 20 extra feet of cabling per jack in the ceiling.

2. Manufacturer: Siemon 10GMX Z-Max 6A Shielded jacks or equal.

2.5 FACEPLATES

A. Faceplates will be supplied for every information outlet (voice, data, and network). Unless otherwise noted. They shall meet the required NEMA standard.

B. All faceplates shall be available in single, duplex, triple, quad plex or six plex arrangement in a single gang configuration.

C. Faceplates shall be available in eight plex arrangement in a dual gang box configuration.

D. Surface mount boxes shall be available in single, dual, quad six plex and twelve plex configuration.

E. Patch Panels

1. All patch panels will be labeled alphabetically starting from at the top of the rack with letter A. See example below:

a. Patch Panel 1 through 40 Jack Number

b. Patch Panel 1 through 40 Jack Number

2. Panel Label: the 48 port patch panels will be terminated from *A1, A2, A3*, and so on until *A40*. Ports 41through 48 will be to be used as spares.

2.6 EMERGENCY PHONES

A. Materials:

1. The Talk-A-Phone is the campus preference for emergency phones to match existing campus preferred VOIP. It requires 120v power, a surge protector, VOIP connection, a blue light strobe and ADA compliant.

a. Wall Mount Model ETP-WMS

b. Tower ETP-MT/R

c. Both equipped with VOIP-500EI Phone.

d. For elevator phones, use VOIP-500EI.

e. Wall-mount color is stainless steel; Tower color is blue and colors shall be discussed with Facilities Staff prior to ordering for project.

f. Where existing campus is equipped with Zenitel, provide to match existing campus system.

B. Manufacturer: Talk-A-Phone Co, 7530 North Natchez Ave., Niles, Ill. 60714-3804,

C. Code Blue Phone, Zenitel or equal.

D. Elevator phones shall be a product of Talk-A-Phone, call-24 or approved equal

2.7 CLASSROOM VOIP INTERCOMS

A. Materials:

1. The ALGO SIP Intercom is the campus preference for Classroom VoIP Intercoms. It is a POE device with 6 watts maximum.

2. Basis of Design: ALGO Model # 8201 or approved equal.

3. IP Paging shall be a product of Singlewire Informa cast, AtlasIED, Valcom or approved equal.

2.8 WIRELESS ACCESS POINTS

A. Where required to be provided and installed by contractor. Contractor shall provide the products manufactured by Aruba, Cisco or approved equal. Where approved equal products are submitted these shall be considered, Final approval shall be provided by owner

B. Wireless Access Point locations to be provided with Minimum (2) CAT-6A cables per District Standards. These locations must be installed with 25’ of cable slack to accommodate any modifications required during the installations.

C. Wireless access points shall be provided and installed to where the project will always have sufficient coverage at all times. General Contractor will be responsible to provide heat map results to the facility when Wifi devices are installed in order to determine proper coverage has been met.

2.9 GENERAL INSTALLATIONS STANDARDS

A. All installation work shall be performed according to published industry guidelines, rules, and regulations. If disputes occur, local, state, and national codes have precedence; then standards such as EIA/TIA; then guidelines from firms such as Building Industry Consulting Services International (BICSI), AT&T, and Verizon; then specific component manufacturer's recommendations.

B. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.

C. The Contractor shall provide sufficient trained staff to monitor all work undertaken and ensure that the requirements of these specifications are met throughout the installation process.

D. All tests will be conducted using equipment that has Laboratory or manufacturer certified calibration at start up and then six months later. The Contractor shall provide a signed copy of the calibration test results for each item of test equipment with the acceptance documentation.

E. All installation work will be of the highest quality. The Contractor shall at all times make every effort to conduct all installation work in a manner so as to minimize the impact on the facilities. Whenever possible, all work will be hidden behind finished materials and all surfaces will be returned to their original condition.

F. The Contractor shall provide and install all pathway and cable support hardware necessary to successfully complete the installation. This includes, but is not limited to, hangers, ladder racks, support brackets, conduit and sleeves, firestop materials, tie-wraps, and access openings such as core drills.

G. The Contractor shall ensure that only staff fully qualified to work on specific types of materials are allowed to undertake the required installation. Particularly, copper and fiber optic cable placement, termination, splicing, and testing shall only be undertaken by staff who are certified by the Structured Cabling System cable manufacturer.

H. The Contractor shall provide all hardware, software, and miscellaneous components necessary to provide a complete system.

I. Contractor shall be responsible to install all owner provided equipment including but not limited to UPS’s Network Data Switches Etc.

J. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:

1. Twelve (12) inches from power lines of <5-kVa.

2. Eighteen (18) inches from high-voltage lighting (including fluorescent).

3. Thirty-nine (39) inches from power lines of 5-kVa or greater.

4. Thirty-nine (39) inches from transformers and motors.

K. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.

L. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

2.10 STATION OUTLETS

A. Station outlets shall be mounted securely at work area locations.

B. Station outlets shall be located so that the cable required to reach the desktop equipment is no more than 16 feet long.

C. Station outlets cannot not be "daisy-chained." As these are to have their own cabling with an IP address associated.

D. Outlets shall be mounted as follows:

1. Wall phone: 48 inches above the finished floor.

2. Standard voice/data outlet: 18 inches above the finished floor.

3. Counter top: 6 inches above the counter top.

2.11 FACEPLATES

A. The faceplates shall have their jack positions labeled. The first line which is used for voice (white jack) is the number 1 line and the second (red jack) is number 2, etc using the color scheme noted in 2.3 C 1 above.

B. The work will be scheduled so that the voice and data networks will be out of service for a minimum period of time.

2.12 CABLE TESTING PROCEDURES

A. The Contractor will provide all tools, equipment, and fully trained staff necessary to conduct fully witnessed acceptance testing of all installed telecommunications-related products and systems.

B. The LACCD district standards includes, but is not limited to, the following:

1. All system(s) shall be checked for compliance with the construction documents. The Contractor shall maintain a check-off list for all tests.

2. The result of the measurements outlined shall be recorded and submitted in a neatly bound format along with current as-built drawings to the District as final proof of system performance. The Contractor shall immediately replace any system which does not meet industry standards and Manufacturers published performance specifications at no cost to the District. Failure to act in a timely and expeditious manner to properly remedy any abnormality resulting from installation/construction defects or workmanship; faulty material; and/or the failure of the systems, components, or the cable media to perform in accordance

with the construction documents and/or the SCS supplier's technical specifications shall cause the District, at its discretion, to place a "hold" on any other telecommunications development or construction associated with this project. The Construction Administrator will notify the Contractor in writing of such action and is absolved and shall be held harmless from any delays, costs over-runs, scheduling difficulties, etc. assessed by others due to the Contractor's failure to meet the final proof of system performance specifications. Final as-builts will be provided, as specified, at the end of the project.

3. All systems shall meet the construction specifications, SCS supplier's performance requirements and be accepted by the District before the work will be considered complete.

C. After the Contractor has provided complete documentation of all testing and the documentation have been reviewed by the District, the Contractor shall conduct "proof of performance" testing, in the presence of District personnel or their designated representatives, on selected components at the direction and discretion of the District. These tests will be conducted on approximately 5% of the installed system capacity. Such testing will utilize the same equipment and procedures used to conduct and document the initial tests but will be applied on a random basis to verify the testing documentation. If in the judgment of the District, the proof-of-performance test results vary significantly from the acceptance test results, the Contractor shall continue with testing beyond the 5% at the discretion of the Construction Administrator until cleared to the satisfaction of the District.

D. A certified laboratory or the manufacturer shall calibrate all test equipment within the last six months, and such certification shall be submitted to the District prior to testing.

E. The Construction Administrator shall be provided a minimum of one week's notice of all acceptance and proof-of-performance testing to be conducted throughout the project.

2.13 INSPECTION AND TESTING PROCEDURES FOR COPPER CABLE

A. The Construction Administrator will conduct routine inspections and document the progress. In the event Construction coordinator determines work is progressing in an incorrect manner and waiting for the regular meeting could cause significant rework by the Contractor, the Contractor's on-site project manager shall be notified.

B. Copper Station and Riser Cables: The Contractor shall conduct witnessed acceptance testing on all station and riser cable installed as part of the project as defined below:

1. All riser cable pairs will be tested for crosses, opens, grounds, reversed and/or transposed pairs, shorts, foreign battery, continuity, and resistance (in ohms). All riser cable pairs shall be tested for loss in dB. All problems will be resolved and the cable re-tested to ensure compliance. Using a Category 6A rated pair scanner or similar device, all copper station cables will be tested to verify the installation complies with the performance requirements of ANSUTINEIA -568-A Category 6A.

2. All test results, including jack numbers and cable lengths, shall be printed on a hardcopy report. All stations shall meet or exceed this performance standard. All pair scanners used on the project shall be calibrated to a single common test cable at be included as a reference with each batch of station test results submitted.

3. At the Contractor's option, the station test results can also be provided in electronic format (CD), as long as a copy of any software required to read and/or print the results is also provided at the same time.

C. Copper Entrance Cables: The Contractor's witnessed acceptance testing on all entrance cables installed as part of this project is defined below:

1. The correct and continuous bonding of cable shields through all inter-building cable splices shall be verified. This test shall be conducted from the voice and data centers and building MDF prior to strapping shield grounds at splice or termination points.

2. Each cable pair shall be tested for crosses, opens, grounds, reversed and/or transposed pairs, shorts, foreign battery, continuity, resistance (in ohms) and loss in dB.

3. All irregularities will be resolved and the cable re-tested to ensure compliance.

2.14 INSPECTION AND TESTING PROCEDURES FIBER CABLE

A. Fiber Optic Riser

1. The appropriate high resolution OTDR device shall be used to test the fiber riser cable. OTDR testing of riser cables is limited to those with one or more 90 bends and/or a length greater than 80 feet.

2. Continuity of all riser and station fiber optic cables, regardless of length, shall be verified by emitting an intense light source at one end of the fiber and measuring the intensity of light using a power meter at the opposite end of the fiber.

3. Tracing printouts (noting the appropriate optical fiber and buffer tube color designation) shall be mounted on separate pages and bound into a three-ring notebook. An incremental scale that reflects the short lengths of cable involved in these tests shall be utilized.

4. All fiber riser cable shall be tested from the building's BDF to each fiber IDF terminal. The results of OTDR testing to define the length of each riser cable shall be documented.

5. The Contractor shall conduct a power meter (loss) test of each fiber optic segment in station and riser cables from patch panel to patch panel. Tests shall be conducted using ANSI/E1A/T1A-526-14A, for Multi-mode and 526-7 for Single-mode. The Contractor shall provide a typed list reflecting cable ID and actual measured loss. Provide an acceptable testing procedure for end-to-end attenuation testing.)

B. Fiber Optic Entrance Cable

1. The appropriate high resolution OTDR device to test the fiber entrance cables shall be used. Tracing printouts (noting the appropriate optical fiber and buffer tube color designation) shall be mounted on separate pages and bound into a three-ring notebook. An incremental scale that reflects the short lengths of cable involved in these tests shall be utilized.

2. All fiber inter-building riser cable shall be OTDR tested at the appropriate longer wavelength (1300 for multimode, 1550 for single-mode) in both directions from the campus voice and data center to each building's MDF terminal, and from the MDF terminal to the voice and data center. The results of OTDR testing to define the length of each riser cable shall be documented, and a printed copy of each strand OTDR test in each direction shall be provided with the test results.

3. The Contractor shall conduct a power meter (loss) test of each fiber optic segment in station and riser cables from patch panel to patch panel. Tests shall be conducted using ANSI/EIA/TIA-526-14A, for Multi-mode and 526-7 for Single-mode. The Contractor shall provide a typed list reflecting cable ID and actual measured loss. ("Testing and Documentation" from the Design Guide 2002 Corning Cable Systems provides an acceptable testing procedure for end-to-end attenuation testing.)

2.15 DOCUMENTATION

A. Fiber Cable Systems

1. All documentation shall be neatly and legibly done and shall provide a clear understanding of the installed system.

2. The Contractor shall prepare "as-built" plans of all work including inter-building, entrance, and riser cable locations with footage. All approved changes and actual in-place footage shall be marked, in red, on a "D" size drawing. The as-builts shall include all fiber optic cable placed with cable lengths, fiber assignments, and cable numbers and counts.

3. The Contractor shall provide signed originals of all acceptance testing documents in a three ring binder, which are:

   a. Fiber optic insertion loss results

   b. OTDR graphs and printouts and test results

   c. Current test equipment certifications

B. Copper Cable Systems

1. The Contractor shall use forms provided by the District or Structured Cabling System manufacturer if approved by the Engineer of Record, to document the successful testing of all inter-building, entrance, riser and tie cables.

2. Test equipment used shall be Tektronix TPS 100 Twisted Pair Cable Analyzer or approved similar device. Category 6A station cable test results noting unique station number and group test results by floor shall be provided. The Contractor shall neatly note floor plans with "as-built" station number and any changes, additions, or deletions to outlet placement. Inter-building, entrance, and riser plans shall be updated to include actual routes, cable numbers and counts, and lengths of cables.

END OF SECTION

SECTION 28 0000

SECURITY SYSTEMS DESIGN CRITERIA

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to General Requirements.

B. Design team or design build team should provide a compliance letter with statement of being fully compliant with Campus standards and requirements for the campus as part of final submission documentation to the district. Design team or design build team should follow the latest District Design Guidelines and standards located on BuildLACCD's website. (http://www.build-laccd.org/contractors-bidders/standards-guidelines.

1.2 DESIGN CRITERIA

A. The operation and maintenance of the Physical Access Control System software, servers, and field processors fall under the authority of LACCD IT Department. Any and all changes or modifications to any of these shall be coordinated with the LACCD IT Department prior to commencement of activity.

B. The operation and maintenance of the Physical Access Control System electrified locks and associated door hardware fall under the authority of LACCD IT/Facilities Department. Any and all changes or modifications to any of these shall be coordinated with the LACCD IT/Facilities Department prior to commencement of activity.

C. This district wide design standard and the accompanying specifications govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Security Systems as specified herein.

D. Each Contractor shall provide all new materials as indicated in the schedules on the drawings and/or in these specifications, and all items required to make their portion of the security systems a finished and working system to comply with the district standards set forth.

E. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13)

F. Description of systems include but are not limited to the following:

1. Electronic Access Control System

2. Electronic Intrusion Detection System

3. Video Surveillance

4. Low Voltage Security Wiring (less than +120VAC) as specified and required for proper system control and communications.

5. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the “Suggested Matrix of Scope Responsibility”.

6. Firestopping of penetrations of fire-rated construction as described here-in Specification Section 28 05 03.

G. Any scope of work described contract documents and specifications shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

H. General:

1. The purpose of this Criteria is to outline typical Electrical and Security Contractor's work responsibilities as related to Security Systems including conduit, cable tray, power wiring and Low Voltage Security Wiring. The prime contractor is responsible for all divisions of work they will perform.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor’s bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.

4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

   a. Lighting Fixtures

   b. Gravity Flow Piping, including Steam and Condensate

   c. Sheet Metal

   d. Electrical Busduct

e. Cable Trays, including 12” access space

f. Sprinkler Piping and other Piping

g. Conduit and Wireway

h. Open Cabling

I. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the “Suggested Matrix of Scope Responsibility” to be provided by the Electrical Contractor.

2. Assumes all responsibility for providing and installing cable tray.

3. Responsible for Security Systems grounding and bonding.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

J. Security Contractor’s Responsibility:

1. Assumes all responsibility for the Low Voltage Security Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the “Suggested Matrix of Scope Responsibility.”

3. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Security equipment which is required to be bonded to the telecommunications ground system.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

K. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable. Refer to additional specifications here-in and each campus standard requirements for recommended and approved products for each system.

2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.

3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.

5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

   a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.

6. The Contractor shall conform to all requirements of the City of Los Angeles Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

7. The Contractor shall also conform to all published standards of the Los Angeles Community College, as related to this installation.

8. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.

9. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

10. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.

11. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

L. Permits, Fees, Taxes, Inspections:

1. Procures for all applicable permits and licenses.

2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.

3. Pay all applicable charges for such permits or licenses that may be required.

4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)

   a. Factory Mutual

   b. Underwriters' Laboratories, Inc.

M. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

N. Change order submitted must be prepared and accompanied by a detailed material and labor takeoff list for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

O. Change order work shall not proceed until authorized and approved by owner. Contractor shall be responsible to thoroughly review each specification, district and campus standard prior to submitting a bid. By summitting a bid, contractor shall be responsible to provide complete working systems at no additional cost to owner unless substantial circumstanced require addition changes to the project that were not foreseen.

P. Warranty requirements at a minimum shall provide a five (5) year service warranty for all equipment, materials, and workmanship. Individual specifications sections may require additional warranty requirements for specific equipment or systems.

Q. Contractor shall be responsible to provide at a maximum a 4-hour response time for servicing or replacing any equipment or devices installed for the project.

R. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

S. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

T. Where several manufacturers’ names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

U. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

V. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured **in writing** from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

W. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

X. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

Y. Installation of all conduit and cabling shall comply with Div. 26 specifications. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

Z. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

AA. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

BB. All cables and devices installed in damp or wet locations, including any underground or

underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

CC. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

1. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

2. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

3. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

4. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

DD. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.

2. Refer to the end of Section this section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."

3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

EE. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.

2. Submitted bound copies of approved shop drawings.

3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site insert address here; submit receipt to Architect/Engineer prior to final payment being approved.

8. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer’s review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer’s comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

9. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

FF. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. O&M file name: O&M.div28.contractor.YYYYMMDD

b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD

5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as “1 of 2”, “2 of 2”, etc.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

GG. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copy of final approved test and balance reports.

5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.

7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.

9. Capacities and utility consumption of equipment.

10. Detailed parts lists with lists of suppliers.

11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.

15. Instruction books, cards, and manuals furnished with the equipment.

HH. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

II. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

JJ. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

KK. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

LL. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner’s operating staff on the security systems. For PACS systems, a minimum 16 hours of system training shall be allocated for each project containing greater than 25 access-controlled entrances. For security systems a minimum 8 hours of system training shall be provided. This training shall be conducted by a manufacturer authorized and certified instructor. Training materials shall be supplied in both printed as well as electronic format and shall be specific to the project.

2. Training shall be formatted into 4-hour increments, so that multiple training sessions may take place depending upon the availability of the staff requiring the training.

3. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

MM. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

NN. All operating conditions and control sequences shall be simulated and tested during the start-up period.

OO. The Contractor, subcontractors, and equipment suppliers are expected to have skilled

technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

PP. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

QQ. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

RR. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

SS. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

TT. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

UU. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION

SECTION 28 0503

THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=12). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

1.1 SECTION INCLUDES

A. This section includes firestopping for through-penetrations and joints in or between the following fire-resistance rated assemblies, including both blank openings, linear openings, and openings containing penetrating items:

1. Floor-ceiling assemblies.

2. Roof-ceiling assemblies.

3. Walls and partitions.

4. Smoke barriers.

5. Construction enclosing compartmentalized areas.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.

1. Through Penetration Firestop Systems (XHEZ)

2. Joint Systems (XHBN)

3. Perimeter Fire Containment Systems (XHDG)

4. Continuity Head-of-Wall Joint Systems (XHBO)

5. Fill, Void or Cavity Materials (XHHW)

6. Firestop Devices (XHJI)

7. Forming Materials (XHKU)

8. Wall Opening Protective Materials (CLIV)

B. All major building codes:

1. International Building Code published by ICC.

2. (Note to specifier: Retain or delete the building codes listed above as applicable).

C. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.

D. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 70: National Electrical Code”.

E. Factory Mutual Approvals (FM) of Norwood, MA “FM 4991: Standard for Approval of Firestop Contractors”.

F. Underwriters Laboratories (UL) of Northbrook, IL “UL Qualified Firestop Contractor Program”

1.4 PERFORMANCE REQUIREMENTS

A. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.

B. When intumescent products are used, provide products that do not contain sodium silicate or any other water soluble intumescent ingredient in the formulation.

C. Provide firestop products that do not contain ethylene glycol.

D. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.

E. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.

F. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall be:

1. Capable of retrofit around existing cables

2. Designed such that two or more devices can be ganged together

3. Maintenance free such that no action is required to activate the smoke and fire sealing mechanism

G. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

H. Provide fire-resistive joint sealants sufficiently flexible to accommodate movement such as thermal expansion and other normal building movement without damage to the seal.

I. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E1966, or ANSI/ UL 2079.

J. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/ UL1479 for penetrations and ANSI/UL2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.

K. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

L. Provide a fire-rated grommet for all individual or small grouped cable applications up to 0.53 in. (14 mm).

M. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.

1.5 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.6 WARRANTY

A. Provide one-year warranty on parts and labor at a minimum. Contractor should provide added warranty to district based on inspection frequency.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) and/or wall opening protective materials (CLIV) and/or joint systems (XHBN) and/or perimeter fire containment systems (XHDG) and/or continuity head-of-wall joint systems (XHBO) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Acceptable Manufacturer: Specified Technologies Inc., 210 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

2. Hilti, Inc., Tulsa, Oklahoma
800-879-8000
www.us.hilti.com

3. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

4. 3M Products

5. Or approved equal

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. General: LACCD standards should be to provide Kit Style assembly system and putty style fire blocking materials where possible. Use only firestopping products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type or joint opening width and movement capabilities, annular space requirements, and fire-rating involved for each separate instance.

B. Intumescent Sealants: Single component intumescent latex formulations containing no water soluble intumescent ingredients capable of expanding a minimum 8 times, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSS Intumescent Sealant

2. Specified Technologies, Inc. (STI) SpecSeal Series LCI Intumescent Sealant

C. Endothermic Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series LC Endothermic Sealant

D. Elastomeric Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture and accommodate minimum ±25 percent movement, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series AS Elastomeric Spray

2. Specified Technologies, Inc. (STI) SpecSeal Series ES Elastomeric Sealant

E. Firestop Devices: Factory-assembled steel collars lined with intumescent material capable of expanding a minimum 30 times sized to fit specific outside diameter of penetrating item, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSC Firestop Collars

2. Specified Technologies, Inc. (STI) SpecSeal Series LCC Firestop Collars

F. Fire Rated Cable Pathways: Gangable device modules capable of being retrofitted around existing cables and comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill and requiring no additional action in the form of plugs, twisting closure, putty, pillow, or sealant to achieve fire and leakage ratings, the following products are acceptable:

1. Specified Technologies Inc. (STI) EZ-Path Fire Rated Pathway

G. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24” (610 mm), the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty Pads

2. Specified Technologies, Inc. (STI) SpecSeal Series EP PowerShield Insert Pads

H. Firestop Putty: Intumescent, 100% solids, non-hardening, water resistant, butyl rubber based putties containing no solvents or silicone compounds, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSP Firestop Putty

I. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film and capable of expanding a minimum 30 times, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series RED2 Wrap Strip

2. Specified Technologies, Inc. (STI) SpecSeal Series BLU2 Wrap Strip

J. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides contained in a flame retardant poly bag, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSB Firestop Pillows

K. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series SSM Firestop Mortar

L. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag), the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal SIL300 Silicone Firestop Sealant

2. Specified Technologies, Inc. (STI) SpecSeal SIL300 SL Self-Leveling Silicone Firestop Sealant’

M. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coatings for horizontal surfaces where greater water resistance is required or inclement weather is anticipated, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal FT305 Firestop Spray

N. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam, the following products are acceptable:

1. Specified Technologies, Inc. (STI) Pensil 200 Silicone Foam

O. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil capable of sustaining a minimum 2,500 lbs (1,134 kg) when subjected to load testing, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal CS Composite Sheet

P. Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal CD Cast-In Firestop Device

Q. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestop gasket for use on steel HVAC ducts, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal FyreFlange Firestop Angles

R. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material capable of expanding minimum 10 times with expansion beginning at 350°F (177°C) for use in blank openings and cable sleeves, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series FP Firestop Plug

S. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal T-Collar Device

T. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing cable penetrations up to 0.53 in. (14 mm) diameter, the following products are acceptable:

1. Specified Technologies, Inc. (STI) EZ-Firestop Grommet (RFG1 or RFG2)

U. Fire-Rated Closet Flange Gasket: Molded, single-component, intumescent gasket for use beneath a closet flange in floor applications, the following products are acceptable:

1. Specified Technologies, Inc. (STI) SpecSeal Series CF34 Closet Flange Firestop Gasket

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.

C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General Requirements: Install through-penetration firestop systems and fire-resistive joint systems in accordance with “Performance Criteria” Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of firestopping products.

1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.

2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of through-penetration firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

3. Protect materials from damage on surfaces subjected to traffic.

4. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition might occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

5. Where joint application is exposed to the elements, fire-resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C-920, “Specification for Elastomeric Joint Sealants”.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage. Contractor shall be responsible to provide visual inspection at end of project and shall be responsible to correct any deficiencies prior to owner’s visual verification. Where owner find enough repairs are needed, contractor shall make repair at no addition cost.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 28 1300

ACCESS CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

B. The following document contains the deployment, technology, and installation standards for Physical Access Control Systems (PACS) within LACCD facilities.

C. Program managers, designers, and contractors shall review and familiarize themselves with the requirements contained herein prior to beginning any project which has a PACS component.

D. For all appendixes listed with this document please refer to BuildLACCD's website (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13)

E. LACCD has developed standards governing the deployment of Physical Access Control Systems to provide a baseline level of security that is required within District facilities. The PACS standards were developed to meet the goals and recommendations as described within the following documents:

1. Chancellor's Directive 185, Dated April 27, 2018 (as Appendix 3)

2. Blue Ribbon Panel on Campus Safety & Emergency Preparedness, Dated December 16, 2015 (as Appendix 4)

3. LACCD Strategic Plan 2018 – 2023, Dated January 18, 2018 (as Appendix 5)

F. These standards shall be utilized to aid in the application of current technology standards and best practices to all new construction as well as renovation projects undertaken within the District.

G. A physical access control system is any system which manages access to areas through the issuance and revocation of entry credentials. The purpose of the PACS is to efficiently and effectively control access to buildings and rooms within buildings based upon 3 key principles:

1. Chancellor's Directive 185, Dated April 27, 2018 (as Appendix 3)

2. Blue Ribbon Panel on Campus Safety & Emergency Preparedness, Dated

December 16, 2015 (as Appendix 4)

3. LACCD Strategic Plan 2018 – 2023, Dated January 18, 2018 (as Appendix 5)

1.2 ACRONYMS USED

A. IT – Information Technology

B. IDS – Intrusion Detection System

C. LACCD – Los Angeles Community College District

D. PACS – Physical Access Control System (Building Access Control)

E. PIN – Personal Identification Number

F. REX – Request to Exit

1.3 TYPICAL PACS DEVICES

A. The PACS consists of the following operating components:

1. PACS Host Server – This is where the core system software typically resides, including the user database from which user workgroups and credentials are derived, as well as the actual operating software of the system.

2. PACS Workstations – These are where system operators / administrators can alter system configurations, enter and delete users, modify access levels, monitor alarms and door positions, remotely release doors when appropriate, and perform all other operator / administrator related tasks.

3. PACS Controlling Software – This is the actual operating system of the PACS. For the District standard of Lenel, it is the On-Guard platform.

4. Door Controllers – This is where local decisions are made regarding the validity of a credential and if the credential should grant access to that particular door at that particular time. Door controllers should be able to function in an offline environment, where there is no connectivity to the host server, and log a minimum of 10,000 transactions. Transaction data shall upload, and any recent system changes should download as soon as host connectivity is restored.

5. Card Readers – These are contactless devices which wirelessly read a user's credential, decrypt the credential identifier and transmit that credential identifier to the Door Controller for validation of access. Dual factor Authentication Card Readers shall also have an integral keypad to allow for Personal Identification Number (PIN) entry. Any card reader or card reader / keypad installed shall be capable of reading any non- proprietary LACCD proximity card or key fob credential issued since 1998.

6. System Credential - A Credential that is issued by LACCD for the purpose of allowing properly authorized individuals to access buildings and selected rooms within buildings. The type of credential can vary, and may include form factors such as proximity cards, multi-class smart cards, or key fobs.

7. Electronic Locking Hardware – This is the door hardware which physically secures the door and releases it for access upon presentation of a valid credential to the card reader.

8. Request to Exit (REX) Sensor – This device allows users to exit through an access- controlled door without triggering a “forced door” alert which results if an access- controlled door is opened without presentation of a valid credential. It is typically either an integral part of the electronic door locking hardware or a separate device mounted above the secure side of the door.

9. Door Position Sensor – This device monitors the door for opening and reclosing and will cause the system to alert if a door is opened without presentation of a valid credential or if the door is left open for more than 10 seconds after presentation of a valid credential.

1.4 DISTRICT STANDARDS FOR PACS DEPLOYMENT

A. The PACS consists of the following operating components:

1. The LACCD has determined minimum levels of physical access control to be deployed at each LACCD College. The following door types are to be equipped with electronic access control and integrated into the District-wide PACS without exception:

2. Any exterior door leading into a building containing classrooms.

3. Any exterior door leading directly into a classroom. (This type of door shall also to be equipped with internal lockdown capability, with such lockdown to be independent of and not interfering with the operations of the District-wide PACS.)

4. Any interior or exterior door leading into a room that contains valuable academic equipment or resources such as computer laboratories, instruments, tools, media equipment / materials, etc. All Childhood Development Centers shall be included.

5. Any interior or exterior door leading into an area containing Critical Infrastructure, where unauthorized entry could drastically impact the daily operation of the college or cause great harm to an individual such as data closets, electrical closets, mechanical equipment rooms, fire suppression equipment rooms, roofs, and other inherently hazardous areas. These doors shall be secured via dual factor authentication such as card and PIN (keypad).

6. Any interior or exterior door leading into any chemical laboratories, chemical storage rooms and any other rooms which contain dangerous substances that could harm an individual unfamiliar with the hazards such substances represent. These doors shall be secured via dual factor authentication such as card and PIN (keypad).

7. Any interior or exterior door leading into an area containing file storage rooms that contain sensitive financial or personal information of individuals. These doors shall be secured via dual factor authentication such as card and PIN (keypad).

8. Any interior or exterior door leading into a storage rooms that contain safes, large sums of cash, works of art, and/or other high value items. These doors shall be

secured via dual factor authentication such as card and PIN (keypad).

9. Any interior or exterior doors leading from a public space into the secured area of the Campus Safety location.

10. Any interior or exterior door leading into evidence storage, weapons storage, quartermaster or other law enforcement equipment rooms. These doors shall be secured via dual factor authentication such as card and PIN (keypad).

1.5 DISTRICT STANDARDS FOR PACS DEPLOYMENT

A. All PACS and IDS components shall be controlled by and report to a common enterprise level software operating platform, in order to facilitate the monitoring of

B. both technologies on a single workstation located within Campus Safety, as well as any other authorized location.

C. This software platform shall be compatible with, and capable of integration to, the current District-wide Lenel platform without exception.

D. The Video Monitoring System (VMS) software platform shall be integrated into the PACS software platform in such a fashion as to cause selected PACS user actions and policy violations as well as IDS / Duress activations to be tagged with descriptive metadata on the recorded video and activate a live viewing screen.

E. The integration shall also provide through the PACS a graphical layout of the floor plan with the location of all sensors shown, and any sensor in the alarmed state shown as blinking red to allow for ease of location.

1.6 ENTERPRISE SOFTWARE CAPABILITIES

A. The PACS system shall be configured as a centralized enterprise system using a District master server and local College servers.

B. System operators and administrators of the PACS shall only be granted access to the application using Windows Active Directory credentials.

C. Audit trail records shall be accurately maintained for a period of three (3) years of which individuals performed programming / configuration / database changes within the PACS as well as records of valid and invalid usage attempts from each card reader.

D. The PACS shall integrate into the District HR system as to allow for credential issuance and revocation for new and terminated employees.

1.7 SYSTEM PERFORMANCE VERIFICATION TESTING AND COMMISSIONING

A. A performance verification testing and commissioning report shall be completed for each PACS project, containing a checklist of all District deployment and installation standards. This testing and commissioning process shall serve to verify compliance with all features and functionality required of the PACS. If any portion of the system fails the testing / commissioning process, the issue shall be corrected, and the process shall begin again. Any system consecutively failing (2) such testing attempts shall be retested at the Contractor’s expense.

B. A representative from each firm involved with any portion of the installation shall be present for the system testing in order to ensure whichever firm is responsible for the failure is present and able to resolve the issue expeditiously

1.8 SYSTEM EQUIPMENT INSTALLATION AND CONFIGURATION SPECIFICATIONS

A. Refer to Appendix 1, Districtwide Security Performance Requirements, for additional details on the equipment and configuration settings that shall be utilized.

B. Refer to Appendix 2 for typical installation details.

1.9 TRAINING AND DOCUMENTATION

A. Support and training costs associated with the PACS will be paid by the Software Installer.

B. A minimum 16 hours of system training shall be allocated for each project containing greater than 25 access-controlled entrances. This training shall be conducted by a manufacturer authorized and certified instructor. Training materials shall be supplied in both printed as well as electronic format and shall be specific to the project.

C. Training shall not begin until the PACS has been completely tested and commissioned, in order that users may be trained on a fully functional system.

D. Training shall be centric to the operational roles that the College deems necessary at the time the training takes place.

E. Training shall be formatted into 4-hour increments, so that multiple training sessions may take place depending upon the availability of the staff requiring the training.

1.10 STANDARDIZED HARDWARE/SOFTWARE PLATTFORM

A. The LACCD PACS standard is the OnGuard Enterprise Access Control System as manufactured by Lenel.

B. Card Readers shall be manufactured by HID Global and be capable of supporting all credentials issued by the District for the last eight years.

END OF SECTION

SECTION 28 2300

VIDEO SURVEILANCE

PART 1 - GENERAL

1.1 SUMMARY

A. The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

B. The following document contains the deployment, technology, and installation standards for Video Surveillance Systems (VSS) within LACCD facilities.

C. Program managers, designers, and contractors shall review and familiarize themselves with the requirements contained herein prior to beginning any project which has a VSS component.

D. For all appendixes listed with this document please refer to BuildLACCD's website (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13)

E. LACCD has developed minimum design standards governing the deployment of Video Surveillance System (VSS) to provide a baseline level of security that is required within District facilities. The VSS standards were developed to meet the goals and recommendations as described within the following documents:

1. Blue Ribbon Panel on Campus Safety & Emergency Preparedness, Dated December 16, 2015 (as Appendix 1)

2. LACCD Strategic Plan 2018 – 2023, Dated January 18, 2018 (as Appendix 2)

F. These standards shall be utilized to aid in the application of current technology standards and best practices to all new construction as well as renovation projects undertaken within the District.

G. A Video Surveillance System documents occurrence within a camera or group of camera's fields of view through the use of video recording software. The purpose of the VSS is to provide live viewing for situational awareness as well as recorded video for forensic analysis.

H. The operation, oversight, and maintenance of the systems discussed herein is primarily the shared responsibility of the following departments:

1. District Information Technology

2. College Administration (IT and Facilities)

3. Campus Safety Office

4. District Safety and Emergency Response

1.2 ACRONYMS USED

A. ALPR – Automatic License Plate Recognition

B. BW – Black & White

C. CAD – Computer Aided Design

D. CJIS – Criminal Justice Information Services

E. DHS – Department of Homeland Security

F. FPS – Frames per Second

G. GIS – Graphical Information Systems

H. ISO - International Organization for Standardization

I. IP – Internet Protocol

J. IR - Infrared

K. IDS – Intrusion Detection System

L. ONVIF – Open Network Video Interface Forum

M. PACS – Physical Access Control System (Building Access Control)

N. PPF – Pixels Per Foot

O. RAID – Redundant Array of Independent Discs

P. SDK – Software Development Kit

Q. UI – User Interface

R. UL – Underwriter's Laboratory

S. VMS – Video Management System

T. VSS – Video Surveillance System

1.3 VIDEO SURVEILLANCE SYSTEM COMPONENTS

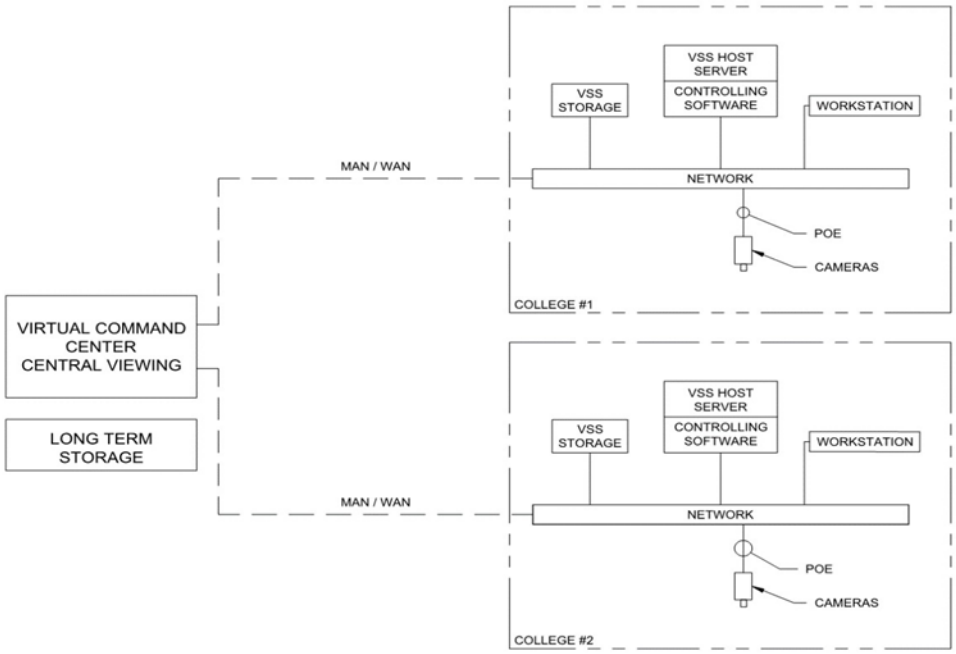
A. Host Server – This is where the core system software typically resides, including the database containing the individual camera configuration, as well as the actual operating software of the system. Manufacturer of the servers shall be selected by the District IT department.

B. Workstations – These are where system operators / administrators can monitor live video / review recorded video, export video for documentary / evidentiary purposes, and modify the operating parameters of the system. These workstations are typically on the robust side in order to effectively process multiple video streams with a minimum of latency. Workstations would typically be provided by the College IT departments, subject to meeting VMS manufacturer minimum specifications.

C. Controlling Software – This is the actual operating system of the VSS, the Video Management System (VMS) which resides on the host server.

D. VSS Storage –Recorded video data is stored here. Typically, a RAID solution is utilized for redundancy.

E. Cameras – Sensors which capture and store events occurring within their field of view.



Video System Component Diagram

1.4 RETENTION STANDARDS FOR VIDEO SURVEILLANCE SYSTEM

A. Retention Period – Standard Video

1. Recorded video shall be stored for a period of no less than thirty (30) days.

2. Video shall be recorded at a minimum of 12 FPS

B. Retention Period – Incident Video

1. Video associated with any security breach shall be retained according to LACCD policy.

1.5 VIDEO SURVEILLANCE SYSTEM TECHNICAL STANDARDS

Video Management System

A. The VMS shall have the following basic functionality at a minimum:

1. The VMS shall be part of an all-encompassing security platform and shall support integration of the following security technologies and systems:

a. Video Surveillance

b. Physical Access Control

c. Intrusion Detection

d. Emergency Phone System

e. Automatic License Plate Recognition

2. The VMS shall have the following certifications:

a. UL 2900-2-3 Level 3 Cyber Security Readiness Certification

b. ISO/IEW 27001 Standard

c. FBI CJIS Compliance for cloud services

d. Microsoft Gold Certification

e. DHS Safety Act Certification

3. VMS shall have the ability to create and customize dynamic live dashboards for system monitoring, displaying data including but not limited to:

a. Health Diagnostics and Reports with Graphical Data Representation

b. SDK Reports

c. Weather Information

d. Live Video

e. Access Control Events

f. Panic / Duress / Intrusion Alarms

4. The VMS shall have the capability of displaying interactive graphical maps with the following functionality as a minimum:

a. The interactive graphical maps shall provide the ability to display any type of third-party entities integrated through an SDK.

b. The interactive graphical maps shall be able to select which floor is to be displayed through a built-in mapping floor selector

c. The interactive graphical maps shall support CAD files, Vector, or GIS maps

d. The interactive graphical maps must be able to display intrusion and arm/disarm zones directly on the map

5. The VMS shall be capable of automatically switching the stream of video from a low-resolution stream to a high-resolution stream based upon the size of the video tile, thereby reducing the load on the network resources.

6. The VMS reporting feature shall be capable of supporting:

a. Comprehensive data filtering for most reports based on entity type, event type, event timestamp, custom fields, and more

b. The ability to display results through graphics such as pie charts and bar graphs

7. The VMS shall support the seamless unification of an Automatic License Plate Recognition (ALPR) system under a single platform. The user interface (UI) shall present a unified security interface for the management, configuration, monitoring, and reporting of the ALPR systems and associated edge devices.

1.6 STANDARD FOR VIDEO SURVEILLANCE SYSTEM CAMERA DEPLOYMENT

A. The LACCD has determined minimum levels of surveillance to be deployed at each LACCD College. The following areas are to be equipped with surveillance cameras meeting the minimum required performance parameters for each type area without exception:

1. Facial Recognition (50-60 PPF across the center of the horizontal field of view):

a. Campus Main Vehicular and Pedestrian Entryways

b. Main building entryways and stairwell doors.

c. Building and Parking Structure Elevators

d. Parking Structure Vehicular and Pedestrian Entryways

e. Cash Handling Areas

f. Areas containing valuable assets

g. Emergency Phones & Surrounding Area

2. General Activity Observation (Minimum 20 PPF across the horizontal center of the field of view):

a. Building exterior perimeters

b. Campus walkways and gathering areas

c. Parking structure general areas

3. Cameras shall have the following basic functionality at a minimum. Detailed definitions of each functional requirement are included in the performance specifications.

a. ONVIF Compliant

b. Wide Dynamic Range

c. Day/Night Capability

d. Motion Detection

e. Analytics Capability

f. Standard Mounting

4. The following camera types will typically be utilized on LACCD projects:

a. Minimum 2 Megapixel (1080p) interior wall / ceiling mount fixed dome type camera, integral IR illumination and varifocal lens, color / low light BW capable, as manufactured by Axis.

b. Minimum 2 Megapixel (1080p) exterior wall / pole mount fixed dome type camera, integral IR illumination and varifocal lens, color / low light BW capable, as manufactured by Axis.

c. Specialty cameras as needed for project specific application

1.7 SYSTEM INTEGRATION CAPABILITY

A. This VSS software platform and cameras shall be compatible with, and capable of integration to, the current District-wide Lenel OnGuard PACS platform, without exception.

B. The VSS software platform and cameras shall be integrated into the PACS software platform in such a fashion as to cause selected PACS user actions and policy violations as well as IDS / Duress activations to be tagged with descriptive metadata on the recorded video and activate a live viewing screen

1.8 SYSTEM ENTERPRISE CAPABILITY

A. The VSS system cameras shall be configured as an enterprise system using local College servers but having the capability to stream surveillance data to an off-site centralized command center.

B. System operators and administrators of the VSS shall only be granted access to the application and camera views using Windows Active Directory credentials. Logon and Password associated user privileges will determine operator operating levels and the ability to view live or recorded video, export video, delete video, or make operational changes to the system programming.

C. Audit trail records shall be accurately maintained for a period of three (3) years of which individuals performed programming / configuration / database changes within the VSS.

1.9 SYSTEM PERFORMANCE VERIFICATION TESTING AND COMMISIONING

A. A performance verification testing and commissioning report shall be completed for each VSS project, containing a checklist of all District deployment and installation standards. This testing and commissioning process shall serve to verify compliance with all features and functionality required of the VSS. If any portion of the system fails the testing / commissioning process, the issue shall be corrected, and the process shall begin again. Any system consecutively failing two (2) such testing attempts shall be retested at the Contractor's expense.

B. A representative from each firm involved with any portion of the installation shall be present for the system testing in order to ensure whichever firm is responsible for the failure is present and able to resolve the issue expeditiously.

1.10 TRAINING AND DOCUMENTATION

A. Support and training costs associated with the VSS cameras will be paid by the System Installer.

B. System training shall be allocated for each project. This training shall be conducted by a manufacturer authorized and certified instructor. Training materials shall be supplied in both printed as well as electronic format and shall be specific to the project.

C. Training shall not begin until the VSS has been completely tested and commissioned, in order that users may be trained on a fully functional system.

D. Training shall be centric to the operational roles that the College deems necessary at the time the training takes place.

E. The College shall be engaged throughout the design process to confirm the appropriate amount of training required.

F. Training shall be formatted into 4-hour increments, so that multiple training sessions may take place depending upon the availability of the staff requiring the training. A minimum of two (2) 4-hour training sessions shall be included in all video surveillance projects.

1.11 STANDARDIZED HARDWARE/SOFTWARE PLATFORM

A. The LACCD standardized platform for the video surveillance cameras will be to provide manufacturer AXIS, Sony, Bosch. Contractor shall obtain campus facilities approval for manufacturer used prior to installation.

B. The LACCD standardized platform for the video management software will be to provide manufacturer Milestone, Lenel, Qognify. Contractor shall obtain campus facilities approval for manufacturer used prior to installation.

1.12 WARRANTY

A. All video surveillance equipment shall be warrantied against any defects in material and workmanship under normal use for a period of five (5) years from date of official acceptance of the completed project by the Owner. The Vendor shall complete a manufacturer "Installation Certification" certifying the date on which the system has been installed to ensure the Owner receives full warranty rights from the manufacturer.

END OF SECTION

SECTION 28 2605

RESCUE ASSISTANCE COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. The standards provided have been set forth for the Contractor, installer to follow for any future projects and or renovations. For a complete list of material for each campus where work is performed, please refer to BuildLACCD campus standards web site (http://www.build-laccd.org/contractors-bidders/standards-guidelines/quick-search-results?type=guidelines&category=13). These standards are provided to serve as a guideline for contraction project to be completed correctly per latest district requirements. Contractors are to confirm any discrepancies between their scope of work and these specs prior to start of any project. After contractor accepts any bid, the contractor shall be responsible to provide their work per the Set Standards.

B. The Area of rescue system shall be provided and installed per latest ADA and LACCD district standards for buildings of 2 stories or more. The purpose of providing such system is to assist individuals in case of emergency where these cannot leave a given floor.

1. Furnish all labor, materials, tools, equipment and services for a complete area of Rescue Assistance Communication System as indicated in Contract Documents and as required by the American Disabilities Act (ADA).

2. Completely coordinate with work of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 QUALITY ASSURANCE

A. Transistors, capacitors, resistors, integrated circuits and other components shall not be operated to exceed their rated values. Design systems for 24 hour continuous operation.

1.3 SUBMITTALS (REFER TO SECTION 26 05 00)

A. Product Data:

1. Technical data on each product including finishes.

2. Description of system operation.

3. Riser diagrams and system data.

4. Equipment design considerations for future expansion when indicated.

5. Materials list and backbox schedule (including unique backboxes).

B. Project Data:

1. Operating and Maintenance Data

   a. Factory-prepared operation and service manual for each system.

   b. Include operation details, schematics, wiring diagrams, color coding, terminal numbers and component values for printed-circuit boards.

   c. Owner Instruction Reports: Refer to Section 26 05 00.

1.4 OPERATION

A. General: Provide two way audible/visual communication between a master annunciator station and the area of rescue assistance communication stations.

1.5 SYSTEM OPERATION

A. With the system in standby mode, all LED's are extinguished and no alarms are heard. A momentary actuation of a Rescue Assistance Call Switch will illuminate the switch and sound a local tone confirming activation. Simultaneously, the associated LED at the Rescue Assistance Annunciator Panel will illuminate and initiate a repeating audio alarm.

B. The Fire Department, or appropriate local authority, can acknowledge receipt of the call by momentarily depressing the associated switch on the Rescue Assistance Annunciator Panel. This will flash both the annunciator LED and the calling stations LED. In addition, a repeating audible signal will begin at the calling station indicating that help is on the way. Actuating the acknowledge switch a second time will cancel the call and return that zone to the standby mode. The repeating audio alarm at the annunciator panel will continue until all calls have been acknowledged or cancelled.

C. A yellow LED will illuminate at the remote annunciator panel if there is a line fault.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cornell #A4200 Series.

B. Housing Devices, Inc. #ADA-1000 Series.

2.2 EQUIPMENT

A. Master Remote Annunciator shall consist of a modular arrangement of intercom 'ON' and flashing red zone LED indicators in multiples of four zones. The annunciator panel shall include a "push to talk" and an audible alarm device with a sound level of not less than 90 dB at 30 cm. The panel shall be constructed of .125" thick clear anodized aluminum. Permanent silk-screened zone designations shall be provided on the panel as well as a designation strip. Backbox and panel dimensions will vary depending upon system configuration and number of zones required.

B. Power source shall be a transformer rated for total system devices with an optional battery-backed DC power supply with battery supply for continuous operation of 15 90 minutes 4 hours.

C. Wiring to call station shall be supervised. In the event of a wire fault, a yellow LED zone indicator on the annunciator shall illuminate and a repeating audio alarm shall sound.

D. Remote Rescue Assistance Call Station shall consist of one momentary switch with LED, incandescent lamp not acceptable, and one audible alarm device with a minimum sound level of not less than 70 dB at 30 cm all mounted on a one gang stainless steel plate. Permanent silk-screened designations shall be provided on the plate.

E. Wiring shall consist of 22 gauge (minimum) wire or as indicated on drawings. Three conductors plus one shielded pair are required between each Rescue Assistance Call Station and the annunciator panel not to exceed 3,000 feet. Power wire shall be 12 gauge (minimum). Two conductors are required between the power supply or transformer and the annunciator panel.

2.3 INSTALLATION

A. Install all components and complete system as indicated and in accord with manufacturer's recommendations and instructions.

B. Install all wiring in conduit from wall outlet to corridor cable tray above accessible corridor ceiling.

C. Contractor is to provide and install a typewritten list in a Plexiglas frame permanently fastened to the wall next to the Master Rescue Assistance Annunciator Panel to indicate the building location of each of the remote area of Rescue Assistance Call Stations and to which annunciator zone and LED they correspond.

D. Contractor is to provide a typewritten list of area of Rescue Assistance Communication Instructions in a Plexiglas frame permanently fastened to the wall next to each remote switch and the annunciator panel to explain the operation of the system.

2.4 SYSTEM TESTING

A. Test each component and complete system for proper operation, including all modes. Perform correctional work when required. Testing shall be done in the presence of the Owner’s Representative(s).

2.5 OWNER PERSONNEL INSTRUCTION

A. Instruct maintenance and staff personnel in complete operation, including actual staff use of system, by authorized distributor personnel. Arrange timing of the session in writing to best coordinate with Owner’s working hours. Allow four (4) hours of training. This training session shall be videotaped by the Contractor.

2.6 WARRANTY SERVICE

A. Warrant all Work of this Section to be free from defects in materials and workmanship for a minimum of 1 year from the date of Owner acceptance of the Work of this Section.

B. All manufacturers' equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of Contractor modified equipment, the manufacturer's warranty may be voided. In such cases, provide a warranty equivalent to that of the original manufacturer.

C. Response Time: Provide a qualified technician familiar with the system at the Project Site within 12 hours after receipt of a notice of malfunction. Provide the Owner with the telephone number attended 8 hours a day, 5 days a week, and an answering service or equivalent facility attended 24 hours a day, 7 days a week, to be called in the event of a malfunction. Provide repairs at no expense to the Owner and at the Owner's request, alternate facilities, services and systems for the duration of the repairs to any defective work of this Section. Provide a complete and operational System, within 48 hours after notification of a malfunction.

D. All work requested due to warranty issues shall be performed during regular working hours unless the Owner agrees to pay the difference in labor rates for overtime or night time work.

E. The Contractor shall use qualified service personnel to respond to all warranty issues or calls.

F. Off Site Service: Conduct all warranty repairs and services at the Project Site, unless in violation of manufacturer's standard product warranty. Provide substitute system equipment, and/or devices acceptable to the Owner for the duration of off-site repairs. Provide transportation for substitute and/or test systems, equipment, devices, materials, parts and personnel to and from the Project Site.

END OF SECTION

SECTION 28 3101

FIRE ALARM AND DETECTION SYSTEMS (ADDRESSABLE)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire alarm and detection systems

B. One-way emergency communications system with voice notification within-building, wide-area, and distributed recipient coverage.

1.2 RELATED WORK

A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 QUALITY ASSURANCE

A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.

B. Installer: A factory-authorized Electrical or Security Contractor licensed with the State and local jurisdiction with five years' experience in the design, installation, and maintenance of fire alarm systems by that manufacturer.

C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the start-up and testing reports.

1.4 REFERENCES

A. ASME A17.1 - Safety Code for Elevators and Escalators

B. NFPA 20 - Standard for Centrifugal Fire Pumps

C. NFPA 70 - National Electrical Code

D. NFPA 72 - National Fire Alarm and Signaling Code

E. NFPA 101 - Life Safety Code

F. UL 2017 – General Purpose Signaling Devices and Systems

G. UL 2572 - Control and Communication Units for Mass Notification Systems

H. California Fire Code (CFC)

1.5 SUBMITTALS

A. Provide product catalog data sheets as shop drawings.

1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings, but required for the operation of the system.

2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.

3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.

B. About all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.

C. Provide installation and maintenance manuals under provisions of Section 26 05 00.

D. Submit manufacturer's certificate that system meets or exceeds specified requirements.

E. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.

F. Voice Alarm Communication System: Submit equipment rack or console layout, grounding schematic, amplifier power calculations, and wiring diagram.

G. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.

H. When required to comply with local or state regulatory reviews, the fire alarm submittal shall have a Professional Engineer's stamp and signature of the state in which the project is completed. NOTE: The Architect/Engineer cannot stamp and seal submittal drawings not prepared under their supervision.

I. All fire alarm devices are to be tested to NFPA 72E and report delivered to the Facilities Director prior to acceptance of system.

J. Fire alarm provider shall hire a low voltage contractor to install the system. Installer must be certified for the system being installed. Contractor must provide proof of certification.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.

a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.

b. Notification appliances: Speakers, speaker strobes, and strobes.

c. In addition to the above, an additional 5% of component parts shall be provided as added stock.

2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet [minimum of one (1) set each] and shall turn over to the Owner upon completion.

3. All spare parts shall be housed in metal cabinet labeled “Fire Alarm Spare Parts.”

4. Trouble shooting and cleaning kits shall be provided.

1.7 REGULATORY REQUIREMENTS

A. System: UL or FM Global listed.

B. Conform to requirements of NFPA 101.

C. Conform to requirements of Americans with Disabilities Act (ADA).

D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.8 SYSTEM DESCRIPTION

A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, voice evacuation equipment, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.

C. Integrating the existing fire alarm system: Provide all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to integrate the existing fire alarm system with the new fire alarm system. This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, auxiliary control and related devices such as, door holders and their control, smoke damper control, fan shutdown, etc. The existing fire alarm system shall be integrated with the new fire alarm system such that the existing fire alarm system's functionality, integrity and annunciation shall be equivalent to pre-construction conditions unless noted otherwise. The functionality and integrity shall be maintained during construction. The entire system shall be able to be completely reset from any single reset location point.
The entire system shall be annunciated at any annunciation location.

D. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.

E. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and self-restoring network communications. Each building shall contain an independent building fire alarm / voice communications system, with full command and control from the campus command center. In no case shall read only network annunciation be acceptable as the only networking function.

F. Voice Communication: The facility shall have an emergency voice alarm communication system. The digitized recorded voice message shall notify occupants that a fire condition has been reported. Emergency manual voice override shall be provided.

G. Firefighter Phone System: A two-way talk path shall be provided for the fire department's use from the voice command center to the secondary fire alarm attack entrances, elevator lobbies, primary and backup power rooms and the entrance to all enclosed stairways.

H. Emergency Communication System (ECS): A system capable of reproduction of prerecorded, synthesized, or live messages with voice intelligibility to indicate the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action. The system shall provide alerting in the building, wide-area notification on the campus and interface with distributed recipient mass notification system.

I. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

J. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.

K. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.

L. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

M. Fire alarm systems and components shall be of the latest technology.

1. The model shall be the latest version put out by the manufacturer.

2. Parts must be readily available for five (5) years.

3. System shall be supported by the manufacturer for five (5) years.

N. System must have the capability to be viewed remotely. The remote viewing shall be Web based.

O. Any contractor that modifies the fire alarm system data base takes full responsibility for the entire fire alarm system data base.

1.9 PROJECT RECORD DOCUMENTS

A. Include location of end-of-line devices.

B. Provide a CAD drawing of each area of the building (minimum scale of 1/16” = 1’-0”) showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.

C. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

D. Contractor shall develop and submit a campus map showing the entire system, including the location of all devices.

E. Contractor shall provide a list of the location of all devices. In addition, all fire alarm devices shall be tagged.

F. System be integrated with college drawings and match current room number signage.

G. Copies of the video training shall be supplied.

H. The Fire Alarm System must pass commissioning prior to acceptance.

I. Four (4) hours of in-person training shall be provided.

1.10 OPERATION AND MAINTENANCE DATA

A. Include operating instructions, and maintenance and repair procedures.

B. Include results of testing of all devices and functions.

C. Include manufacturer’s representative's letter stating that system is operational.

D. Include the CAD floor plan drawings.

E. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.11 DOCUMENT STORAGE CABINET

A. The cabinet shall have all fire alarm system documents, including record drawings, wiring diagrams, operation manuals, etc. A legend sheet permanently attached to the door shall contain system passwords and inspection logs. The enclosure shall also provide two (2) key ring holders for system keys and a location for a standard size business card with service contact information. The cabinet will have, permanently and securely mounted inside, a digital flash memory device with a minimum of 4 GB of storage capacity and a standard USB B connector for uploading and downloading electronic versions of record documents and system programming information.

B. The cabinet shall be red in color with an identification label reading “FIRE ALARM DOCUMENTS”. Refer to Identification Section 26 05 53. The cabinet shall be lockable.

C. The final version of the system database program shall be stored within the cabinet.

1.12 WARRANTY

A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.

B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

1.13 ANNUAL INSPECTION/TESTING AND SERVICE CONTRACT

A. Provide cost to furnish service, inspect, and test all devices of the fire alarm system per the requirement of NFPA for one (1) year, starting one year after the Date of Substantial Completion. Submit written reports of inspection testing per NFPA 72, Chapter 14.

B. Provide an alternate cost for a complete inspection/testing and service/maintenance contract for the fire alarm system for one (1) year two (2) years, starting one year after the Date of Substantial Completion. Submit sample contract terms and conditions for review with shop drawings.

C. The Owner may enter into a contract directly with the vendor after shop drawing submittals. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS BY COLLEGE – NO SUBSTITUTIONS

A. City – Edwards EST

B. East – Edwards EST

C. Harbor – Edwards EST integrated into PA system

D. Mission – Notifier

E. Pierce – Silent Knight

F. Southwest – Simplex

G. Trade Tech – Edwards EST

H. Valley – Simplex

I. West – Siemens

2.2 FIRE ALARM CONTROL PANEL (FAP)

A. Control Panel: Modular, power-limited electronic design. Provide surface wall-mounted enclosure as shown on plans. Enclosure shall be minimum 0.060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

B. Each Signaling Line Circuit (SLC loop) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer’s system capacity of analog sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:

Minimum Total Addressable Points:	250	500	2000			
Minimum Total SLC loops (including	1	2	4	6	8	10

board, ready for field connections):

Panel Expansion Capability, Minimum Total SLC loops: 10

Minimum Node capacity for Network System: 100

C. Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC) Boards:

1. Each board shall communicate directly with each addressable analog sensor and binary input to determine normal, alarm, or trouble conditions. Analog signals would be used for automatic test and determination of maintenance requirements.

2. Each board shall contain its own microprocessor and shall be provided to monitor addressable inputs and to control addressable outputs (addressable relays). The board shall communicate and provide power to all devices on its loop over a single pair of wires, except where 4-wire devices require a separate power circuit.

D. Interconnection of Multiple Fire Alarm Panels:

1. The pathways of interconnected fire alarm panels or systems shall be as follows:

2. Pathway Class X: Circuits with redundant pathways capable of transmitting an alarm signal during an open or a non-simultaneous single ground fault on a circuit conductor wiring system. Wiring of outgoing and return conductors shall be physically separated by a minimum of 50 feet or by a two-hour rated enclosure.

3. Fire Alarm System shall be connected to the central panel.

   a. No stand-alone systems.

   b. All systems and stations must register on the main panel.

4. System shall be installed with a fiber network.

5. New buildings must be integrated into the existing main college system.

E. Central Processing Unit:

1. The central processing unit (CPU) shall communicate with the monitor and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.

2. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.

3. All power for the unit shall be supervised and supplied by the FAP.

F. Display:

1. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.

2. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all addressable points. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.

3. Displayed descriptions of addressable points shall include actual room names/numbers selected by the Owner. This information shall be obtained prior to programming. Room names/numbers shown on floor plans shall not be used.

4. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. Twenty different passwords with four levels of security shall be supported to prevent unauthorized manual control or programming.

5. System shall indicate if a fire damper is open or closed, and the location of the damper, on the fire alarm display.

G. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure.

H. Serial Interface Board: The board shall provide interfaces to a printer, LCD display and other monitoring devices through RS-232 connections. The minimum operational distance between the board and the peripheral devices shall be 500 feet. Up to three (3) RS-232 outputs shall be supported.

I. Power Supply:

1. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications and drawings. Each component of the fire alarm system requiring 120 VAC input power shall be served from a dedicated emergency branch circuit. Provide two #12 conductors and one #12 ground in 3/4" conduit to a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Identify/label breaker and branch circuit in accordance with NFPA requirements and Specification Section 26 05 53.

2. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Over-current protections shall be provided on all power outputs.

3. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.

4. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

J. Surge Protection:

1. All fire alarm control panels, NAC panels, etc. shall be provided with a surge protection device (SPD). The SPD shall be UL listed to Standard 1449 Rev 3. The unit should be clearly labeled in accordance with Identification Section 26 05 53. The SPD shall have thermal fuses to protect against fire in short circuit conditions. The unit shall provide visual indication that the unit is protecting and functioning.

2. Any communications or signaling circuits associated with the fire alarm system, which leave or enter a facility, shall be provided with a surge protection device. The devices shall be as recommended by the fire alarm system manufacturer.

K. Digital Communicator:

1. Provide dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats, with the capability of transmitting each device address point in a format compatible with the central station receiver.

2. Communicator shall be fully supervised and shall operate on loop start phase lines ahead of the building PBX system.

3. Communicator shall be FCC registered. Contractor shall provide two RJ31X jacks. Contractor to provide connection of communicators to Owner's telephone system.

4. Approvals: UL listed - UL 864/NFPA 72, FM approved.

5. The communicator shall be provided integral to the fire alarm panel as furnished by the fire alarm panel manufacturer. If the panel construction requires a separate unit, the unit shall be as manufactured by Silent Knight, Ademco, or fire alarm panel manufacturer approved equal.

L. Digitized Voice Command Center (VCC):

1. The Digitized Voice Command Center (VCC) shall contain all equipment required for all audio control, firefighter phone system control, signaling, and supervisory functions. This shall include digital voice units and microphones.

2. Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised single channel automatic digitized voice evacuation system with manual emergency voice communication system.

b. Audibly and visually annunciate the active or trouble condition of every signal circuit and firefighter phone circuit.

c. Audibly and visually annunciate any trouble condition of tone generators and digital voice units required for normal operation of the system.

d. Provide all-call activities through activation of a single control switch.

e. Provide automatic, digitally recorded voice messages and tones.

3. Audio Amplifiers:

   a. The audio amplifiers will provide a single channel audio power at 25/70 volts RMS for distribution to speaker circuits.

   b. Provide multiple audio amplifiers mounted in the transponder or in the main fire alarm control panel, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

   c. The audio amplifier shall include an integral power supply, and shall provide the following controls and indicators:

      1) Normal Audio Level LED

      2) Incorrect Audio Level LED

      3) Battery Trouble LED

      4) Amplifier Trouble LED

      5) Audio Amplifier Gain Adjust

   d. Includes audio input and amplified output supervision backup input.

4. Audio Message Generator (Digitized Voice):

   a. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a digitized voice message to all speakers in the building.

   b. Actuation of any alarm initiating device shall cause a digitized message to sound over the speakers. The message shall be repeated four (4) times.

   c. A built-in microphone shall be provided to allow paging through speaker circuits.

   d. The audio message generator shall have the following controls and indicators to allow for proper operator understanding and control:

      1) All Call LED

      2) On-Line LED

      3) All Call Switch

5. Voice Messages:

   a. A pre-programmed custom digital voice message shall be used for notification appliance speaker circuits. The messages shall be approved by the Authority Having Jurisdiction (AHJ). Voice messages shall be from a male voice. The messages shall be provided in the multi-lingual language of the predominant building population.

   b. Message shall be preceded by a tone and message shall be repeated four times until silenced.

c. Messages shall be annunciated by a single channel in all evacuation signal zones throughout the building.

d. Primary messages shall be annunciated in the zone of fire alarm and adjoining areas' evacuation signaling zones, and the secondary message in all other evacuation signaling zones.

e. Message shall be as shown in the following table. These messages are not intended to specify the exact wording required, but to specify the minimum information conveyed by the message:

Alarm Type	NAC Area	Preceding Tone	Message
Fire Alarm	Single Channel-all areas	Three Chimes	May I have your attention please? A fire emergency has been reported in the building. Proceed calmly to the nearest exit and leave the building immediately. Do not use the elevators. Use stairwells where necessary. Occupants that are unable to use stairways shall report to designated Areas of Rescue Assistance.
Fire Alarm	Dual Channel-Primary Message Area of alarm and adjoining evacuation signaling zones	Three Chimes	May I have your attention please? A fire emergency has been reported in the building. Please evacuate to a different area or floor of the building and await further instructions. Occupants that are unable to use stairways shall report to designated Areas of Rescue Assistance.
Fire Alarm	Dual Channel-Primary Message Area of alarm and adjoining evacuation signaling zones	Three Chimes	May I have your attention please? A fire emergency has been reported in the building. Proceed calmly to the nearest exit and leave the building immediately. Do not use the elevators. Use stairwells where necessary. Occupants that are unable to use stairways shall report to designated Areas of Rescue Assistance.
Fire Alarm	Dual Channel-Secondary Message All other evacuation signaling zones	Three Chimes	May I have your Attention please? A fire emergency has been reported in another area of the building. Please stand by for further instructions. Please do not use elevators
Test	All areas	One Chime	"May I have your attention please? May I have your attention please? This is a test of the building emergency alarm system. This is only a test."
All Clear	All areas	One Chime	"May I have your attention please? May I have your attention please? The reported emergency has been investigated and normal conditions have been restored. You may return to all areas of the building."

6. Speaker Circuit Control Switches/Indicators:

   a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.

   b. The speaker circuit control panel shall include switches to manually activate or de-activate each speaker circuit in the system.

   c. Buttons shall be provided on the voice command center to manually activate all auxiliary messages. (i.e. all clear, severe weather, homeland security warning, custom message)

2.3 EMERGENCY TELEPHONE DEVICES

A. Portable Emergency Telephone Handset Jack:

1. Flush mounted on stainless steel plate at locations indicated on plans.

2. Insertion of the remote handset plug into a jack shall send a signal to the fire commend center and shall sound a ring indication in the handset.

B. Fixed Emergency Telephone Handset:

1. Recessed telephone cabinet painted red and clearly labeled EMERGENCY TELEPHONE at locations indicated on plans.

2. Lifting of the handset cradle shall send a signal to the fire commend center and shall sound a ring indication in the handset.

2.4 SIGNALING LINE CIRCUIT DEVICES

A. Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

2. Analog Ionization Type Sensor: Shall use the dual chamber ionization principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

3. Each smoke detector shall connect directly to an SLC loop.

4. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.

5. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

6. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.

7. A test means shall be provided to simulate an alarm condition.

8. Where operation is noted as required below 32ºF and/or above 120ºF, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32ºF and 120ºF.

9. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Recall, D=HVAC Control, SW=Stairwell, CR=Computer Room, SD=Smoke Dampers, DH=Door Hold Release, FD= Fire Door Release.

B. Projected Beam Type Detectors:

1. This device shall utilize photoelectric analog smoke sensor technology. Provide with transmitter and associated receiver. Microprocessor-based detector shall provide a minimum of eight sensitivity levels, temperature and dirt compensation, and automatic gain control. Sensor to contain beam alignment adjustments and receiver calibration.

2. Detector shall connect directly to an SLC loop or shall be provided with multiple monitor modules, as required, to connect to the SLC loop and for monitoring alarm and trouble output contacts. The detector shall be provided complete with all mounting hardware provided and installed where indicated on the drawings.

3. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.

4. Provide with remote indicator panel providing LED indications of alarm and trouble.

C. Duct Smoke Detectors:

1. Duct-type smoke detectors shall use the same analog photoelectric ionization sensor technology, with the same features specified for standard smoke detectors, except with additional features as specified below.

2. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where the detector housing is larger than the duct height, the Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer’s recommendations.

3. Provide a remote alarm LED indicator device if detector is not visible from a floor-standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.

D. In-Duct Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

2. Analog Ionization Type Sensor: Shall use the dual chamber ionization principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

3. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.

4. Each smoke detector shall connect directly to an SLC loop.

5. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided to match the duct application. Provide a two-piece head/base design.

6. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

7. Provide a remote LED indicator device mounted in ceiling directly below detector with a single-gang faceplate labeled: Duct Smoke Detector.

E. Manual Pull Stations:

1. Manual stations shall match the description on the drawings (refer to the General Electrical Equipment Schedule). The stations shall be mounted where shown on the drawings and be provided with all necessary mounting hardware. Use surface mount only on precast concrete or structure.

2. Addressable, single action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering.

3. Addressable, single action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provide device with clear Lexan tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted.

4. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.

F. Heat Detectors:

1. Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135ºF and at 15ºF per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.

   a. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Shutdown.

2. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.

3. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof detectors are used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.

4. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.

5. Provide a remote LED indicator device if detector is not visible from a floor-standing position.

6. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.

7. A test means shall be provided to simulate an alarm condition.

G. Carbon Monoxide/Heat/Smoke Combination Detector:

1. Multi-criteria sensor for photoelectrical smoke sensing, heat and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.

2. The combined photoelectric smoke detection/heat/CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.

3. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.

4. The detector shall use only one address on the SLC.

5. CO sensor cartridge element shall be field replaceable.

H. Monitor Modules:

1. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits. Contractor option: Use an interface module (2-wire operation) for Style B circuits connected to normally-open dry contacts, such as a flow switch.

2. The module shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware shall be provided.

3. The module shall supply the required power to operate the monitored device(s).

4. The module shall provide address setting means using rotary decimal or DIP switches.

I. Addressable Relays:

1. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional slave relay(s), as required, rated for the electrical load being controlled (contractor to match voltage, amps, etc.).

2. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.

3. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.

4. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2.5 NOTIFICATION APPLIANCE DEVICES

A. Device Color:

1. Wall Mounted: White housing with red lettering.

2. Ceiling Mounted: White housing with red lettering.

3. WG subscript indicates wire guard is required.

B. Visual Alarm Devices:

1. Wall mounted.

2. Ceiling mounted.

3. High intensity (candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.

   a. Candela Ratings: V1=15, V3=30, V7=75, VH=110, VS=177.

4. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.

5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

C. Audio Horn Alarm Devices:

1. Wall mounted.

2. Ceiling mounted.

3. Sound Rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the occupied area.

4. Device shall be capable of a high and low dB level setting. Unless noted otherwise, the device shall be set to the high setting at building completion.

5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

D. Audio (Speaker) Alarm Devices - Wall Mounted:

1. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range.

2. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.

3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice with voice intelligibility.

4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.

E. Audio (Speaker) Alarm Devices - Ceiling Mounted:

1. 4” speaker, round housing, flush mounted (provide tile bridge where applicable).

2. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.

3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice and background music with voice intelligibility.

4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.

F. Combination Audio Horn and Visual Notification Device:

1. Wall mounted.

2. Ceiling mounted.

3. Combine horn and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.

G. Combination Audio (Voice) and Visual Notification Device:

1. Wall mounted.

2. Ceiling mounted.

3. Combine speaker and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.

H. Weatherproof Visual Notification Device:

1. High intensity strobe, square housing, 75 candela rating, suitable for wet locations. Provide with weatherproof back box.

2. Mounting: Semi-flush wall.

3. Conduit shall not be exposed.

I. Weatherproof Audio/Visual Notification Device:

1. Electronic horn with high intensity strobe, square housing, 75 candela, suitable for wet locations. Provide with weatherproof back box.

2. Mounting: Semi-flush wall.

3. Conduit shall not be exposed.

OR

J. Weatherproof Voice/Visual Notification Device:

1. Speaker with high intensity 75 candela rated strobe. 25 VRMS with a minimum of four (4) tap settings which shall allow field adjustment of the sound output across a minimum range of 78 to 87 dBA (UL 1480), 400 Hz to 4 KHz (6dBA cutoff) frequency range.

2. Mounting: Semi-flush wall.

3. Conduit shall not be exposed.

K. Mini-Horn Audio Notification Device:

1. Electronic horn.

2. Mounting: single-gang flush wall.

L. Emergency Communication Message Display (CMD):

1. LED illuminated text sign operating in response to fire alarm control panel inputs. Two independently illuminated text messages (ANNOUNCEMENT and EVACUATE). Messages shall be either static or flashing.

2.6 ELEVATOR SHAFT DAMPER CONTROL

A. Smoke detectors in the hoistway or elevator lobbies shall open the elevator hoistway vent automatic damper upon detection of smoke.

2.7 NAC EXTENDER PANELS (NEP)

A. As shown on the plans or as a Contractor’s option if not shown, furnish and install NAC extender panels as necessary to provide remote power supply for notification appliance circuits (NAC).

B. Each NEP shall be self-contained remote power supply with batteries, and battery charger mounted in a surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP provides a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.

C. Power for each NEP shall be from a local 120 VAC emergency circuit. Provide two #12 conductors and one #12 ground in 1/2" conduit to each NEP from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer’s standard handle lock-on device.

D. Mounting: Surface.

2.8 ANNUNCIATION

A. Color Graphics Network Annunciation System:

1. The annunciator shall provide custom color graphics displays for the control panel to annunciate the status of the panel and every peripheral device. It shall record and display system historical information on an LCD flat panel display.

2. The annunciator shall have the ability to display a minimum of 256 custom screens and shall be fully field programmable. The fire alarm vendor shall develop screens from DXF or DWGCAD files provided by the Owner.

3. Operator control shall be via an attached keyboard and mouse.

4. The annunciator shall store all alarms, troubles and operator activity to an internal hard drive and shall have a capacity of 10,000 events without data loss.

5. Events shall have a time and date stamp.

6. Graphics shall contain eight (8) different colors from a palette of sixty-four (64).

7. Graphics software shall be provided to display on single or multiple screens, the status of every device located on a floor plan of the building. Alarms shall be audio and visual and shall annunciate regardless of the screen that is currently visible. Text on screens shall be a minimum of 1/10" high. Coordinate with the Owner, the floor plan on each screen prior to programming.

8. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE capability at the color graphics annunciation location.

9. The systems shall operate on the most current UL 864 listed computer system. The system shall be supplied by the fire alarm vendor and be listed for fire alarm use.

10. Provide an uninterruptible power supply (UPS) to provide a minimum of 10 minutes of operating power for the computer graphic annunciator upon loss of normal power.

11. All equipment for the color graphics network annunciator shall be suitable for locating on a desk, provided by the Owner. When multiple workstations are required (multiple locations within a facility or multiple buildings on a campus), they shall be server/client based configuration.

12. Remote Client Workstations: All workstations shall have the same user functionality. User shall have the ability to take over network control functionality from any station as follows:

    a. Request to take control

    b. Accept/deny control request

    c. Restore command center to normal operation

    d. Priority request override

13. PC computer workstation shall have the following minimum operating system requirements:

    a. Operating system shall be a minimum of Microsoft Windows 7.

    b. 3.0 GHz processor (server workstation)

    c. 128 GB RAM installed (server workstation)

    d. i7 Intel processor (client workstation)

    e. 32 GB RAM installed (client workstation)

    f. 500 GB hard drive

g. 22-inch LCD monitor minimum

B. Printer:

1. Printer shall be UL 864 listed and shall be the automatic type with code, time, date, location, category and condition.

2. The printer shall provide hard copy printout of all changes in status of the system and shall time-stamp such printouts with the current time of day and date. The printer shall be standard carriage with 80 characters per line and shall use standard bond paper. The printer shall be enclosed in a separate enclosure, suitable for placement on desk or countertop. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association Standard EIA-232D. Power to the printer shall be 120 VAC, 60 Hertz.

3. The printer shall be connected to the graphics annunciator PC and shall have all interfaces in place to be connected to the Fire Command Center and all transponders in case of network or hardware failure.

C. Remote LCD Annunciators:

1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability. Minimum 80-character display.

2. Communications and power to the annunciators shall be supervised. The annunciator shall receive power from the fire alarm control panel.

3. A single key switch shall enable all switches on the annunciator.

4. Mounting: Flush.

D. Facility Management Control System (FMCS) Interface:

1. Provide addressable relays to report the following to the FMCS via dry contact monitoring on the FMCS:

a. General Alarm

b. System Trouble

c. Supervisory Alarm

d. Other Alarms (if applicable)

OR

2. Provide BACnet IP interface for fire alarm panel to communicate status with the FMCS. Provide list of points and descriptions to FMCS supplier.

a. UL listed to Standard 864. Provide RJ45 connection and cable.

E. Fire Alarm Remote Indicator:

1. Red LED type.

2. Mounts flush to a single gang box.

F. Fire Alarm Remote Indicator and Test Switch:

1. Red LED type.

2. Key switch test selector.

3. Mounts flush to a single gang box.

2.9 ETHERNET NETWORK

A. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X wiring, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and restore network communications.

B. The IP network shall be fiber optic cable, single or multi-mode fiber. The TCP/IP network switches shall be industrial grade managed switching hubs. Network switches shall be UL864 listed, shall provide a minimum of four (4) or a maximum of eight (8) 10/100 Mbps shielded RF-45 connectors for Ethernet connections, and selectable multi-mode or single-mode fiber ports. The switches shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to ensure power to the switch is always available. Switches shall provide LED indicators for data rate, activity/link integrity, power, and loop detection.

C. IP Monitor and Relay Module: The IP relay/input module shall have a minimum of four (4) dry contact inputs and four (4) dry contact outputs. The relay output shall be rated at 0.5 amps at 24 VDC. This unit shall be monitored and controlled by the graphics workstation to operate functions and/or operations/activations on any fire alarm network system connected to the GEGW. The module shall be UL2572 and UL864 listed.

D. Voice Over IP Module Encoder/Decoder: Each control panel audio source connected to the LAN/WAN network interface shall consist of a supervised audio decoder capable of decoding MP3, WMA, G.700, and PCM data streams in HTTP, UDP, or RTP format. Audio decoder shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the FACP to ensure reliable and monitored power. UL 2572 and UL864 listed.

2.10 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS

A. Smoke Damper:

1. Motorized type, 120 VAC, furnished and installed by MC. Fire alarm control and power connections by EC. A subscript is used to identify the device with a specific air handler or zone for its sequence of operation.

B. Smoke or Fire/Smoke Damper Controller:

1. Provide an enclosure and equipment for interface of dampers with the fire alarm system and temperature control system

C. Hoistway Damper (Elevator Shaft Damper):

1. Motorized type, 120 VAC, furnished and installed by MC. Fire alarm control and power connections by EC. A subscript is used to identify a hoistway damper with a specific elevator or bank of elevators.

D. Duct Smoke Detector and Smoke Damper Control:

1. Sampling type duct detector in ducts 18” and larger. In-duct smoke detector in ducts less than 18”. Detector shall be mounted within 5’ of smoke damper. Motorized type 120 VAC, smoke damper furnished and installed by MC. Fire alarm control and power connections by EC. Remote indicator mounted in visible location. Provide auxiliary relay base or addressable control module. The smoke damper shall close upon activation of the detector, and a supervisory signal shall be sent to the fire alarm control panel.

E. Flow Switch:

1. Connection to flow switch to monitor fire protection flow switch or discharge output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.

F. Monitor Switch:

1. Connection to monitor switch to monitor fire protection system supervisory switches or output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.

G. Post Indicator Valve:

1. Connection to post indicator valve for sprinkler system supervisory notification. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC. Provide surge protection device as recommended by the fire alarm system manufacturer on line entering/leaving the facility.

H. Electronic Bell:

1. Electronic bell for sprinkler alarm, electro-mechanical type, 120 VAC. Furnished and installed by MC. Fire alarm control and power connections by EC.

I. Door Hold Open Device:

1. Integral with door hardware, 120 VAC. Furnished and installed by GC. Fire alarm control and power connections by EC.

J. Hold Open Override:

1. Hold open override connection to GC-provided power door operator. EC shall intercept the hold open switch wiring (unless specific contacts for this purpose are provided on the door) and connect addressable relay to override this switch and allow the door to close. All modifications to the power door operator shall be coordinated with the GC.

2.11 WIRING

A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer’s recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.

B. All network wiring shall be fiber and installed in conduit.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of vegetation, grass, grass roots, shrubs, tree stumps, trees, upturned stumps, weed growth, tree roots, brush, masonry, concrete, rubbish, debris and other materials.

2. Removal of concrete and bituminous surfaces.

3. Removal of existing fences and gates.

1.2 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction, current edition, as a minimum requirement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TREE AND STUMP REMOVAL

A. Remove trees and stumps indicated or required to be removed. Remove trees, together with bulk of roots, to a minimum depth of 4 feet below required grade, and within a radius of approximately 7 feet beyond perimeter of trunk at grade.

B. Fill and compact excavation from tree and stump removal. Fill in 6 inch layers, each compacted to 90 percent of maximum density in accordance with ASTM D1557, or as directed by geotechnical report, whichever is greater.

1. Back filling shall not commence until the excavation is inspected and tested.

3.2 CONCRETE AND BITUMINOUS SURFACING REMOVAL

A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicated limits. Cutting shall be performed to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1 1/2-inch, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.3 FENCING

A. Existing fences scheduled to remain may be removed to facilitate the Work, provided they are installed to their original condition.

B. Fencing indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact excavations.

C. Install chain link fencing indicated to be relocated.

3.4 CLEANUP

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

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.

1.2 PROJECT REQUIREMENTS

A. General:

1. Before grading, contact Underground Service Alert of Southern California (USASC) for information on public buried utilities and pipelines. Retain the services of an underground utility locator for on-site utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall conform to requirements specified in this and related sections.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain installed stakes until their removal is required for the Work. Provide replacement grade or location stakes lost or disturbed.

B. Install grade stakes and compare to indicated grades. If discrepancies are found between existing grades and grades indicated on Drawings, do not proceed until discrepancies are resolved.

3.2 ROUGH, (REMEDIAL) AND FINE GRADING

A. Rough grade area sufficiently high to require cutting by fine grading:

1. Grade area for bituminous surfacing and other paving to the indicated grades, equal to the section of the indicated base and pavement.

2. Slope banks to required finish grades as cut progresses or leave cuts full and finish grade by mechanical equipment to provide grades and soil densities indicated on the Drawings.

3. Rough grade, fill and compact banks beyond indicated finish grades. Finish grade banks and slopes to indicated grades and specified soil densities.

4. Grade Only Areas: In areas not indicated to receive pavement, rough grade to approximate finish grades and then scarify, moisten and roll to obtain required density and indicated finish grades.

5. Tolerances: Finish grades shall be within a tolerance of 0.05 inch per foot above or below grades indicated. Provide an average grade as indicated.

6. Soils import requirement
   a. The contractor must provide test report, at his own cost, to indicate the soils is clean based on the requirements in EPA standards and subset DTSC "Clean Imported Fill Material", October 2001.
   b. The contactor shall ensure that the import soil submittal complies with Greenbook standards.
   c. The contractor shall obtain paperwork from the LOR or a District Environmental agency confirming that the import fill material is characterized, handled, and documented in accordance with EPA and State of California regulations.

B. Base:

1. After subgrade has been constructed to approximate required grades, scarify to a depth of at least 6 inches:

   a. After scarifying, process loosened material to a finely divided condition and adjust moisture content to optimum condition by addition of water, addition and blending of dry suitable material, or by drying of existing material.

b. Install base course in accordance with Specifications.

2. Tolerance of completed grades of base or subgrade shall not vary more than 0.03 inch per foot from grades indicated. Provide an average grade as indicated.

3.3 SHORING

A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.

B. Design and Calculations: Provide in accordance with requirement of Cal OHSA.

C. Remove shoring upon completion of the Work of this section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.4 EXCESS MATERIAL DISPOSAL

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

3.5 PROTECTION

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

END OF SECTION

SECTION 31 23 16

EXCAVATION AND FILL FOR PAVING

PART 1 - GENERAL

1.1 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.

2. Bonds: Post as required by authorities having jurisdiction over the area.

3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.2 SUBMITTALS

A. Imported Soils: A geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this section.

1.3 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction, current edition, except as modified herein.

PART 2 - PRODUCTS

2.1 BASE MATERIALS

A. Concrete Slabs on Grade: Provide “Crushed Aggregate Base “as specified in the Standard Specifications for Public Works Construction, Section 200: “Rock Materials,” with ¾ inch maximum size aggregates. Provide 4”-inch thick base, unless noted otherwise.

B. Bituminous Surfacing: As indicated on Drawings.

2.2 FILL AND BACKFILL MATERIALS

A. Fill and backfill materials shall be previously excavated materials or imported fill material, free of clods and stones larger than 3-inch, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.

B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended or aerated to stabilize and upgrade the material.

C. Imported Fill Material:

1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.

2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieves. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported material shall be clean and

free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

D. Other Fill Materials: Brick rubble and broken concrete originating from the Project site may be legally disposed of off the Project site or incorporated in fill, if reviewed by a geotechnical engineer, retained by the Owner as an Owner Consultant. Unless otherwise required, no such materials may be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
3/4 inch (19mm)	100
3/8 inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.

3. Provided backing for weep holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.

4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed by the Architect.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Clear the Project site as required in Section 31 1000 - Site Clearing.

3.2 PROTECTION

A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.

B. Protect adjacent existing improvements including landscaping against damage.

3.3 EXISTING UTILITY LINES

A. Protect existing utility lines from damage or displacement.

B. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of 2 feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.

3.4 EXCAVATION

A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

3.5 FILL

A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

B. Provide fill materials as specified in Part 2 - Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.

C. Soils import requirement

1. The contractor must provide test report, at his own cost, to indicate the soils is clean based on the requirements in EPA standards and subset DTSC "Clean Imported Fill Material", October 2001.
2. The contactor shall ensure that the import soil submittal complies with Greenbook standards.
3. The contractor shall obtain paperwork from the LOR or a District Environmental agency confirming that the import fill material is characterized, handled, and documented in accordance with EPA and State of California regulations.

D. Imported fill materials shall be sampled by a geotechnical engineer, retained by the Owner as an Owner Consultant, for compliance with the requirements of Part 2 of this Section.

E. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall submit samples to a DSA approved independent approved testing laboratory for testing.

F. Initial sampling shall be performed by the geotechnical engineer, retained by the Owner as an Owner Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain both the initial and additional samples from the identified site and shall submit samples to the approved independent testing laboratory for testing.

G. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing tested for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

H. The independent approved testing laboratory shall perform the required tests and report results of tests noting if the tested material passed or failed such tests and shall furnish copies to the Project Inspector, Architect, OAR, DSA, Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in

accordance with applicable provisions of the Contract Documents, CBC, and the DSA. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the DSA as required by CBC.

I. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.

J. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.6 INSTALLATION OF MATERIALS

A. Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the geotechnical engineer, retained by the Owner as an Owner Consultant, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but no more than 1 in 20. Provide adequate drainage at all times during construction of the Work of this section.

3.7 COMPACTING

A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.

B. Unless otherwise indicated, compact each layer of earth fill to a relative compaction of at least ninety percent where placed in non-structural areas, landscaping areas and utility trenches. Jetting or flooding of backfill should not be permitted. The upper 24” of subgrade supporting pavements should be compacted to at least ninety five percent relative compaction.

C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each compacted layer before installing the next succeeding layer.

3.8 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.

B. The geotechnical engineer, retained by the Owner as an Owner Consultant, will sample imported fill materials from their designated source before delivery to the Project site.

C. Installation of backfill shall be observed by the geotechnical engineer, retained by the Owner as an Owner Consultant.

D. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavation Work before the installation of fill and/or other materials.

E. Compaction: Test compaction in accordance with ASTM D1557, Method C.

3.9 PROTECTION

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

3.10 CLEANING

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

END OF SECTION

SECTION 31 23 23

EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

1.2 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.3 SUBMITTALS

A. Imported Soil: A geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain initial product Sample for testing in accordance with the terms of Article 3.05 of this section.

1.4 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bedding material from trench bottom to one foot above the pipe:

1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.
2. Sand complying with the Specifications for cement concrete aggregates.

B. Backfill Materials:

1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 ½-inch in any dimension.
2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.
3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200 mesh sieve. Material shall provide a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.1 GENERAL

A. Before excavation, contact the "Underground Service Alert of Southern California" (USASC) for information on buried public utilities and pipelines. For on-site utilities retain an underground locating service.

B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Section 01 50 00 - Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.

C. Saw-cut concrete or bituminous paving for trench installation.

D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.

E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.

F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.

G. Do not install piping lengthwise under concrete walks without review by the Architect.

H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.

1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade
Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structures	36 inches below finished grade
Soil, Sewer & Storm Drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)
Irrigation Pipe:	nonpressure pipe 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.

I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.

J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.

L. Do not install backfill until required inspections and testing is completed.

M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.

N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 90 percent of the maximum density. Jetting or flooding of backfill should not be permitted.

O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.

P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.

Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117 - Pavement Repair.

3.2 IMPORT/EXPORT OF MATERIALS

A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.

B. Soils import requirement

1. The contractor must provide test report, at his own cost, to indicate the soils are clean based on the requirements in EPA standards and subset DTSC “Clean Imported Fill Material”, October 2001.
2. The contactor shall ensure that the import soil submittal complies with Greenbook standards.
3. The contractor shall obtain paperwork from the LOR or a District Environmental agency confirming that the import fill material is characterized, handled, and documented in accordance with EPA and State of California regulations.

C. Imported fill materials shall be sampled by a geotechnical engineer, retained by the Owner as an Owner Consultant, for compliance with the requirements of Part 2 of this section.

D. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall perform the tests by utilizing an independent approved testing laboratory.

E. Initial sampling shall be performed by the geotechnical engineer, retained by the Owner as an Owner Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.

F. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

G. The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and

shall furnish copies to the Project Inspector (IOR), Architect, OAR, DSA, Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the DSA as required by CBC.

H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.

I. Upon completion of import operations, provide the IOR a certification statement attesting that imported material has been obtained from the identified source site.

3.3 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.

B. Compaction test shall be performed in accordance with ASTM D1557, method "C."

3.4 PROTECTION

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

3.5 CLEANUP

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

END OF SECTION

SECTION 32 01 90 33

TREE PROTECTION

PART 1 – GENERAL

1.01 SUMMARY:

A. Provide all labor, materials, equipment, services, and miscellaneous and incidental work to provide all TREE PROTECTION as indicated on the Drawings and as specified including:

1. Protection and welfare of all existing trees that are to remain, including trimming, cabling, and repair of such trees as necessary.

2. Contractor shall submit tree maintenance plans including temporary irrigation system for Owner's Representative's approval.

3. Completely coordinate all Work.

B. Related Sections:

1. Section 01500 - Construction Facilities and Temporary Controls.

2. Section 02060 - Demolition.

1.02 DEFINITIONS:

A. "Injury" is defined, without limitation, as any bruising, scarring, tearing, or breaking of roots, branches or trunk.

B. "Drip line" is defined as the outermost limits of the tree canopy.

1.03 QUALITY ASSURANCE:

A. General Responsibility: The Contractor shall be directly responsible for protection and welfare of existing trees within the Contract Limits, which are noted to remain. This responsibility shall continue throughout the full construction period until the entire Project is completed and accepted by Owner and through completion of the guarantee period.

B. Qualifications of Workmen: only a certified arborist or certified tree worker shall perform Trimming. Provide at least one person approved by Owner who shall be present at all times during tree protection and trimming operations, who shall be thoroughly familiar with the type of work involved, and who shall direct all protection and trimming work.

1. All tree trimming on this project shall be under the direction of Owner's Representative.

2. Pruning of mature trees shall be considered as part of this project at the discretion of the Landscape Architect and/or Owner's Representative.

C. Reference Standards: Published specifications, standards, tests, or recommended methods of trade, industry or governmental organization apply to work of the Section.

1. International Society of Arboriculture (ISA) "Guide for Establishing Values of Tree and Other Plants," prepared by the Council of Tree and Landscape Appraisers (CTLA).

2. "Cabling, Bracing and Guying Standards for Shade Trees," as published by the National Arborist Association (NAA), 174 RT 101, Bedford, New Hampshire, 03102.

3. International Society of Arboriculture (I.S.A.) - Tree Pruning Guidelines.

1.04 SUBMITTALS:

A. Refer to Section 01300 for procedure.

B. Pruning.

C. Moving Equipment.

D. Guying materials.

E. Fencing materials.

F. Maintenance plan.

1.05 JOB CONDITIONS:

A. Prior to performing any work of the Contract, Contractor shall call for a site meeting with the Owner's Representatives. This meeting shall occur prior to construction of any nature on site. The purpose of the meeting shall be to establish the conditions of all existing trees to be preserved or relocated upon receipt of the site by the Contractor. Failure to call for said meeting implies acceptance by the Contractor of trees to be preserved in their existing condition.

B. Sequencing Schedule: Coordinate and cooperated with other trades to enable work to proceed as rapidly and efficiently as possible.

1.06 GUARANTEE:

A. Contractor shall guarantee that all plants covered by the provisions of this Section will be in a healthy and flourishing condition of active growth 1 year from the date of Substantial Completion.

B. During the warranty period the Contractor shall be liable for damages to all trees covered by the provisions of this Section and shall pay compensation to Owner.

1. Contractor shall reimburse Owner for loss of trees due to damage or lack of care (See Section 1.13 - Repair Compensation).

2. For trees injured, but not a complete loss to Owner, the Owner's Representative shall determine the amount of penalty.

C. Contractor will not be held responsible for failures due to neglect by Owner, vandalism, etc., during the warranty period. Report such conditions to Owner's Representative.

1.07 TREE PROTECTION FENCING:

A. Tree Protection Fence: Eight (8') foot high cyclone fence, sturdy and capable of acting as a barrier against objects, vehicles, etc., on site during construction process. It shall be constructed and designed so as to allow for relocations as required and shall have gate access to inside for care of tree. It shall be continuously maintained and repaired as necessary. Metal shall be galvanized with posts set in 12" diameter x 24"depth footings with top rails.

B. Install tree protection fencing around trees to be preserved at their dripline or at a minimum of 15' from the tree's trunk. Stands of trees may be fenced as a group. Fencing shall remain until landscape work has commenced, and it shall then be removed as directed by the Owner's Representative.

C. During the course of construction, relocation of the fence may be required to facilitate construction. The Contractor shall do so as directed by the Owner's Representative at no additional expense to the Owner and reset if necessary.

1.08 PROTECTION OF TREES:

A. Water: Provide ample water supply of potable quality and sufficient quantity for all operations required under this section.

B. The existing trees to be preserved presently are in excellent condition. Trees shall not be allowed to deteriorate and shall be maintained in a healthy and vigorous condition during the course of construction and maintenance period.

C. During the course of construction the Contractor shall take all necessary precautions, as outlined herein, to protect the existing trees to be preserved from injury or death. Protection shall be given to the roots, trunk, and foliage of all existing trees to remain.

D. Trees subject to the provisions of this Section, which have been injured, shall be repaired immediately by an approved, certified arborist. Repair may include removal of rough edges and sprung bark and severely injured branches as directed by the Owner's Representative.

E. Tree protection fencing shall be installed for the protection of existing trees to be preserved. No construction, demolition, or work of any nature will be allowed within the fenced area without prior written approval by the Owner's Representative.

1. Approval by the Owner's Representative for work within the fenced area shall not release the Contractor from any of the provisions specified herein for the protection of existing trees to be preserved.

2. During the course of construction of approved work within the fenced area, no roots larger than two (2") inches in diameter shall be cut without prior written approval by the Owner's Representative.

F. During construction the existing site surface drainage patterns shall not be altered within the area of drip line or in compliance with the development plans.

G. Contractor shall not alter the existing water table within area of drip line during rough grading (as directed by Owner's Representative.)

H. Take necessary measures to maintain healthy living conditions for existing trees to be preserved. Such measures shall include but not be limited to periodic washing of leaves for the removal of dust, etc.

I. Do not permit the following within the drip line of any existing tree to be preserved:

1. Storage or parking of automobiles or other vehicles.

2. Stockpiling of building materials or refuse of excavated materials.

3. Skinning or bruising of bark.

4. Use of trees as support posts, power poles, or signposts; anchorage for ropes, guy wires, or power lines; or other similar functions.

5. Dumping of poisonous materials on or around trees and roots. Such material includes but is not limited to paint, petroleum products, dirty water, concrete slurry, or other deleterious materials.

6. Cutting of tree roots by utility trenching, foundation digging, placement of curbs and trenches, and other miscellaneous excavation without prior written approval by Owner's Representative.

7. Damage to trunk, limbs, or foliage caused by maneuvering vehicles or stacking material or equipment too close to tree.

8. Compaction of the root area by movement of trucks or grading machines; storage equipment, gravel, earth fill, or construction supplies, etc.

9. Excessive water or heat from equipment, utility line construction, or burning of trash under or near shrubs or trees.

10. Damage to root system from flooding, erosion, and excessive wetting and drying resulting from dewatering and other operations.

J. Excavation Around Trees:

1. Excavation or fill within drip lines of trees shall be done only where absolutely necessary and with the direction of the Owner's Representative.

2. Where trenching for utilities is required within drip lines, it shall be under the supervision and direction of the Owner's Representative. Trenching within a tree's dripline area may require the use of hand tools.

3. Where excavation for new construction is required within drip line of trees, hand excavation may be required to minimize damage to root system. Damaged roots or roots requiring removal that are larger than 2" diameter shall be cleanly cut by a hand saw. Cuts shall be made back to healthy root tissue.

4. Exposed roots and soil areas shall not be allowed to dry out before permanent backfill is placed. Temporary earth cover or organic mulch shall be provided, or roots shall be packed with wet peat moss or four layers of wet, untreated burlap and temporarily supported and protected from damage until permanently covered with backfill. The cover over the roots shall be wetted to the point of runoff daily. When complete, install broken concrete retaining walls as shown on Plan Details wherever the grade around a tree to be saved is higher of lower by 6" from the existing grade. See Planting Plan and Details.

5. Pruning may be required to balance loss to root system caused by damage or cutting of root system. Thinning shall not exceed 30 percent of existing foliage and shall be directed by the Owner's Representative.

1.09 TREE PRUNING:

Pruning: Trees, which require pruning shall be inspected by Owner's Representative and the Contractor before starting work this work. All Pruning shall be in accordance with the standards of the International Society of Arboriculture or as directed by the Owner's Representative. A sample tree shall serve as a guide in the pruning of the remaining trees.

1.10 TREE REMOVAL:

Trees designated for removal shall be removed to a point at least 1' (one foot) or more below subgrade. Refer to Spec. Sect. 02060, Demolition. Trees shall not be felled but cut down in sections and lowered to the ground to minimize damage to other trees and planting and protect against injury to anyone in the vicinity.

1.11 TREE REMOVAL:

A. The Owner's Representative and the Contractor's Arborist will identify limbs and roots, which are to be trimmed.

B. The Owner's Representative shall direct the removal of branches from trees and large shrubs that are to remain if required clearing for new construction.

C. Dead and damaged trees that are determined by the Owner's Representative and arborist to be incapable of restoration to normal growth pattern shall be removed.

D. Cut evenly, using proper tools and skilled workmen, to achieve neat severance with the least possible damage to the tree.

E. In the case of root cuts, apply wet burlap or other protection, approved as noted herein, to prevent drying out, and maintain them in a wet condition as long as necessary for temporary protection.

1.12 IRRIGATION SYSTEM:

A. Protect existing irrigation system from damage. Wherever possible leave water source for watering trees and keep ground around all trees to remain in the area sufficiently moist until the end of project.

1.13 REPAIR COMPENSATION:

A. Damage to existing tree crowns or roots over 2 inches in diameter shall be immediately reported to Owner's Representative in writing, and, at the direction of the Owner's Representative, repaired immediately at the Contractor's expense by an approved, certified arborist.

B. The Owner's Representative shall direct repair of trees damaged by construction operations. Repairs shall be made promptly after damage occurs to prevent progressive deterioration of damaged trees.

C. Any tree to remain which is damaged or destroyed owing to the Contractor's negligence or failure to provide adequate protection shall be compensated for in accordance with "The Guide for Establishing Values of Trees and Other Plants as produced by the International Society of Arboriculture.

D. Maintenance including watering, fertilizing, pruning, pest control, and other care to bring the replacement tree to the same general condition of original item shall be the responsibility of the Contractor.

E. Damaged tree limbs or trees which have died as a result of injury during construction shall remain the property of Owner and shall remain or be removed by the Contractor as directed by Owner's Representative.

1.14 MAINTENANCE:

A. Contractor shall be responsible to perform periodic inspections of existing trees to be preserved and submit written proposals to the Owner's Representative for additional maintenance work as may be required to ensure the health and general well-being of the trees. Contractor shall retain, at the direction of the Owner's Representative additional specialists as may be required to perform this work.

B. Irrigation: During construction the existing trees to be preserved shall, at the directions of the Owner's Representative, be irrigated to a minimum of 3' depth. Quantities and lengths of time are variable and shall depend upon climactic conditions or per the direction of the Owner's Representative.

END OF SECTION

SECTION 32 01 90

LANDSCAPING

PART 1 – GENERAL

1.01 DESCRIPTION

Division 1 applies to this Section. Provide all labor, materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with the installation of the Work of this Section, complete as shown on the Drawings and/or specified herein.

A. Work In This Section: Principal items include:
   1. Examine all other Sections for Work related to those other Sections and required to be included in this Section.
   2. Fine grading in landscaping areas.
   3. Landscaping.
   4. Rodent and vermin control.
   5. Soil Testing and Soil Preparation
   6. Plants and Planting
   7. Staking
   8. Herbicide
   9. Watering and maintenance

B. Related Work Not In This Section:
   1. Section 01532 - Tree Protection
   2. Section 02810 - Irrigation
   3. Section 02970 - Landscape Maintenance

1.02 SUBMITTALS

Refer to Section 01300 for procedures.

A. Materials list: Submit complete material list prior to performing any work. Material list shall include manufacturer, model number, and description of all materials and equipment to be used. The Contractor shall also furnish the articles, equipment, materials, or processes specified by name in Drawings and Specifications. For Tree Submittals, provide photo image, height, canopy, width and caliper at 4' height. A nursery worker shall stand next to the tree in the image for a sense of scale. For Shrub, Groundcover and Vine Submittals, provide photo image, height and width of the entire plant. No substitutes will be allowed without prior written acceptance. Equipment or materials installed or furnished without prior approval of the Architect may be rejected and the Contractor required to remove such materials from the site at his own expense. All cut sheets, nursery images of trees and samples of materials shall be submitted 3 weeks prior to installation

B. Manufacturer's Product Specification Cut Sheets/Data:
   1. Provide 6 copies for all materials
   2. Submit manufacturer's standard printed product data for all items, referenced to article number in this specification for which each item is being submitted.
   3. Submit manufacturer's printed installation instruction and methods.
   4. Material Safety Data Sheets (MSDS): For all products used.

C. Required Manufacturer's Product Specification Cut Sheets /Physical Samples:

   Delivery may begin upon approval of Cut Sheets/Samples or as directed by Owner's Representative. Submit Samples in the form of Cut Sheets and Physical samples as required by the Landscape Architect or Owner's Representative and store on the site until furnishing of material is complete. Samples and Cut Sheets required are listed below:

   1. Irrigation Equipment (see Section 32 8400)
   2. Submit 'bagged' samples of each of the following, (2) samples of each, accompanied by (6) copies of the manufacturers specification cut sheets:

      Physical Samples of Bark Mulch
      Decomposed Granite/Stabilizer
      Decorative Rock/Pea Gravel
      Planting Mix, and Soil Amendments. NOTE: Approved samples of each to remain on site until furnishing of materials is complete. Delivery may begin upon approval of all submittals or as directed by Owner's Representative.

   3. Cut Sheets for Tree Root Control Barriers and Aluminum Edging
   4. Cut Sheets for Tree Stakes/Weed Whip Guards
   5. There shall be at least one (1) photograph of each species of tree, shrub, vine and ground cover to be planted. All photographs shall be taken with a person/or a scale in each photo next to the plant. Include with the photographs of all trees a notation of caliper, canopy width and height of each species of tree. If there are multiple boxes or gallon sizes of the same plant, include separate information for each container sized tree.
   6. Fertilizer Analysis: also provide labels of each fertilizer used and the quantities used in each application
   7. Soil Amendment Analysis
   8. Analysis of Imported Topsoils and Sand
   9. Cut Sheets of Herbicides, Pesticides and Fungicides: Furnish manufacturer's certification by the USDA, description of ingredients, and recommendations for usage and application rates for each material to be used and dates of application 10.Cut Sheets shall be provided for all other products noted in Part 2, 2.01 Soil Additives, Fertilizers, and Herbicides and 2.02 Staking Material.

D. Certificates: The Contractor shall submit, at time of delivery, to the Inspector of Record (IOR), delivery receipts or tickets of all amendments and soil additives, reflection actual quantities and types of materials delivered to the project site. Delivery receipts or tickets shall include the name of the project and the date of the actual delivery. Four (4) copies of all receipts / tickets shall be forwarded to the Architect, by the Contractor. Approval of types and quantities by the IOR and Architect are required prior to working in or spreading any amendments or soil additives.

E. Prior to being placed on maintenance-Refer to Section 3.06 "Inspection, Start of Maintenance" - the Contractor shall submit a schedule of all activities planned during the maintenance period. This shall be accepted by the Grounds Supervisor prior to the start of the maintenance period. All schedule changes shall be documented and accepted by the Grounds Supervisor.

F. Prior to the date of the final walk-through, the Contractor shall acquire from the Grounds Supervisor approved reproducible prints and shall produce the final record from the job record set of all changes made to all plans during construction, label said prints, "As-Builts" and deliver to the Grounds Supervisor and as required by any Local Agency. Prior to the date of final inspection, the Contractor shall deliver to the Grounds Supervisor the "Landscape and Irrigation Guarantee" as required. Said Guarantee shall be on the Contractor's letterhead and dated the scheduled final acceptance date.

G. All turnover items noted in other specification sections shall be delivered prior to the final walk-through.

H. Supply a monthly record of all herbicides, insecticides, fertilizes, and disease control chemicals with rates and amounts used noted.

1.03 PROTECTION OF WORK

The Contractor shall be responsible for protection of all adjacent finished surfaces and materials, both interior and exterior, while performing all landscape and irrigation operations, including maintenance. These finishes and materials shall be cleaned and returned to as-new condition when work is completed.

1.04 GUARANTEES AND REPLACEMENTS: Refer to Section 01780.

A. Shrubs: Guarantee shrubs from the time of installation to the end date of the 90 day Maintenance Period.

B. Trees: Guarantee all trees to live in a healthy condition for (1) one year from the end date of the Maintenance Period. Dead or unhealthy trees shall be replaced within 10 days after notification of Contractor by the Owner's Representative or the Architect.

C. Dead and Non-Vigorous Plants: As soon as weather permits, replace all dead plants and all plants not in a vigorous condition as noted at the end of the Maintenance Period.

D. Replacements: Plants used for replacement shall be the same kind and size as specified on the Planting Plan. They shall be furnished, planted, and fertilized as specified at no additional cost to the Owner. Replacement plants shall be maintained for a period of

time equal to the original maintenance period. They shall be in excellent condition following the replacement and maintenance.

E. Provide Certificate of Compliance from authority having jurisdiction indicating approval of plants, fertilizer and herbicide mixture. Plant Materials: Described by ASTM Z60.1; free of disease or hazardous insects.

PART 2 – PRODUCTS.

2.01 SOIL ADDITIVES, FERTILIZERS, LANDSCAPE MATERIALS, AND HERBICIDES

A. Mulch :"Walk On-Chips" as supplied by EarthWorks Soil Amendments Inc., (951)782-0260, or equal approved by the Owner's Representative. The mulch shall consist of fibrous, woody bark mixture of varied particle size.

B. Prepared Planting Mix for Backfill in all Planting Pits Except Raised Planters: Materials and amounts specified here are anticipated. This amendment is for bidding purposes and shall be superseded by recommendation of soil test/analysis report. Mix shall be the following materials thoroughly mixed:
   - By volume: 30% GroMulch and 70% excavated soil
   - Plus 2 lb. 12_12_12 commercial fertilizer per cubic yard of mix.
   - Plus: 3 lb. Agricultural grade gypsum per cubic yard of mix
   - Plus: 2 lb. Iron sulfate per cubic yard of mix

C. Ammonium Sulfate: Shall be standard brand (NH4) 2SO4.

D. Urea Formaldehyde: 35_0_0 shall be standard brand, as approved by the Architect.

E. Iron Sulfate: Shall be standard brand 20% Fe.

F. Vitamin B1 Root Hormone: Hormone shall be Superthrive, Hormex, or equal approved by the Architect.

G. Nitrolized Fir bark Fines: Fines shall be "Forest Humus" as sold by Kellogg Company, or equal approved by the Architect.

H. Commercial Fertilizer: Fertilizer shall be 12_12_12, standard commercial brand as approved by the Architect. Nitrogen for this mix shall be derived from 2% ammoniac, 5% urea, and 14% urea formaldehyde.

I. Gro Mulch: Mulch shall be as manufactured by the Kellogg Co.

J. Herbicide: Herbicide shall be Roundup or equal approved by the Architect.

K. Fertilizer Tablets: Agriform per manufacturer's recommendations.

L. Agricultural Gypsum: Gypsum shall be agricultural calcium sulfate CaS04 approved by Landscape Architect. This shall only be used in clay or adobe soils.

M. Mycorrhizal Fungal Inoculant: Plant and Tree Saver Transplant manufactured by Plant Health CareInc. or equal.

N. Soil Sulfur: Agricultural grade sulfur containing a minimum of 99% sulfur (expressed as elemental).

2.02 STAKING MATERIAL:

A. Stakes: Stakes for larger plant material shall be 2" diameter x 10'_0" long lodge pole stakes, actual dimension.

B. Ties: Ties shall be V.I.T. Cinch Ties, Model #CT32 For 24" box trees.

C. Tree Trunk Guards: Guards shall be Arbor Guard by Deep Root, (714) 898_0563, or equal approved by the Architect and shall be installed on the trunks of all trees in lawn areas.

D. Root Control arrier: All 48" box, 36" box, 24" box and 15 gallon trees planted within 6' of any hardscape areas (sidewalks, walls, concrete drainage swales, cubs, driveways or swales, cubs, driveways or any other structure) shall include root barriers, root barriers shall extend 5' on either side of the trunk for a total length of 10'. Root barriers are as follows:

1. 36" box trees, 24" box trees, and 15 gallon trees - Model # UB 18-2 available from DeepRoot, (800) 766-8835
2. 48" box trees - Model # UB 24-2 available from DeepRoot, (800) 766-8835

2.03 ALUMINUM EDGING

Not used

2.04 JUTE MESH

Shall be Anti-Wash / Geo Jute by Pacific Soil Stabilization, (805) 925-7737

2.05 PLANT MATERIALS

A. Quality and Size:

1. Quality and size of all plants shall be No. 1 grade. They shall be fresh, vigorous, of normal growth, free of disease, insects, insect eggs and larvae, with strong root systems.

2. Sizes of plants shall be as stated on the planting plan. No root bound or undersized materials shall be allowed.

3. Protect and maintain plant material in a healthy and vigorous condition until planted.

4. Do not install plant material when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

5. Do not place plants in containers or asphalt paving when outdoor temperature exceed 100 degrees F. for a period exceeding 16 hours.

B. Pruning: Pruning shall not be done prior to delivery except by special approval of the Architect.

1. Tree Trimmer Qualifications: Company specializing in pruning trees with proof of ISA Arborist Certification and ISA Tree Worker Certification.
2. Tree Pruning: ISA - Pruning Standards for Shade Trees.

C. Inspection: Inspection of plant materials required by City, State, or Federal authorities shall be a responsibility of the Contractor, and he shall obtain permits or certificates prior to delivery of plants to site.

D. Plant Marking: Each plant shall be clearly marked with a waterproof tag as to its botanical name as required by California State Agricultural Laws.

E. Deliver, store, protect and handle products to site under provisions of Section 01600 - Materials and Equipment.

2.06 IMPORTED TOPSOIL

A. Class A topsoil: good class A topsoil should be used as in the following definition. The soil must have good structure. If necessary, the soil can be conditioned to help improve the physical soil properties.

1. Topsoil shall be free of roots. Clods and stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds such as nut grass roots and nodules, sticks, brush and other litter. It shall not be infested with nematodes or other undesirable insects or plant disease organisms.
2. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil. Total pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent by weight.
3. Gradation limits - Soil shall be a sandy loam, loam, or clay loam. The definition of soil texture shall be per the USDA classification scheme.

B. Quality controls: All topsoils to be imported for the planting areas shall receive an "Agricultural Suitability Analysis" of soils before being placed in the planting areas. Soil shall be tested from the source site. There shall be 1 (one) test from each source site. After delivery to site the soil shall again receive 1 (one) soil test before final placement. These tests are to be collected at the site, by Wallace Labs; analysis and recommendations made by Wallace Laboratories, 365 Coral Circle, El Segundo CA 90245, Ph. (310) 615-0116 Fax (310) 640-6863. Tests shall be submitted to the architect for approval before placing soils. Tests shall include the following:

1. Must include pH measurement in the Saturation Extract, Electro conductivity of the saturation extract and Sodium Adsorption Ratio of the saturation extract. The approved procedures are the following:

PH	Method 21
Saturation Extract	Method 2
Sodium Adsorption Ratio	Method 20b

Methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled "Diagnosis and Improvement of Saline and Alkali Soils".

2. The following nutrients and elements must be determined with an approved extraction method. Interpretation data must be given citing concentrations, which are considered to be low, medium and high: boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorus, potassium, sodium, sulfur, and zinc. The approved methods are those cited by the Council on Soil Testing and Plant Analysis and those methods currently used by soil scientists and agronomists and published in Communications in Soil Science and Plant Analysis, Soil Science and Soil Science Society of America Journal. Approved methods are Mehlich Number 3, Bray PI, Bray P2, Olsen P, DTPA, ammonium acetate, ammonium bicarbonate-DTPA, wid hot water extract for boron.
3. The saturated extract must be analyzed for calcium, magnesium, sodium, boron, chloride, nitrate, and sulfate.
4. The following trace metals must be measured by the DTPA extract: Aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin and vanadium.
5. The presence of calcium carbonate and/or magnesium carbonate must be determined by commonly used methods.
6. Soil Texture and Organic Matter content may be estimated or determined by commonly used methods.
7. Interpretation of nutritional deficiencies or excesses and potential toxicities must be given.
8. If required, determine the following by methods approved by the American Society of Agronomy as published in the Methods of Soil Analysis, methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled "Diagnosis and Improvement of Saline and Alkali Soils," and bulk density of clods by the method published in Soil Science, vol 155, 325-330 (1993):
9. Exchangeable Ammonium cation
   Base Saturation
   Cation Exchange Capacity
   Carbonates Determination
   Soil Bulk Density (Compaction)
   Sand, Silt and Clay determination
   Water Infiltration Rate

   Elemental determinations to be made according to methods approved by the EPA or by the American Society of Agronomy.

C. Possible sources of class A topsoil:
   1. Excavations or grading of native topsoil from undeveloped areas.
   2. Excavations or grading of topsoil fronm previously landscaped or formed areas.

3. Excavations or grading of topsoil from previously non-landscaped or non-farmed areas if the soil is thoroughly evaluated for potential toxic materials.
4. Soil supply companies supplying natural topsoil without excessive amending.
5. Manufacturing of topsoil with less desirable soil as long as the soil has matured and developed the characteristics of class topsoil.

D. Contractor Responsibilities.
1. Provide inspections, tests and similar quality control services as specified below. The contractor will pay cost for these services.
2. Employ and pay an independent agency to perform specified quality control services.
3. Owner will engage and pay for services of an independent agency to perform inspections and tests, which are not required by the specification.
4. Retest where results of required inspections, tests or similar services prove unsatisfactory workmanship and materials and do not indicate compliance with specifications regardless of whether the tests and services where not the responsibility of the contractor will be paid by the Contractor.

E. Owner Responsibility: Owner will provide and pay for inspections, tests and similar quality control services not specified.

F. Duties of Testing Agency.
1. Retest where results of required inspections, tests or similar services prove unsatisfactory workmanship and materials and do not indicate compliance with specifications regardless of whether the tests and services where not the responsibility of the contractor will be paid by the Contractor.
2. Independent testing agency engaged to perform inspections, sampling and testing of materials shall cooperate with architect and contractor in performance of its duties and shall provide qualified personnel to perform required inspections and tests.
3. Agency shall notify architect, owner and contractor promptly of irregularities or deficiencies observed in the work or materials during performance of its services.
4. Agency is not authorized to release, revoke, alter or enlarge requirements of specifications or approves or accepts any portion of work or materials.
5. Agency shall not perform any duties of contractor.

G. Submittals
1. Independent testing agency shall submit written report of each inspection, test or similar service to architect and owner unless contractor is responsible for service. If contractor is responsible for service, submit written report of each inspection, test or similar service through contractor.
2. Each source of topsoil shall be tested with representative submittal samples and at various depths. Soil shall be tested from the source site. There shall be a 1 (one) test from each source site. After delivery to site the soil shall again receive 1 (one) soil test before final placement. The owner reserves the right to

test delivered materials at owner's expense. If any delivered material fails to meet the specifications, the material will be promptly removed from the site at the contractor's expense. The contractor shall pay for the testing of any materials not meeting specifications.

2.07 DECOMPOSED GRANITE MATERIALS

A. Decomposed Granite "Gail's Gold" or equal. Screen evenly and grade from 3/32" max to 0".
   1. Sources:
      a. Gail Materials, INC 951.279.1095

B. Stabilized Binder
   1. Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite.

2.08 EXCESS DECOMPOSED GRANITE MATERIALS

A. Provide owner's authorized rep. with the following excess materials for use in future decomposed granite repair: One (1) 40 to 50 lb. Bags of the aggregate paving blended with proper amount of Stabilizer.

PART 3 – EXECUTION

3.01 FINE GRADING

A. Where any portion of irrigation system is installed after grading and fertilizing has been performed, refill and re-fertilize upper portion of backfill as specified herein.

B. Fine Grading: Upon completion of rough grading, perform required fine grading of planted areas.
   1. Before and during preliminary fine grading, dig out and remove all weeds and grasses. Dispose of off-site at Contractor's expense.
   2. Remove all rocks larger than one half (1/2) inch in the upper 8" of soils.
   3. Do not work the soil when moisture content is such that excessive compaction will occur, nor when soil is so dry that clods will not break readily.
   4. Apply water, if necessary, to provide ideal density for cross-tilling and for planting.
   5. Grade so as to anticipate or match the certified finished grades and swales.
      a. Remove or redistribute excess soil before the application of fertilizer and mulch.
      b. Where soil is to be replaced by plants and/or mulch, make allowance to prevent efficiency in the depth of mulch when final grading is completed.
      c. Excess soil generated from the planting holes and not used as backfill or in establishing the final grades shall be removed from the site.

C. Grades and Elevations: When weed abatement, soil preparation and amending is completed, and the soil has dried so as to be readily worked, fine grade planting areas to elevations shown on Contract Drawings.

1. Where grades are not otherwise indicated, provide uniform levels or slopes between points where elevations are given.
2. Make minor adjustments of grade where so requested by the Owner's Representative.
3. Provide finished grades which are even, uniform and without abrupt change of surface.
4. Slope soil areas away from structures to allow natural runoff of water, regrade swale surfaces as required for a minimum 2% run-off, or as indicated on plan. Grade low spots and swales when soil is at optimum moisture content for working.
5. Provide final finished soil grades in planter areas 2 inches below paving and curbs, or as shown on the Contract Drawings. Add mulch on top of soil.
6. Compact all soil to final grades: minimum 80%, maximum 85%, unless otherwise required by soils report or for structural reasons.

3.02 SOIL TESTING, CONDITIONING, FERTILIZING, AND WEED ABATEMENT

A. Soil Testing: Soils test on site shall be conducted twice:

(1) after rough grading is complete

(2) before planting commences, but after irrigation installment and soil amendments have been applied.

Tests are to be collected at the site, by Wallace Labs; analysis and recommendations made by Wallace Laboratories , 365 Coral Circle, El Segundo CA 90245, Ph. (310) 615-0116, Fax (310) 640-6863. The contractor will pay for cost for these services. Copies of tests shall be submitted to the Architect. Contractor shall allow two weeks for each round of soil testing to take place. Tests shall include the following:

1. Must include pH measurement in the Saturation Extract, Electro conductivity of the saturation extract and Sodium Adsorption Ratio of the saturation extract. The approved procedures are the following:

PH	Method 21
Saturation Extract	Method 2
Sodium Adsorption Ratio	Method 20b

Methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled "Diagnosis and Improvement of Saline and Alkali Soils".

2. The following nutrients and elements must be determined with an approved extraction method. Interpretation data must be given citing concentrations which are considered to be low, medium and high: boron, calcium, copper, iron, magnesium, Manganese, molybdenum, phosphorus, potassium, sodium, sulfur, and zinc. The approved methods are those cited by the Council on Soil Testing and Plant Analysis and those methods currently used by soil scientists and agronomists and published in Communications in Soil Science and Plant Analysis, Soil Science and Soil Science Society of America Journal. Approved methods are Mehlich Number 3, Bray PI, Bray P2, Olsen P, DTPA, ammonium acetate, ammonium bicarbonate-DTPA, with hot water extract for boron.
3. The saturated extract must be analyzed for calcium, magnesium, sodium, boron, chloride, nitrate, and sulfate.
4. The following trace metals must be measured by the DTPA extract: Aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin and vanadium.
5. The presence of calcium carbonate and/or magnesium carbonate must be determined by commonly used methods.
6. Soil Texture and Organic Matter content may be estimated or determined by commonly used methods.
7. Interpretation of nutritional deficiencies or excesses and potential toxicities must be given.
8. If required, determine the following by methods approved by the American Society of Agronomy as published in the Methods of Soil Analysis, methods of the United States Salinity Laboratory as published in the Agricultural Handbook Number 60 entitled "Diagnosis and Improvement of Saline and Alkali Soils," and bulk density of clods by the method published in Soil Science, vol 155, 325-330 (1993):

   Exchangeable Ammonium cation
   Base Saturation
   Cation Exchange Capacity
   Carbonates Determination
   Soil Bulk Density (Compaction)
   Sand, Silt and Clay determination
   Water Infiltration Rate
   Elemental determinations to be made according to methods approved by the EPA or by the American Society of Agronomy.

B. Weed Abatement: Determine that rodents and vermin are not present. If rodents and vermin are present control shall be undertaken by a licensed pest control applicator. Weed abatement shall be two grow-kill cycles. Anticipate at least 8 weeks for weed abatement. Contractor shall coordinate the scheduling of any spraying of herbicide to

occur on a Friday afternoon or school holiday and shall notify the District one (1) week prior to applications in order for them to post notice. The irrigation system needs to be fully operational and be functioning prior to and during the weed and kill operation. Keep soils moist for 3 weeks. Spray all areas to receive lawn, shrubs or ground cover with herbicide. Keep soils moist for five weeks. Again spray all areas to receive lawn, shrubs or ground cover with herbicide. Follow the manufacturer's recommendations.

C. After weed abatement, remove and dispose of all dead weeds, including roots.

D. For existing turf areas to be removed, remove all turf, weeds and roots plus 1" of soil below.

E. Soil Amendments for planting areas: Do not spread amendments until approval of delivered materials has been received from the IOR and Architect. Materials and amounts specified here are anticipated. This amendment is for bidding purposes and shall be superseded by recommendation of soil test/analysis report.

F. Tilling: All planting areas in th epark that are 90% soil compaction or above shall be cross-ripped 12" on center to a maximum depth of 10" below grade and follow with rototillage to reduce soil clods to a maximum diameter of 1 -inch in the top 8 inches. Remove stones and foreign matter over one half (1/2) inch in diameter from upper 8" of soil. Planting areas too small for power equipment shall be hand dug and tilled to a depth of 10" below grade. (All tilling shall be completed prior to adding conditioners and fertilizers, unless occupied by existing trees that remain in place) . Any part of the irrigation system, including heads, damaged during tilling shall be replaced with new equipment.

G. Planting Areas: The following amendments are anticipated. Exact mix and quantities shall be per the recommendations from soil testing results. All planting areas shall receive the following:

1. Gro-Mulch: 3 cubic yards per 1,000 square feet thoroughly mixed into the top 6" of soil for lawn, and 5 cubic yards per 1,000 square feet mixed into top 10" for shrubs and ground cover.
2. Gypsum: 40 lbs./1,000 square feet thoroughly mixed into the top 6" of soil.
3. Commercial fertilizer: 20 lbs./1,000 square feet thoroughly mixed into the top 6" of soil.

H. Jute Mesh or Matting: Begin at the top of the slope by anchoring the jute mesh in a 6" by 6" wide trench with a 6" steel staple every 12". Backfill and compact the trench after stapling. Roll the blankets down the slope in the direction of the water flow. The edges of parallel rolls of jute mesh must be stapled with approximately a 2" overlap. When the pieces must be spliced down the slope, place the epics end over end (shingle style) with approximately 6" overlap. Staple through overlapped area approximately 12" apart. Also, put 1 staple per square yard all along the roll. Jute mesh is to be installed on all slopes 2-1/2:1 and greater. Repair and stabilize all jute mesh installation that is disturbed during planting installation

3.03 PLANTING

A. General:
   1. Verify that soils test has been conducted to confirm that amendments have been properly installed prior to commencing planting. Verify that any heads or any parts of the irrigation system damaged by tilling has been repaired, and complete system is operational.
   2. Plant all materials as soon as site is available and weather conditions are suitable.
   3. Do not plant when weather conditions are unfavorable to good work.

B. Tree and Large Shrub Planting:
   1. Stake plant locations and get approval before excavating pits, making necessary adjustments as directed. Excavate all one gallon and larger plant pits to dimensions shown below.
   2. Excavate pits for all plants as shown on the planting details. Tree pits shall be of such a depth that after planting and settling, the crown of the plant shall be at or slightly above its original line of grade and the ball shall sit on compacted soil. The following are minimum sizes for shrub and tree pits:
      a. 1 gallon plants: 12" diameter hole, depth per detail.
      b. 5 gallon plants: 24" diameter hole, depth per detail.
      c. 15 gallon plants: 30" diameter hole, depth per detail.
      d. Boxed trees shall be twice the width of the root ball or a minimum of one foot all around, whichever is greater.
   3. Set in Agriform fertilizer tablets per manufacturer's recommendations.
   4. Compact backfill in bottom of pit and tamp firmly. Set plants in center of pits in vertical position so that the soil level of the crown of the plant is flush with or slightly higher than the finish grade after the soil has settled. Backfill with prepared soil mix as described above.
   5. Do not spread amendments/prepared soil mix until approval of delivered materials has been received from the IOR and Owner's Representative.
   6. Form a shallow basin around the edge of tree ball by depressing the soil slightly below the finish grade. Do not raise basin rims above general finished grade. Keep basin within the edges of the tree ball. Each basin shall be of a depth to hold at least two (2) inches of water.
   7. Apply root hormone to each tree as follows:
      a. Construct tree basins at rim or outer edge of the tree ball so that the water will stay on the top of the ball.
      b. Apply root hormone at a rate of 2 ounces to 2 gallons of water. Pour it on the top of the tree ball within the basin rim. Immediately after applying root hormone, fill the tree basin with water and allow it to settle within the soil. Repeat applications of clear water once or twice, depending on the condition of the tree ball or as directed by the Architect or Owner's Representative.

c. Tree balls shall be set in their pits before application of root hormone and shall be mulched immediately after its application and its irrigation into the ball.
d. Apply a second feeding of root hormone in the same manner and amount as above during the maintenance period or within 30 days after the tree is planted, whichever is longer.
e. Each tree with a trunk of 12" diameter or less, in a lawn or where string trimmers are used, shall receive a tree trunk guard, to installed per manufacturer's specifications.

C. Shrub Installation
1. Plant shrubs in areas as designated on the Drawings.
2. Grade shrub and ground cover areas 2" below top of walks and curb. Float to a smooth, uniform grade as shown on Drawings. All areas shall slope to drain.
3. Where no grades are shown, establish a smooth and continuous grade between existing or fixed controls such as walks, curbs, catch basins and elevations at steps or buildings. Roll, scarify, rake and level as necessary to make a true, even surface. All finish grades shall meet the approval of the Architect or Owner's Representative before installation of ground cover. All grades shall slope to drain.
4. Loosen soil to a depth of 12" in shrub area and grade to remove ridges and depressions. Remove any additional stones and foreign matter over one half (1/2) inch in diameter from upper 8" of soil. Float areas to finish grade. Apply soil conditioners as specified above, mixing thoroughly into the soil to the depths indicated.
5. Do not pile soil around the crown of any plant. Smooth soil around plants and leave all areas in a neat and clean condition.
6. Water with a light spray.

D. Mulching: Apply 'Walk on Bark' or approved equal to all planting areas to a depth of four inches (3"). (unless decomposed granite is noted to be placed between plant material - see Plan) Mulch shall not be piled upon plant stems and trunks.

E. Grading: Grade areas around plants to finish grades and dispose of excess soil off the site.

F. Pruning: Prune plants according to standard horticultural practice as needed or as directed by the Architect or Owner's Representative.
1. Tree Trimmer Qualifications: Company specializing in pruning trees with proof of ISA Arborist Certification and ISA Tree Worker Certification.
2. 4. Tree Pruning: ISA - Pruning Standards for Shade Trees.

G. Staking: Stake all trees as shown on Drawings and details with stakes on the windward side of trees. Tie stakes so as to avoid abrasion of the tree. All nursery stakes and ties shall be removed after planting.

3.04 Decomposed Granite: Do not install decomposed granite or crushed 3/8" or 1/4" minus aggregate paving during rainy conditions or below 40 degrees Fahrenheit and falling.

A. BLENDING STABILIZER

Blend 12 to 16 lbs (call manufacturer for exact blend) of Stabilizer per 1-ton of decomposed granite or crushed 3/8" or 1/4" minus aggregate screenings. It is critical that Stabilizer be thoroughly and uniformly mixed throughout decomposed granite or crushed 1/4" or 3/8" minus aggregate screenings. Bucket blending is not acceptable. Blending with a rake and or shovel is not acceptable.

B. PLACEMENT

1. After pre-blending, place the Stabilized decomposed aggregate or 3/8" or 1/4" crushed aggregate screenings on prepared sub-grade. Level to desired grade and cross section.
2. Depth of pathways - 3" for heavy foot traffic and light vehicles.

C. WATERING

Water heavily to achieve full depth moisture penetration of the Stabilized pathway Profile. Water activates Stabilizer. To achieve saturation of Stabilized pathway Profile, 25 to 45 gallons of water per 1-ton must be applied. During water application randomly test for depth using a probing device to the final depth.

D. COMPACTION

1. Upon thorough moisture penetration, compact aggregate screenings to 85% relative compaction by compaction equipment such as; a 2 to 4-ton double drum roller or a 1,000 lb. Single drum roller with vibratory plate tamp. Do not begin compaction for 6 hours after placement and up to 48 hours.
2. Take care in compacting decomposed granite or crushed 3/8" or 1/4" minus aggregate screenings when adjacent to planting and irrigation systems. Hand tamping with 8" or 10" hand tamp recommended.

E. INSPECTION

Finished surface of pathway shall be smooth, uniform and solid. There shall be no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no spongy areas. Loose material shall not be present on the surface. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

3.05 INSPECTION, START OF MAINTENANCE

A. Inspection: An inspection shall be made of all planted areas by the Owner's Representative or by the Architect when the landscape installation complete. The maintenance period will begin after approval by the Owner's Representative or the

Architect. Contractor shall give at least 7 days' notice in advance of the inspection time. If the Owner wants early completion of any portion of the project, "start maintenance for that portion may begin following inspection and approval by the Owner's Representative or the Architect.

B. Maintenance Period

1. The 90-day Maintenance Period begins at the end of the substantial construction completion date for the entire project.
2. The Maintenance Period shall be 90 calendar days.
3. Any day when the Contractor fails to adequately maintain plantings, replace unsuitable plants, control weeds, trash or other work as determined necessary by the Grounds Supervisor, will not be credited as one of the plant maintenance days.

3.06 MAINTENANCE OF LANDSCAPE AREAS

A. Maintenance

1. Before the start of the 90-day Maintenance Period, the Contractor is responsible for maintaining the installation. This period of maintenance responsibility is not part of the 90 day Maintenance Period that begins when the entire project is installed, inspected, and approved for "Start of Maintenance. If the Contractor fails the final inspection, the 90-Day Maintenance Period will begin when the Owner's Representative and the Architect are satisfied that the project is ready for "Start of Maintenance."
2. If the Maintenance Period is extended beyond the 90 Day time because of rejection by the Owner's Representative or by the Architect, or for whatever reason, then the entire installation will remain the responsibility of the Contractor unless otherwise determined by the Owner's Representative.
3. The year's guarantee of the trees begins at the end of the Maintenance Period. Any rejected material shall be replaced and the 90-Day Maintenance Period shall be started from that time for the replaced material only.
4. Maintain trees and plants in a vigorous, thriving condition by watering, cultivating, pruning, spraying, and any other necessary operation. Keep all shrubs free of weeds. Remove weed roots and stolons from the soil before planting and as necessary after planting.
5. No stripping of lower branches ("raising-up") of young trees shall be permitted. Lower branches shall be retained in a "tipped back" or pinched condition with as much foliage as possible to promote caliper trunk growth (tapered trunk). Lower branches can be cut flush with the trunk only after the tree is able to stand erect without staking or other support. Sucker growth shall be removed if deemed appropriate by the Grounds Supervisor. Any pruning shall be conducted by a Certified Arborist.

6. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached which have vertical spacing of from 18" to 48" and radial orientation so as not to over lay one another; to eliminate diseased or damaged growth; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain growth within space limitations; to maintain a natural appearance; to balance crown with roots. Any pruning shall be conducted by a Certified Arborist.
7. Evergreen trees shall be thinned out and shaped when necessary to prevent wind and storm damage. The primary pruning of deciduous trees shall be done during the dormant season. Damaged trees or those that constitute health or safety hazards shall be pruned at any time of the year as required to eliminate these conditions. Any pruning shall be conducted by a Certified Arborist.
8. Tree trunks shall be protected at all times from any damage by maintenance equipment. Do not allow weed whippers to touch tree trunks.
9. The objectives of shrub pruning are the same as for trees. Shrubs shall not be clipped into balled or boxed forms unless such is required by the design and directed by the Grounds Supervisor.
10. All pruning cuts shall be made to lateral branches or buds or flush with the trunk, "Stubbing" will not be permitted.
11. Maintain all planting areas by watering, weeding, replanting, and other necessary operations. Keep planting areas free from weeds by removing roots and stolons and keeping the area in a clean and acceptable condition through the end of the Maintenance Period.
12. The Contractor shall check weekly all systems for proper operation. Lateral lines shall be flushed out after removing the last sprinkler head or two at each end of the lateral. All heads are to be adjusted as necessary for unimpeded coverage.

3.07 FINAL INSPECTION

A. Owner's representative shall make a final inspection upon completion of the specified Maintenance Period.
B. Contractor shall request final inspection in writing a minimum of 10 calendar days prior to anticipated date of inspection.
C. All areas shall be weed-free, rodent/vermin free, with healthy growth and ful turf/lawn establishment at the final inspection.

3.08 CLEAN UP

Upon completion of all construction and before final acceptance, the Contractor shall broom clean entire paved area. All tools, surplus materials, equipment, debris, and rubbish shall be removed from the site and the site shall be left in a clean, neat condition such as to meet the

approval of the Owner's Representative and/or the Architect. During the Maintenance Period, all hardscape/paving areas and gutters shall be clear of debris, leaves, trash etc.

4.00 Hydrostolonized Turf

- Install six (6) bushels of Kikuya stolons per 1000 s.f.

Acre rates for slurry

- 1500 lbs. wood fiber mulch
- 120 lbs. m-binder
- 100 lbs. 46-0-0 fertilizer

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Paving for playground, parking areas, areas between buildings, synthetic track surfacing adjacent to planting and turf areas as indicated.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 22 00 - Grading.

1.2 SUBMITTALS

A. Shop Drawings: Submit site plan indicating extent of paving and accessories.

B. Product Data: Manufacturer's technical data for materials and products.

1.3 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction.

1.4 PROJECT CONDITIONS

A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. A copy of the soils report is available for examination in the office of the Architect during regular office hours of the Architect.

PART 2 – PRODUCTS

2.1 BITUMINOUS MATERIALS

A. Provide materials of the class, grade, or type indicated on the Drawings, conforming to relevant provisions of Section 203 - Bituminous Materials of the Standard Specifications for Public Works Construction.

2.2 HEADERS

A. Concrete: Per specification Section 32 1313 - Site Concrete Work.

PART 3 – EXECUTION

3.1 HEADERS

A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.

B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of adjacent undisturbed earth.
C. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
D. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
E. Provide additional stakes and anchorage as required to fasten headers in place.

3.2 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

A. Thickness of Surfacing: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
B. Provide surfacing material over base course.
C. Surfaces of walls, concrete, masonry, or existing bituminous surfacing indicated to be in direct contact with installed bituminous surfacing shall be cleaned, dried and uniformly coated with an asphaltic emulsion film.
D. Thicken edges of bituminous surfacing that do not abut walls, concrete, or masonry, and edges joining existing bituminous surfaces. Remove headers at existing bituminous surfacing where new bituminous surfacing is to be installed. Thicken edges an additional 2 inches and taper to the indicated or specified thickness 6 inches back from such edges.
E. At stairways, adjust thickness of paving such that the first tread is equal in height to all other treads.
F. Provide adequate protection for concrete, planting areas, and other finish Work adjacent to areas indicated to receive bituminous surfacing.
G. Placing:
    1. Do not install bituminous surfacing when atmospheric temperature is below 40 degrees F; or when fog or other unsuitable weather conditions are present. Temperature of mixture at time of installation shall not be lower than 260 degrees F in warm weather or higher than 320 degrees F in cold weather.
    2. Where 2-inch or 3-inch thick surfacing is indicated or specified, install surfacing in one course. Where surfacing is indicated or specified 4 inches or more in thickness, except for thickened edges, install bituminous surfacing in courses of approximately equal thickness, each course not exceeding 2 ½ inches in thickness.
H. Stakes or Screeds: Provide grade or screed stakes spaced not more than 15 feet apart in flow lines with grades of less than one percent. Continuous screeds may be provided instead of stakes.
I. Spreading: Install bituminous surfacing in a manner to cause least possible handling of mixture. In open areas and wherever practicable, install by mechanical means with a self- propelled mechanical spreader. In confined or restricted areas, install mixture with hot shovels and rakes, and smooth with lutes.

J. Joints: Provide vertical joints between successive runs. Install joints true to line, grade, and cross section. Lapped joints are not permitted.

K. Rolling:

1. Finish roll with a self-propelled tandem roller weighing at least 8 tons. Break down roll with a self-propelled roller weighing between 1 ½ tons and 8 tons.
2. Roll in a manner that preserves flow lines and the established finished grades. Break down roll in areas adjacent to flow lines parallel to flow lines. Break down roll after bituminous surfacing is installed without shoving or cracking of mixture under roller. Continue finish rolling until surfacing is unyielding, true to grade, and meets requirements for specified smoothness. Areas inaccessible to finish roller may be finish rolled with breakdown roller or tamped with hot tamping irons and smoothed with hot smoothing irons or hand roller.
3. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth to properly compact.
4. Compacted bituminous surfacing shall be provided with a bulk specific gravity of at least 2.31 when tested in accordance with ASTM D1188.

3.3 TOLERANCE

A. Smoothness: Surface of bituminous surfacing after rolling, shall be even, smooth and uniform in texture with no voids or rock pockets, free of roller marks or other irregularities, and not varying by more than 0.03 foot, except at local depressions or raised areas as indicated, when a 10-foot straightedge is placed on surface.

B. Grade: Finished grade shall not vary more than 0.02 foot above or below required grade. Variations within prescribed tolerance shall be compensating so that average grade and cross-section are provided.

C. Premium paving tolerances and requirements for synthetic track:

1. General: Test in-place asphalt concrete courses for compliance with requirements or thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Owner's representative.
2. Thickness: Tolerances for thickness shall be ¼ inch, plus or minus.
3. Planarity: The asphalt substrate shall not vary from the planned cross slope by more than plus or minus 0.1 percent. The finished asphalt shall not vary, plus or minus, under a 10 feet straight edge greater than 1/8 inch. Flood test the surface with the use of a water truck. If, after 30 minutes on a 70-degree F day, "bird baths" are evident at a depth more than 1/8 inch repair using the best method of correction.
4. Corrective Measures: Determine if the planarity, cross slopes, and general specifications have been met. If all of the conditions have been met notify the Owner in writing of the acceptance of the asphalt paving.

3.4 TESTING

A. After first coat of surface seal has been installed and after a 24-hour period, the flood test shall be completed of the bituminous surfacing in presence of the Project Inspector. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.

3.5 SURFACE SEALING

A. After bituminous surfacing has passed flood test, clear and allow to dry and provide one more coat of surface seal.
B. Where indicated, provide multiple coats of surface seal to existing bituminous surfacing.
C. Where new bituminous surfacing joins existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.

3.6 PROTECTION

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

3.7 CLEANUP

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

END OF SECTION

SECTION 32 12 36

EMULSIFIED SLURRY SEAL

PART 1 – GENERAL

1.1 SUMMARY

A. The work shall consist of mixing asphaltic emulsion, aggregate, set-control additives and water, and spreading the mixture on a surfacing or pavement.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Asphaltic Emulsion: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Material certificates.

D. Log of slurry seal application, including dates, times, temperature readings and other pertinent information.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Standard Specifications: Comply with latest editions and supplements for Caltrans Standard Specifications Sections 37 and 94. These Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: The slurry seal shall not be applied if either the pavement or air temperature is below 50 degrees Fahrenheit. and falling, but may be applied when both pavement and air temperatures are above 45 degrees Fahrenheit and rising. No slurry seal shall be applied when there is a possibility of freezing temperatures at the project location within 24 hours after application.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees Fahrenheit for oil-based materials, 50 degrees Fahrenheit for water-based materials, and not exceeding 95 degrees Fahrenheit.

PART 2 – PRODUCTS

2.1 ASPHALTIC EMULSION

A. Asphaltic emulsion shall be a quick-setting type, grade QS1h anionic, or grade CQS1h cationic, conforming to the provisions in Caltrans Standard Specifications Section 94, Table 4. The grades of asphaltic emulsion shall be at the option of the Contractor.

2.2 AGGREGATE

A. Aggregate shall conform to the provisions in Caltrans Standard Specification Section 37-2.02C, Type II

2.3 WATER

A. Water shall be such quality that the asphalt will not separate from the emulsion before the slurry seal is in place in the work. If necessary for workability, a set-control agent that will not adversely affect the slurry seal may be used.

2.4 MIX DESIGN

A. Compatibility of the emulsified asphalt, aggregate, water and additives shall be evaluated in the mix design. The slurry seal mixture shall conform to the requirements specified when tested in accordance with the Caltrans Standard Specifications Section 37-2.03.

2.5 PAVEMENT MARKING PAINT

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with Caltrans Standard Specifications - Section 84 (Federal Specification No. TT-P-1952 for Blue, Red and Green paint; and State of California Standard Specification No. PTWB-01 for White, Yellow and Black paint) with drying time of less than 45 minutes.
   1. Color: White

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

A. Prior to applying the slurry seal, loose material, oil spots, vegetation, and other objectionable material shall be removed. A standard cleaning method such as sweeping, flushing, or other means will be acceptable. If water is used, cracks shall be allowed to dry thoroughly before slurry surfacing. Manholes, valve boxes, catch basins, and other utility boxes shall be protected from slurry seal by a suitable method.

B. Treat cracks wider than 0.25 inches in the pavement surface with an approved crack sealer prior to application of slurry seal.

3.2 PLACING

A. The slurring mixture shall be uniformly spread on the existing surfacing within the rate specified without spotting, re-handling or otherwise shifting of the mixture.
B. Slurry seal shall not be placed when the atmospheric temperature is below 50 degrees Fahrenheit or during unsuitable weather.
C. Slurry seal shall be spread at a rate specified in Caltrans Standard Specifications Section 37-2.06.
D. The mixture shall be uniform and homogeneous after spreading on the existing surfacing and shall not show separation of the emulsion and aggregate after setting.
E. Lumping, balling, or unmixed aggregate will not be acceptable.
F. Adequate means shall be supplied to protect slurry seal from damage by traffic until such time that the mixture has cured sufficiently so that the slurry seal will not adhere to and be picked up by the tires of vehicles.
G. No excess buildup, uncovered areas, or unsightly appearance shall be permitted on longitudinal or traverse joints. The contractor shall supply suitable equipment to produce a minimum number of longitudinal joints throughout the project. When possible, a longitudinal joint shall not be place in a wheel path. Less than full box width passes will be used only as required. If less than full box width passes are used, they shall not be the last pass of any paved area. A maximum of six inches shall be allowed for overlap of longitudinal joints.
H. Area which cannot be accessed by the mixing machine shall be surfaced using hand squeegees to allow complete and uniform coverage. If necessary, the area to be handworked shall be lightly dampened prior to mix placement. Handwork shall exhibit the same finish as that applied by the spreader and shall be completed prior to final surfacing.
I. Care shall be taken to apply straight lines along curbs and gutters. No run-off on these areas will be permitted. Roofing felt or heavy plastic may be used to begin or end a pull cleanly.
J. Rolling is not necessary for slurry seal on roadways. Parking areas shall be rolled by a self-propelled, 10-ton (maximum) pneumatic tire roller equipped with a water spray system. All tires shall be inflated per manufacture’s specifications. Rolling shall not start until the slurry has cured sufficiently to avoid damage by the roller. Areas which require rolling shall receive a minimum of two full coverage passes.

3.3 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
B. Allow paving to age for 30 days before starting pavement marking.
C. Sweep and clean surface to eliminate loose material and dust.
D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to allow a minimum wet film thickness of 15 mils.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
C. Remove and replace or install additional slurry seal mixture where test results or measurements indicate that it does not comply with specified requirements.

3.5 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an Environmental Protection Agency (EPA) approved landfill.

END OF SECTION

SECTION 32 13 13

SITE CONCRETE WORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland cement concrete pavement, cement walks, curbs, gutters, trash pick-up area, ramps, mowing strips, fence post footings, sliding gate concrete tracks, catch basins, pipe bedding and encasements, thrust blocks, transition structures, flagpoles and light standard bases and footings, athletic equipment footings and equipment pads.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 35 93 - Off-site Improvement Procedures.
3. Section 01 35 96 - Off-site Improvement Procedures (B-Permit).
4. Section 03 20 00 - Concrete Reinforcement.
5. Division 23 - HVAC.
6. Division 26 - Electrical.
7. Section 31 22 00 - Grading.
8. Section 31 23 16 - Excavation and Fill for Pavement.
9. Section 32 12 16 - Asphalt Paving
10. Section 33 11 00 - Site Water Distribution Utilities.
11. Section 33 30 00 - Site Sanitary Sewer Utilities.
12. Section 33 40 00 - Storm Drainage Utilities.

1.2 SUBMITTALS

A. Shop Drawings: Submit plans, elevations and details of concrete site Work.

B. Product Data: Submit mix designs and manufacturer's technical data for materials and products. Submit 3-inch by 3-inch concrete Sample of each specified color.

C. Material Sample: Submit one concrete bumper to the Project Inspector for destructive testing.

1.3 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete, Mortar and Related Materials: Comply with applicable provisions of Standard Specifications for Public Works Construction, Section 201 - Concrete, Mortar and Related Materials:

1. Concrete: 28-day compressive strength 2,500 psi, unless specified otherwise.

2. Reinforcing Mesh: ASTM A185, 4 by 4/W1.4 by W1.4 welded wire mesh.
3. Expansion Joint Filler: Preformed expansion joint filler, bituminous type, complying with ASTM D994.

B. Form Materials:
1. Side forms: Douglas fir, Construction Grade or Better or metal forms.
2. Stakes: Douglas fir, Construction Grade or Better or metal stakes.

C. Concrete Parking Bumpers:
1. Precast concrete, smooth and free of pits and rock pockets, providing a minimum 28-day compressive strength of 3,500 psi. Size at least 7 ½-inch wide, 5 ½-inch high and 6-foot long. Reinforce with two #5 reinforcing bars. Provide 2 3/4-inch diameter pre-drilled holes for anchor installation.
2. Bumper Anchors: Provide ½ inch diameter by 18-inch long galvanized steel pipe.
3. Bumper Adhesive: Provide adhesive recommended by bumper manufacturer/installer for fastening bumpers to concrete pavement.

PART 3 – EXECUTION

3.1 CONSTRUCTION OF FORMS FOR CAST-IN-PLACE STRUCTURES

A. Concrete Pavement: Install Portland cement concrete pavement in compliance with the Standard Specifications for Public Works Construction, Section 302- Roadway Surfacing.

B. Miscellaneous Exposed Concrete: Install concrete curbs, walks, gutters, cross gutters, access ramps, driveways, catch basins, yard boxes, vaults and similar structures, in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.

C. Exposed Concrete Bases: Install bases, such as for post, flagpole, light standards and similar bases, in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.

D. Post, flagpole, light standard footings below grade, underground conduit bedding, encasements, thrust blocks and similar structures may be placed \directly in excavations conforming to the required sizes.

E. Reinforcement installation and concrete placement, surface finishes, curing and removal of forms shall be performed in compliance with applicable provisions of Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction. Provide heavy broom finish at slopes exceeding six percent and medium broom finish at slopes up to six percent.

3.2 INSTALLATION OF PARKING BUMPERS

A. Install bumpers as indicated on the Drawings. On bituminous paving, install anchors through pavement and into the ground a minimum of 12 inches. On concrete pavement, install bumpers in a continuous bed of adhesive.

3.3 CLEAN UP

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

3.4 PROTECTION

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

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Parking stripes, markings and accessibility symbols.
2. Exterior athletic court markings.
3. Playground markings.
4. Fire lane “No Parking.”
5. Curb marking and red curbs.

B. Related Requirements:

1. Division 01 - General Requirements.

1.2 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings, indicating location, extent, color and texture of markings.

B. Material Samples: Submit color Samples.

1.3 PROJECT CONDITIONS

A. Do not install markings when adverse weather conditions are forecasted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Paint: Water emulsion-based traffic paint must be approved by OEHS.

1. Dunn Edwards: Vin-L-Stripe.
2. Pervo Paint Company: Acrylic Traffic Paint.
3. Sherwin Williams: Setfast Acrylic Traffic Paint.
4. Vista Paint Corporation: Traffic Paint.
5. Equal.

PART 3 – EXECUTION

3.1 PAVEMENT MARKINGS

A. Application of Paint:

1. Prior to application of paint, allow the pavement to properly cure. Clean and prepare in accordance with paint manufacturer's written recommendations.
2. Provide mechanical equipment to apply paint in a uniform, straight or curved pattern, without gaps, holidays, runs, or other defects.
3. Do not permit traffic until paint has completely cured.

4. Apply two coats in thickness recommended by manufacturer.
5. Playground Markings: Submit Samples to Architect for review. Limited color palettes may be submitted.

B. Marking Width and Color: Unless indicated otherwise, marking width and color are as follows:

Location	**Width**	**Color**
Parking stall lines	4 inches	White
Traffic markings		
Striping:	4 inches	Yellow
General	4 inches	Yellow
Accessible Parking	4 inches	Blue
International Symbol of Accessibility (ISA)	2 inches	White on blue background
Athletic Court Lines:	2 inches	*White
Letters and numbers:		As indicated

*Where two sets of lines overlap, one set shall be white and the other set shall be yellow.

3.2 PROTECTION

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

3.3 CLEANUP

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

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases; concrete foundation for posts.

C. Manual gates and related hardware.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with CLEFMI – Product Manual.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.5 ACTION SUBMITTALS

A. Product Data: Within 35 calendar days after the Contractor has received the District's Notice to Proceed, submit:

1. Materials list and cut sheets of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades; do not use architect's drawings. If heights are not indicated on drawings, fencing shall be 8'- 0" high.
4. Manufacturer's recommended installation procedures which, when accepted by the Architect, will become the basis for accepting or rejecting actual installation procedures for the Work.

PART 2 – PRODUCTS

2.1 CHAIN LINK FENCING AND GATES

A. General: Where vinyl coated fabric is called for on the drawings, also provide color coated framing, posts, rails and associated items. Similarly where galvanized fabric is indicated, associated framing and accessories shall be galvanized.

1. Pipe sizes indicated are commercial pipe sizes.
2. Tube sizes indicated are nominal outside dimensions.

2.2 GALVANIZING

A. On steel framework and appurtenances, provide galvanized finish with not less than the following weight of zinc per sq. ft. Typical.
   1. Pipe: 1.8 oz, complying with ASTM A120.
   2. Square Tubing: 2 oz, complying with ASTM A123.
   3. Hardware and Accessories: Comply with table II of ASTM A121.
   4. Fabric: 2.0 oz, complying with class II of ASTM A121.

2.3 FABRIC

A. Provide galvanized 9 gage wire and 0.148” vinyl coated wire in 2” mesh (or 1” where indicated on drawings), with top and bottom salvages twisted and knuckled. Galvanized finish where indicated on the drawings. Vinyl coated finishes shall be in the color selected by the Architect Provide fabric in one-piece widths.

2.4 POSTS, RAIL, AND ASSOCIATED ITEMS

A. End, Corner, Slope, and Pull Posts:
   1. Provide at least the following minimum sizes and weight:

Material and Dimensions	lbs/ft.
Pipe, 4” Outside Dimension	10.8

   1. From 8’-1” to 17’-0” high fence, end & corner posts shall be 6” diameter pipes, 19 lbs/ft
   2. From 17’-1” to 20’-6” high fence, end & corner posts shall be 8” diameter pipes, 28.60 lbs/ft.
   3. Finish: Vinyl Coated : Color selected by the Architect Galvanized finish (where indicated on drawings)

B. Line Posts:
   1. Provide minimum sizes and weights as follows:

Material and Dimensions	lbs per liner ft.
Pipe, 4” Outside Dimensions	10.8

   2. From 8’-1” to 17’-0” high fence, end & corner posts shall be 6” diameter pipes, 19 lbs/ft
   3. From 17’-1” to 20’-6” high fence, end & corner posts shall be 8” diameter pipes, 28.60 lbs/ft.
   4. Finish: Vinyl Coated : Color as Selected by the Architect or Galvanized finish (where indicated on drawings)

C. Gate Posts:
   1. Provide gate posts for supporting single gate leaf, or one leaf on a double gate installation, for nominal gate widths as follows:

Material and Dimensions	lbs per lin ft

Pipe, 4” Outside Dimension, 10.8 lbs/ft.

Vinyl Coated: Green or Galvanized Finish (where indicated on drawings)

2. Over 13 feet wide, and up to 18 feet wide: Use 6.625” outside diameter pipe weighing 14.0 lbs per lin ft.
3. Over 18 Feet Wide: Use 8.625” outside diameter pipe weighing 24.70 lbs per lin ft.

D. Top Rails:
1. Use 1.9” outside diameter pipe weighing 2.72 lbs per lineal ft. vinyl coated; or
2. Provide in manufacturer’s longest lengths, with expansion type couplings approximately 6” long for each joint.
3. Provide means for attaching top rail securely to each gate, corner, pull, slope and end post.

E. Post Brace Assemblies:
1. Provide at end and gate posts, and at both sides of corner, slope, and pull posts, with the horizontal brace located at mid-height of the fabric.
2. Use 1.9” diameter pipe weighing 2.72 lbs per lineal ft. vinyl coated for horizontal brace.
3. Use 3/8” diameter rod with turnbuckle for diagonal truss.

F. Tension Wire: Provide 7 gage galvanized vinal coated coiled spring wire at bottom of fabric.

G. Post Tops:
1. Provide single piece steel, wrought iron, or malleable iron, Vinyl coated designed as weathertight closure cap.
2. Provide one cap for each post.
3. Provide caps with openings to permit through passage of top rail.

H. Stretcher Bars:
1. Provide one-piece lengths equal to full height of fabric, with a minimum cross-section of 3/16” x 3/4”.
2. Provide one stretcher bar for each gate and end post, and two for each corner, slope, and pull post, except where fabric is woven integrally into the post.

I. Stretcher Bar Bend:
1. Provide steel, wrought iron, or malleable iron, spaced not over 15” on centers, to secure stretcher bars to end, corner, pull, slope, and gate posts.
2. Bands may be used also with special fittings for securing rails to end, corner, pull, slope, and gate posts.

2.5 GATES-SWINGING AND ROLLING

A. General:
1. Fabricate gate perimeter frames of tubular members.

2. Provide additional horizontal and vertical members to assure proper operation of the gate and for attachment of fabric, hardware, and accessories.
3. Space so frame members are not more than 8 feet apart.
4. Fabricate Gate Frames from:

Materials and Dimensions:	lbs per lineal ft.
Pipe 1.90” Outside Diameter:	2.72
Tubing, 2” Square:	2.60

B. Fabrication:
1. Assemble gate frames by welding with special malleable or pressed steel fittings and rivets for rigid connections.
2. Use same fabric as used in the fence.
3. Install fabric with stretcher bars at vertical edges as a minimum.
4. Attach stretchers to gate frame not more than 15” on centers.
5. Attach hardware with rivets or by other means which will provide security against removal and breakage.
6. Provide diagonal cross-bracing consisting of 3/8” diameter adjustable length truss rods on gates where required to provide frame rigidity without sag or twist.

C. Swinging Gate Hardware:
1. Provide following for each gate:
   a. Hinges:
      1) Pressed or forged steel, or malleable iron, to suite the gate size; non-lift-off type, offset to permit 180 degree opening.
      2) Provide 1-1/2 pair of hinges for each leaf over 6 feet in nominal height.
   b. Latches:
      1) Provide forked type to permit operation from either side of the gate. Plunger-bar type is not acceptable.
      2) Provide padlock eye as integral part of latch.
   c. Keeper: Provide keeper for vehicle gates, which automatically engages the gate leaf and holds it in the open position until manually released.
   d. Double Gates:
      1) Provide gate stops for double gates consisting of mushroom or flush plate, with anchors.
      2) Set in concrete to engage the center drop rod or plunger bar.
      3) Provide locking device and padlock eyes an integral part of the latch, requiring one padlock for locking both gate leaves.
   e. Gates: Gates in path of travel across an exit to a public way or to a safe dispersal area must comply with exit door hardware and shall have Panic hardware and lever handled latches, (CBC Section 1133B.1.1.1.4). Hardware shall not require pinching, grasping or twisting motion to operate and provide solid kick plates 10” minimum high 3” maximum from paving on

both sides of the gate. Gates shall also have a 5 lb. maximum opening pressure and door maneuvering clearance.

D. Rolling Gate Hardware:

1. Provide the Following for Each Gate:

a. Latches:

1) Provide forked type or plunger-bar type to permit operation from either side of the gate.

2) Provide padlock eye as integral part of latch.

3) Mounting height 30”-44” A.F.F.

b. Universal Track Bracket: Provide 10 gage galvanized steel brackets with 3/8” diameter galvanized J-Bolts and nuts.

c. Rear Wheels:

1) Provide 5” outside diameter, 4” diameter V-Groove, galvanized steel roller bearing wheel.

2) Anchor rear wheels to gate frame with 5/8” diameter bolts.

d. Double Wheel Carriage: Provide 1” x 2” x 14 ga galvanizing steel tube axle with 3/8” diameter galvanized J-Bolts and 6” diameter rubber tire with galvanized steel roller bearing hub.

e. Provide locking device and padlock eyes as an integral part of the latch.

2.6 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Wire Ties:

1. For tying fabric to line posts, use 9 gage galvanized wire ties spaced 12” on center.

2. For tying fabric to rails and braces, use 9 gage galvanized wire ties spaced 24” on center.

3. For tying fabric to tension wire, use 11 gage galvanized hot rings spaced 24” on center.

4. Manufacturer’s standard wire ties will be acceptable if or equal strength and durability.

B. Concrete: Comply with provisions of Section 03300 for 2500 psi concrete.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

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

3.2 INSTALLATION

A. General:

1. Install posts at a maximum spacing of 8 feet on center.
2. Install corner or slope posts where changes in line or grade exceed a 30-degree deflection.

B. Excavating:
1. Drill holes for post footing in firm, undisturbed or compacted soil, strictly adhering to the dimension and spacing shown.
2. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site if so directed.
3. When soil from rock is encountered near the surface, drill into rock at least 12” for line posts and at least 18” for end, pull gate, and corner posts. Drill hole at least 1” greater diameter than the largest dimension of the post to be placed.
4. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed minimum depths as specified above.

C. Setting Posts:
1. Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.
2. Center and align posts in hole.
3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation.
4. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
5. Trowel tops of footings, and slope or dome to direct water away from posts.
6. Extend footings for gate posts to the underside of bottom hinge.
7. Set keeps, stops, sleeves, and other accessories into concrete as required.
8. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing material or other curing method accepted by the Architect.
9. Grout-in those posts which are set into sleeved holes concrete constructions, or rock excavations, using non-shrink portland cement grout or other grouting material accepted by the Architect.

D. Concrete Strength:
1. Allow concrete to attain at least 7% of its minimum 28-day strength before rails, tension wires, and/or fabric is installed.
2. Do not, in any case, install such items in less than seven days after placement of concrete.
3. Do not stretch and tension fabric and wire, and do not hang gates, until concrete has attained its full design strength.

E. Rails and Bracing:
1. Install fence with a top rail and bottom tension wire.
2. Install top rails continuously through post caps or extension arms, bending to radius for curved runs.
3. Provide expansion couplings as recommended by the fencing manufacturer.

4. Provide bracing to the midpoint of the nearest line post or posts at all end, corner, slope, pull and gate posts.
5. Install tension wires parallel to the line of fabric by weaving through the fabric, and tying each post with not less than 6 gage galvanized wire, or by securing the wire to the fabric.

F. Installing Fabric:
1. Leave approximately 2” between finish grade and bottom salvage.
2. Excavate high points in the ground to clear the bottom of the fence.
3. Place and compact fill to within 1” of the bottom of the fabric in depressions if no mow curb.
4. Pull fabric taut and tie to posts, rails, and tension wires.
5. Install fabric on outward side facing side of fence, and anchor to framework so that the fabric remains in tension after pulling force is removed.
6. Install stretcher bars by threading through or clamping to fabric on 4” centers, and secure to posts with bands spaced 15” on centers.

G. Installing Gates:
1. Install gates plumb, level, and secure for full opening without interference.
2. Install ground-set items in concrete for anchorage in accordance with the fence manufacturer’s recommendations as accepted by the Architect.
3. Lubricate and adjust the hardware for smooth operation.

H. Miscellaneous:
1. Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns.
2. Bend ends of wire to minimize hazards to persons and clothing.
3. Fasteners:
   a. Install nuts from tension band and hardware bolts on side of fence opposite fabric side.
   b. Peen the ends of bolts to prevent removal of nuts.
4. Repair coatings damaged in the shop or field erection, using a hot-applied repair compound applied in accordance with its manufacturer’s recommendations as accepted by the Architect.

END OF SECTION

SECTION 32 33 13

SITE FURNITURE

Design Requirements:

1. No wooden product of any kind.
2. Possible material for tables, chair and benches are:
    a. Hard Plastic.
    b. Concrete.
    c. Metal – aluminum preferred.
3. Designer shall consult College Facility Director for final selections.
4. Designer shall review and adapt most current College Master Plan, facility Master plan and College Design Standards to establish bases of design.
5. All furniture shall meet current ADA requirement.
6. All furniture shall be secured by anchoring, placed inside a secure enclosure or embedded into the ground/floor to prevent thief.
7. No fiber glass umbrellas shall be used.
8. Fabric umbrellas shall be avoided unless requested by the Campus Facility Director.
9. All furniture shall have minimum 3 years full warranty including discoloring and 9 years warranty on material.
10. All benched shall have metal handlebars or [ ] type of divider in the middle with spacing not to exceed 42” to prevent horizontal occupancy.
11. Apply anti-graffiti coating if requested by the Owner.
12. Sample Products: Wausau Tile concrete & metal tables as well as trash receptacles and benches.

    Concrete tables - they also come in ADA 3 seater options

    http://www.wausaumade.com/products/tables

    2 seater tables for above grade installation - non-anchoring

    http://www.wausaumade.com/products/tables/mf1022-0

    Bench

    http://www.wausaumade.com/products/benches-chairs/tf5065

END OF SECTION

SECTION 32 84 00

LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Division 1 applies to this Section. Provide all labor, materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the Work of this Section, complete as shown on the Drawings and/or specified herein.

B. Work in This Section: Principal items include:

1. Irrigation mains.
2. Laterals.
3. Sprinkler heads.
4. Control valves.
5. Coupler valves, etc.
6. Automatic controllers.

C. Related Work Not In This Section: Examine all Sections for Work related to Work of this Section; principal items of which are:

1. Landscaping - refer to Section 32 93 00.
2. Landscape Maintenance – refer to Section 32 01 90.

D. Definition: The word Architect as used herein shall refer to the Landscape Architect or the Owner.

1.2 QUALITY ASSURANCE AND REQUIREMENTS:

A. Permits and Fees: Contractor shall obtain and pay for any and all permits and all inspections as required.

B. Manufacturer's Directions: The manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the Drawings and Specifications.

C. Ordinances and Regulations: All local, municipal and state laws, and rules and regulations governing or relating to any portion of this Work are hereby incorporated into and made a part of these Specifications, and their provisions shall be carried out by the Contractor. Anything contained in these Specifications shall not be construed to conflict with any of the above rules and regulations or requirements of the same. However, when these Specifications and Drawings call for, or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these Specifications and Drawings shall take precedence.

D. Explanation of Drawings:

1. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his Work and plan his Work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are diagrammatic and indicative of the Work to be installed. The Work shall be installed in such a manner as to avoid conflicts between Irrigation systems, planting, and architectural features.
2. All Work called for on the Drawings by notes or details shall be furnished and installed whether or not specifically mentioned in Specifications.

3. Contractor shall not willfully install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in the engineering. Such obstructions or differences should be brought to the attention of the Owner's authorized representative. In the event this notification is not performed, Contractor shall assume full responsibility for any revision necessary.
4. Work of this Section which is allied with the Work of other trades shall be coordinated as necessary.

E. Underwriters Laboratories: Electrical wiring, controls, motors, and devices shall be UL listed and so labeled.

1.3 SUBMITTALS: Refer to the General Conditions for procedures.

A. Materials List:
1. The Contractor shall furnish the articles, equipment, materials, or processes specified by name in Drawings and Specifications. No substitutions will be allowed without prior written acceptance by the Architect.
2. Complete material list shall be submitted prior to performing any Work. Material list shall include manufacturer, model number, and description of all materials and equipment to be used.
3. Equipment or materials installed or furnished without prior approval of the Architect may be rejected and the Contractor required removing such materials from the site at his own expense.
4. Approval of any item, alternate, or substitute indicated only that the product or products apparently meet the requirements of the Drawings and Specifications of the basis of the information or samples submitted.
5. Manufacturer's warranties shall not relieve Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.
6. If equipment is as specified, no manufacturer descriptive catalogs are necessary in submittal.

B. Record Drawings:
1. Contractor shall provide and keep up to date and complete "as-built" record set of blue-line prints or CADD files which shall be corrected daily and shown every change from the original Drawings and Specifications and exact "as-built" locations, sizes, and kinds of equipment. Prints for these purposes may be obtained from the Architect at cost. This set of Drawings shall be kept on the site and shall be used only as a record set.
2. These Drawings shall also serve as Work progress sheets and shall be the basis for measurement and payment for Work completed. These Drawings shall be available at all times for site reviews and shall be kept in a location designated by the Architect. Should the record blue-line or CADD file as-built progress sheets not be available for review or not up to date at the time of any site reviews, it will be assumed that no Work has been completed and the Contractor will be assessed the cost of that site visit at the current billing rate of the Architect. No other inspections shall take place prior to payment of that assessment.
3. The Contractor shall make neat and legible notations on the as-built progress sheets daily as Work proceeds, showing the Work as actually installed. For example, should a piece of equipment be installed in a location that does not

match the plan, the Contractor must indicate that equipment has been relocated in a graphic manner so as to match the original symbols as indicated in the irrigation legend. The relocated equipment and dimensions will then be transferred to the original as built plan at the proper time.

4. Before the date of the final site review, Contractor shall create a transparency or CADD drawing showing all information from the as-built prints. The dimensions shall be made so as to be easily readable even on the final controller chart (See section C below).
5. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
    a. Connection to existing water lines.
    b. Connection to existing electrical power.
    c. Gate valves.
    d. Routing of sprinkler pressure lines. (Dimension max. 100' along routing.)
    e. Sprinkler control valves.
    f. Routing of control wiring.
    g. Quick coupling valves.
    h. Other related equipment as directed by the Architect.
6. On or before the date of the final site review, the Contractor shall deliver the corrected and completed transparencies or CADD drawings to the Architect. Delivery will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the Drawings.

C. Controller Charts:
1. Record Drawings shall be approved by the Architect before controller charts are prepared.
2. Provide one controller chart for each controller supplied.
3. The chart shall show the area controlled by the automatic controller and shall be the maximum size which the controller door will allow.
4. The chart is to be a reduced drawing of the actual as-built system, of a maximum size that will fit inside controller housing, double sided if required for readability.
5. The chart shall be a blackline print and a different color shall be used to indicate area of coverage for each station, using pastel or transparent colors.
6. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils.
7. These charts shall be completed and approved prior to final acceptance of the irrigation system.

D. Operation and Maintenance Manuals:
1. Prepare and deliver to the Architect within 10 calendar days prior to completion of construction, two hard cover binders with three rings containing the following information:
    a. Index sheets stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturer's representative.
    b. Catalog and part sheets on all materials and equipment installed under this Contract.
    c. Guarantee statement.
    d. Complete operating and maintenance instruction on all major equipment.

2. In addition to the above mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for major equipment, and show evidence in writing to the Architect at the conclusion of the project that this service has been rendered.

E. Equipment to Be Furnished:

1. At time of final acceptance, Irrigation Contractor shall deliver to the Owner:
   a. Two keys for opening valve boxes.
   b. Two keys for each automatic controller.
   c. Hose and Swivel Assemblies: Supply one (1) set of hose and swivel assemblies for every five (5) quick coupling valves installed.
   d. Two special wrenches suitable for operating each type of shut-off valve installed.
   e. Operating instructions and parts lists, as printed by each manufacturer of each type of equipment installed. Refer to "Material" section of the specifications and legend on the drawings.
   f. List of equipment with names and addresses of local manufacturer representatives.
   g. "As-built" drawings and controller charts.
2. The above mentioned equipment shall be turned over to the Owner at the conclusion of the project. Before final acceptance can occur, evidence that the Owner has received material must be shown to Architect.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be.

1.5 GUARANTEE:

A. The one (1) year guarantee for sprinkler irrigation system shall be made in accordance with the General Conditions. A copy of the guarantee form shall be included in the operations and maintenance manual.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Materials for irrigation installation shall be new materials and as specified unless specifically approved in writing by the Owner's representative as equal products. They shall conform to provisions of the Drawings and Specifications.

B. Pipe & Fittings:

1. Pressure Main Line Piping and Fittings: Sizes 2-1/2" and smaller shall be Schedule 40 PVC, on surface Schedule 40 galvanized pipe and fittings.
2. Non-Pressure Lines (buried): Shall be PVC Schedule 40.
3. Plastic fitting shall be the schedule of pipe being fitted (Sch. 40 and 80), PVC II, N.S.F. rated. Plastic fitting shall be polyvinyl chloride (PVC) high impact, extruded from B.F. Goodrich Geon 8700 A similar and equal to Lasco Industries, Sloane Mfg. Co., or equal, and PVC solvent weld cement as recommended by pipe manufacturers.
4. All pipe and fittings shall conform to specific requirements as follows:
   a. PVC (Solvent Weld):

1) Pipe: Manufactured from virgin polyvinyl chloride compound in accordance with ASTM D 1785or ASTM D 2241, cell classification 12454B, and hydrostatic design stress rating not less than 2,000 P.S.I.
2) Fittings (Solvent weld or thread) Standard weight, Schedule 40, side gated, injection molded PVC complying with ASTM D 2466, cell classification 12454B, including threads when required.
3) PVC nipples shall be Schedule 80 with machine threads.
4) All PVC pipe must be labeled with the following markings:
   (a) Manufacturer's name.
   (b) Nominal pipe size.
   (c) Schedule or class.
   (d) Pressure rating in A.S.T. (Not required on drip tubing).
   (e) NSF National Sanitation Foundation) approval (Not required on drip tubing).
   (f) Date of extrusion.
5) Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation method prescribed by the manufacturer.
6) Galvanized Pipe and Fittings:
   (a) Pipe shall be galvanized steel, American National Standard Institute (ANSI), Schedule 40 galvanized, mild steel screwed pipe.
   (b) Fittings: Screwed beaded malleable iron, or 125 pound cast iron, flanged.
   (c) Unions (2" and Smaller): Ground joint pattern.
   (d) Unions (Larger Than 2"): Flanged type, packed with 1/16" thick fiber gaskets.

C. Quick Coupling Valves: Valves shall be as shown in legend and details.
D. Hose and Swivel Assemblies: Supply 1 set of hose and swivel assemblies for every 5 quick coupling valves.
E. Sprinkler Heads: Heads shall be of the adjustable type, sizes, and designations as shown on Drawings, or equal, and shall be sized, selected, and placed in a manner to achieve complete water coverage of areas to be watered.
F. Gate Valves: Valves shall be as shown in the legend and details.
G. Gate Valve Boxes: Boxes shall be round plastic valve boxes with locking covers, manufactured by Brooks or Carson or equal, and shall be of size and type as called out on the Drawings and in the details.
H. Remote Controller and Valves: Shall be as indicated in the legend and on the drawings.
I. Boxes For Remote Control Valves: Boxes shall be rectangular plastic boxes with locking covers, manufactured by Brooks or Carson or equal.
J. Controller: shall be as shown in legend and plans.
K. Drip Irrigation: Shall be Rain Bird XF Series or equivalent, as indicted in legend and plans.
L. Electrical:
   1. High Voltage: All high voltage electrical service required for automatic controller and other equipment noted on Drawing for irrigation system will be provided by others. Irrigation Contractor shall be responsible for final connection.
   2. Low Voltage: Connections between controller and remote control valves shall be made with direct burial AWG-UF, 600 volt wire, insulation thickness 3/64", utilizing low density high molecular weight polyethylene insulation. Splices, where permitted, shall be waterproofed using Rainbird, Pen-tite, or 3M-DBY

connectors or fusible heat shrinking tubing and housed in a box. Boxes for other irrigation may be utilized for this purpose. Wire sizing shall be a minimum of #14 "UF. 600 volt underground wiring. Common wire is to be white in color, and all others a different color.

M. Copper Pipe and Copper Fittings: Pipe and fittings shall be provided wherever local codes require its use, as for example under building slabs and attached to parking structure roofs.

N. Protective enclosures: backlfow devices and other above-ground devices shall be equipped with a vandal resistant protective enclosure, min. 1 ¼" diameter steel tube frame, min. #13 expanded metal panels, single swing with gated end, lockable, powder-coated per owner's color preference.

PART 3 - EXECUTION

3.1 WORK PROCEDURES:

A. Contractor shall follow local building codes, customary practices and as follows:

B. General: The Contractor shall connect to existing water supply as shown on the Drawings and as necessary to carry out the intent of the Drawings and Specifications. Check location of lines, valves, other underground utilities, etc., and receive approval of Owner's representative before any installation. The Contractor shall check and verify existing water pressure and available gallonage before starting Work and shall inform the Architect if not adequate as designed.

C. Trenches, Subgrades, and Backfill: Excavate trenches, prepare subgrades and backfill true to line and grade with sufficient room for pipe fittings, testing, and inspection operations. Cut bottom of trench so that pipe barrel rests uniformly on trench bottom. Do not backfill until pipe system has been subjected to a hydrostatic test as specified.

D. Depth: Depth of coverage for irrigation piping shall be as follows:
   1. Main lines - 18 inches minimum depth.
   2. Lateral lines - 12 inches minimum depth.
   3. Where subslab conflicts, install as deep as possible.
   4. 24 inch depth for all lines under driveways.

E. Backfill: Backfill trenches after acceptance of Work with suitable approved material, tamping soil around pipe, and thoroughly water settling all trench fills. Trenches under walks and roads shall be backfilled in accordance with General and Special Conditions of the Specifications. Wherever subsidence of trenches occurs, the Contractor shall be responsible for restoring all to final grade.

F. Control Valves: Locate control valves in close proximity to walks or to accessible areas; control valves shall never be more than 12" from walks or nearest access as indicated on Drawings and in a manner to make them accessible to manual operations without interference of water spray from heads.

G. Quick Coupling Valves: Install all quick coupling valves as indicated on Drawings and to conform to the full intent and meaning of the Drawings and the Specifications.

H. Pipe: All pipe shall be laid true and accurate to grade with full length of pipe section lying solidly on a firm base. If grade or joint of pipe is disturbed after laying, it shall be taken up and relaid.
   1. Clean interior of pipe thoroughly and remove all dirt or foreign matter before lowering pipe into trench, and keep clean during operations by plugs or other approved method. The ends of all threaded pipe shall be reamed out full size and with a long taper reamer so as to be partially bell-mouthed and perfectly

smooth. All offsets shall be made with fittings. All water lines shall be thoroughly flushed out before the heads are installed.

2. Threads on pipe shall be cut with sharp clean dies to conform to American Standards Association Specifications and so that not more than 2 threads are left exposed on the pipe.
3. Joints in all screwed metallic and metallic to plastic piping shall be made by applying specified pipe joint compound tape to the threaded end with one-half inch lapping before screwing joints together.
4. Do not lay pipe in water or mud. Keep ends of pipe securely closed when work is not in operations to prevent water or other matter from entering the lines.
5. Long runs of PVC pipe shall be slightly snaked in the trench to allow for contraction.
6. Replace without cost to the Owner any pipe that is found to be defective.
7. Provide unions and fittings as necessary to make all connections to existing lines and to complete Work as intended on the Drawings.
8. Install dielectric couplings and flanges as required at the junction of pipes or fittings made of dissimilar metal.
9. Risers to sprinkler heads shall be Schedule 80 PVC, or as shown in the details, and offset from laterals as indicated on the Drawings.
10. All sprinkler heads next to walks, paths, parking areas, and any areas where people normally walk shall be the pop-up type. No fixed sprinkler risers shall be installed next to such walks, paths, or parking areas.
11. Solvent weld joints will be made as follows:
    a. Good square cuts, clean and free of debris and shavings and moisture.
    b. Main Line Only: Apply p-70 Weldon or equal. Finish make up of joint using Weldon 711 or equal. Hot glue will not be permitted.

I. Tests: Test all sprinkler mains after pipe is laid and joint completed by submitting to a pressure test of static pressure in the presence of the Owner's representative. Do not backfill any trench until the Owner's representative has approved the test. Repair any leaks until lines meet test requirements and the Owner's representative's approval. All laterals shall be tested under main pressure for leaks; any leaks shall be repaired. All tests with the exception of the laterals shall be for the duration of 4 hours with a maximum drop of 4 psi allowed.

J. Flushing of System:
1. After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion Work has been completed, and prior to installation of sprinkler heads, the control valves shall be opened and full head of water used to flush out the system.
2. Sprinkler heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Architect.

K. Sprinkler Heads: Install sprinkler heads as directed. Where they adjoin the edges of walks, set turf pop-up heads in 2" from edge and shrub and rotor heads 6" in from edge. Special conditions for installing heads shall be as shown on the Drawings.
1. Space the sprinkler heads as shown on Drawings or as directed and as necessary to gain full water coverage of the sprinkler areas. Adjust heads as necessary, changing sizes and nozzles until Work is approved.
2. Add sprinkler heads as needed or as directed for full water coverage of all areas without extra cost to the Owner.

3. Make final adjustments of all sprinkler heads after soil has settled.

L. Finish Grade: Bring all areas excavated for the installation to a neat and true finish grade to match adjoining areas.

M. Completion: Leave entire installation in complete working order, free from any and all defects in material, workmanship, or finish, regardless of any discrepancies and/or omissions in Drawings and Specifications.

3.2 TEMPORARY REPAIRS:

A. Owner reserves the right to make temporary repairs as necessary to keep the sprinkler system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibility under the terms of the guarantee as herein specified.

3.3 MAINTENANCE:

A. The entire sprinkler irrigation system shall be under full automatic operation for a period of seven days prior to any planting.

3.4 CLEANUP:

Clean-up shall be performed as each portion of Work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained to the Work of others shall be repaired and Work returned to its original condition.

3.5 PROJECT RECORD (AS-BUILT) DRAWINGS

A. Document field changes from original design and construction documents. Maintain on-site and separate from original construction documents, one complete set of documents labeled “Project Field Documents”. Keep documents current. Do not permanently cover work until accurate “as-built” information is recorded.

B. Record pipe network alterations on a daily basis. Record work that is installed differently than shown on construction documents. Record accurate reference dimensions, measured from at least two permanent reference points, of each control zone kit assembly, each zone boundary, each air relief valve assembly, each flush point assembly, and other irrigation components enclosed within valve box.

C. Obtain from General Contractor CADD files prior to construction completion. Duplicate information contained on “Project Field Documents” maintained on-site using technical drafting pen or AutoCAD. Label each sheet "Record Drawing".

D. Provide “Record Drawings” to Owner’s Representative. Completion of Record Drawings is required prior to final construction review at completion of irrigation system installation.

END OF SECTION

SECTION 32 84 13

LANDSCAPE DRIP IRRIGATION

PART 1 - GENERAL

1.01 SCOPE

A. This section specification information is for low volume dripline irrigation products including Control Zone Kits, Dripline, compatible fittings, and Low Volume Emission Devices.

B. Provide labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the drip irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein.

1.02 RELATED WORK

A. Division 00 – Procurement and Contracting Requirements

B. Division 01 – General Requirements

C. Division 22 – Plumbing

D. Division 26 – Electrical

E. Division 31 – Earthwork

F. Division 32 – Exterior Improvements

G. Division 33 - Utilities

1.03 SUBMITTALS

A. Materials List: Include dripline and low-volume irrigation components, control zone components, shop drawings and other components shown on drawings and installation details or described herein. Quantities of materials need not be included.

B. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on materials list.

C. Shop Drawings: Submit shop drawings called for in installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to installation details as part of shop drawing documentation.

1.04 FLUSHING AND TESTING

A. Schedule testing with Owner’s Representative a minimum of three (3) days in advance of testing.

B. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct line flushing and testing procedures.

C. Recommended Dripline and Emitter Lateral Flushing Procedures.

1. Flush the system every two weeks for the first six (6) weeks and check the water that is flushed out for cleanliness. Establish a regular system flushing schedule for the future based on results from the initial six-week flushing schedule.

2. Flush the system completely after any repairs are made and monitor system operation closely under regular system flushing schedule.

3. Check the pressure at the supply and flush headers on a regular basis and compare with the pressure readings taken after installation.

D. Recommended Dripline and Emitter Lateral Leakage Testing Procedures.
1. Subject installed dripline tubing and emitter lateral piping to water pressure equal to specified operating pressure for ten (10) minutes. Test with control zone components and dripline flush valve components installed.
2. Partially backfill buried pipe and tubing to prevent movement under pressure. Expose couplings, fittings, and valve components.
3. Visually inspect valve assemblies and fittings for leakage and replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until test segment is free from leaks. Cement or caulking to seal leaks is prohibited.

E. Recommended Dripline and Emitter Lateral Operational Testing Procedures.
1. Activate each dripline and emitter lateral control zone valve in sequence from controller. Provide either one additional person with radio or use handheld remote to activate remote control valves from controller. Manually activating remote control valve using manual bleed mechanism at remote control valve is not an acceptable method of activation. Owner's Representative will visually observe operation, water application patterns, and leakage.
2. Replace or adjust defective valve, fitting, dripline segment, emitter lateral segment, or appurtenance to correct operational and coverage uniformity deficiencies.
3. Repeat test(s) until each dripline or emitter lateral test segment passes testing procedures. Repeat tests, replace components, and correct deficiencies at no additional cost to Owner and/or Owner's Representative.

1.05 GUARANTEE/WARRANTY AND REPLACEMENT

A. The purpose of guarantee/warranty is to ensure that Owner receives irrigation materials of prime quality, installed and maintained in thorough and careful manner.

B. Contractor is responsible for providing guarantee/warranty of irrigation materials, equipment, and workmanship against defects for period of one (1) year from formal written acceptance by Owner's Representative. Fill and repair depressions. Restore landscape, utilities, structures and site features damaged by settlement of irrigation trenches or excavations. Repair damage to premises caused by defective items. Make repairs within seven (7) days of notification from Owner's Representative.

C. Replace damaged items with new and identical materials, using methods specified in contract documents or applicable codes. Make replacements at no additional cost to contract price.

D. Guarantee/warranty applies to originally installed materials and equipment, and replacements made during guarantee/warranty period.

PART 2 – MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. For purposes of specificiation, Rain Bird is shown as the specified manufacturer. Substitutions are allowed on an equivalent basis..

2.02 LATERAL PIPE AND FITTINGS

A. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.

Use Schedule 40 conforming to dimensions and tolerances established by ASTM Standard D1785; UV radiation resistant.

B. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Use PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings for threaded pipe connections as specified on the drawings and details.

D. Threaded joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

2.03 DRIP IRRIGATION COMPONENTS

A. Control Zone Kits

1. General Information

a. Control zone kit assemblies for dripline irrigation zones must include control valve, filtration, and pressure regulation components sized to meet the hydraulic demands and flow requirements of the zones that they service.

2. Low Flow Control Zone Kit for dripline zones with flows from 0.2 to 5.0 GPM (0.8 to 18.9 lpm), shall include low flow valve (LFV) and pressure regulating filter (PRF).

a. Low Flow Valve (LFV) component specifications shall include:

1) Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials

2) Diaphragm with a double-knife seal, constructed of durable Buna-N rubber with a clog-resistant metering orifice

3) Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter

4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations

5) Inlet pressure rating: 20 to 120 PSI (1,4 to 8,3 bar)

6) Female threaded inlet and outlet connections
7) Anti-siphon valve configuration shall incorporate atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval

b. Pressure Regulating Filter (PRF) shall combine filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
1) Compact “Y” filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating.
2) Standard 200 mesh (75 micron) filter screen constructed of durable stainless steel attached to a polypropylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
3) Normally-open pressure regulating device with preset outlet pressure of approximately 30 PSI (2,1 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
4) Male threaded 3/4” (19 mm) inlet and outlet connections.

(or)

3. \ Medium Flow Control Zone Kit for dripline zones with flows from 3.0 to 15.0 GPM (11.4 to 56.8 lpm).
a. Including \ DV or ASVF valve and pressure regulating filter (PRF).
b. DV Valve component specifications must include:
1) Valve body and bonnet constructed of high impact, weather-resistant plastic, stainless steel and other chemical/UV resistant materials
2) Energy-efficient, low-power encapsulated solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
3) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
4) Inlet pressure rating: 20 to 120 PSI (1.4 to 8.3 bar)
5) Female threaded inlet and outlet connections
6) Anti-siphon valve configuration \ includes listed features and incorporates atmospheric vacuum breaker with I.A.P.M.O and A.S.S.E. listing approval

c. Pressure Regulating Filter (PRF) combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. PRF component specifications include:
   1) Compact “Y” filter body and cap configuration constructed of glass-filled, UV-resistant polypropylene, with 120 PSI (8,3 bar) operating pressure rating. \
   2) Standard 200 mesh (75 micron) filter screen constructed of durable stainless steel attached to a polypropylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
   3) Normally-open pressure regulating device with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
   4) Male threaded 1” (25 mm) inlet and outlet connections.

(or)

4. \ Medium Flow Commercial Control Zone Kits for dripline zones with flows from 3.0 to 20.0 GPM (11.4 to 75.7 lpm), including PESB valve with PVC ball valve and pressure regulating quick-check basket filter and PGA valve with pressure regulating basket filter.
   a. PESB valve assembly component specifications must include:
      1) 1” (25 mm) PVC full-port ball valve with female threaded inlet and outlet connections
      2) PESB valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials
      3) Diaphragm constructed of a durable Buna-N rubber material reinforced with nylon
      4) One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
      5) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
      6) Inlet pressure rating: 20 to 200 PSI (1,4 to 13,8 bar)
      7) Female threaded inlet and outlet connections
   b. PGA valve assembly component specifications must include:
      1) PGA valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials

2) Diaphragm constructed of a durable Buna-N rubber material reinforced with nylon
3) One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
5) Inlet pressure rating: 15 to 150 PSI (1,4 to 13,8 bar)
6) Female threaded inlet and outlet connections

c. Pressure Regulating Quick Check Basket Filter combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. Pressure regulating basket filter component specifications must include:
1) Basket style body and jar-top cap constructed of heavy-duty glass-filled, UV-resistant polypropylene, with 150 PSI (10,3 bar) operating pressure rating.
2) Indicator incorporated into filter cap that changes color from green to red during operation when the filter element requires cleaning.
3) Standard 200 mesh (75 micron) filter screen constructed of stainless steel attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
4) Normally-open in-line pressure regulating device, constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 PSI (10,3 bar), with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
5) Male threaded 1” (25 mm) inlet and outlet connections.

(or)

5. Control Zone Kit for dripline zones with flows from 15.0 to 40.0 GPM (56,8 to 151,4 lpm), including PESB valve and two parallel pressure regulating quick-check basket filters.
a. PESB valve assembly component specifications must include:
1) PESB valve body and bonnet constructed of durable glass-filled nylon, stainless steel and other chemical/UV resistant materials

2) Diaphragm constructed of a durable rubber material reinforced with nylon
3) One-piece solenoid with captured plunger and 90 mesh (200 micron) solenoid filter
4) External bleed for manual system flushing during start-up, internal bleed for manual zone activation during maintenance operations
5) Inlet pressure rating: 20 to 200 PSI (1,4 to 13,8 bar)
6) Female threaded inlet and outlet connections

b. Pressure Regulating Quick Check Basket Filter combines filtration and pressure regulation in one integrated unit for protection of downstream components of drip irrigation system. Pressure regulating basket filter component specifications must include:
1) Basket style body and jar-top cap constructed of heavy-duty glass-filled, UV-resistant polypropylene, with 150 PSI (10,3 bar) operating pressure rating.
2) Indicator incorporated into filter cap that changes color from green to red during operation when the filter element requires cleaning.
3) Standard 200 mesh (75 micron) filter screen constructed of stainless steel attached to propylene frame. Screen is serviceable for cleaning purposes by unscrewing cap from filter body and removing filter element.
4) Normally-open in-line pressure regulating device, constructed of durable, UV resistant non-corrosive material able to accommodate an inlet pressure rating of not less than 150 PSI (10,3 bar), with preset outlet pressure of approximately 40 PSI (2,8 bar). Pressure regulating device allows full flow with minimal pressure loss unless inlet pressure is greater than preset level. As inlet pressure increases above preset level, internal spring compresses to reduce downstream pressure.
5) Male threaded 1” (25 mm) inlet and outlet connections

B. Dripline Components
1. General Information
a. Provide flexible dual-layered pressure-compensating inline Dripline.
b. Provide insert or compression fittings that are compatible with inline emitter tubing as indicated on construction drawings.
2. Rain Bird XFD On-Surface Dripline with pressure-compensating inline emitters.:
a. Available Rain Bird XFD On-Surface Dripline model numbers for POTABLE water systems; a dual-layered, brown colored dripline tubing with emitter flow rates and spacing as shown:

1) Rain Bird XFD-06-12; 0.6 GPH (2,3 lph) emitters spaced 12” (30,5 cm) on-center
2) Rain Bird XFD-06-18; 0.6 GPH (2,3 lph) emitters spaced 18” (45,7 cm) on-center
3) Rain Bird XFD-09-12; 0.9 GPH (3,4 lph) emitters spaced 12” (30,5 cm) on-center
4) Rain Bird XFD-09-18; 0.9 GPH (3,4 lph) emitters spaced 18” (45,7 cm) on-center

b. Available Rain Bird XFDP On-Surface Dripline model numbers for NON-POTABLE water systems; a dual-layered, purple colored dripline tubing with emitter flow rates and spacing as shown:
1) Rain Bird XFDP-06-12; 0.6 GPH (2,3 lph) emitters spaced 12” (30,5 cm) on-center
2) Rain Bird XFDP-06-18; 0.6 GPH (2,3 lph) emitters spaced 18” (45,7 cm) on-center
3) Rain Bird XFDP-09-12; 0.9 GPH (3,4 lph) emitters spaced 12” (30,5 cm) on-center
4) Rain Bird XFDP-09-18; 0.9 GPH (3,4 lph) emitters spaced 18” (45,7 cm) on-center

c. Required dripline tubing material and performance specifications include:
1) XFD tubing; dual-layered, brown in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
2) XFDP tubing; dual-layered, purple in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference of the polyethylene tubing at spacing specified by model number
4) Inline emitters designed to pressure-compensate by lengthening the emitter’s turbulent flow path (Rain Bird patent pending)
5) Consistent flow rate from each installed inline emitter when emitter inlet pressure is supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)
6) Required filtration for XF Series dripline tubing and emitters is 120 mesh (125 micron)

3. Rain Bird XFCV Dripline with Heavy-Duty Check Valve and pressure-compensating inline emitters.

a. Available Rain Bird XFCV Dripline with Heavy Duty-Check Valve model numbers for POTABLE water systems; brown colored dripline tubing with emitter flow rates and spacing as shown:
   1) Rain Bird XFCV-06-12; 0.6 GPH (2,3 lph) emitters spaced 12” (30,5 cm) on-center
   2) Rain Bird XFCV-06-18; 0.6 GPH (2,3 lph) emitters spaced 18” (45,7 cm) on-center
   3) Rain Bird XFCV-09-12; 0.9 GPH (3,4 lph) emitters spaced 12” (30,5 cm) on-center
   4) Rain Bird XFCV-09-18; 0.9 GPH (3,4 lph) emitters spaced 18” (45,7 cm) on-center

b. Required dripline tubing material and performance specifications include:
   1) XFCV tubing; dual-layered, brown in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   2) Inline emitter that includes a 3.5psi check-valve to facilitate 8ft of holdback
   3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference of the polyethylene tubing at spacing specified by model number
   4) Inline emitters designed to pressure-compensate by lengthening the emitter’s turbulent flow path (Rain Bird patent pending)
   5) Consistent flow rate from each installed inline emitter when emitter inlet pressure is supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)
   6) Required filtration for XF Series dripline tubing and emitters is 120 mesh (125 micron)

4. Rain Bird XFS Sub-Surface Copper-Colored Dripline with Copper Shield™ Technology and pressure-compensating inline emitters.
   a. Available Rain Bird XFS Sub-Surface Copper-Colored Dripline model numbers for POTABLE water systems; dual layered, copper colored dripline tubing with emitter flow rates and spacing as shown:
      1) Rain Bird XFS-06-12; 0.6 GPH (2,3 lph) emitters spaced 12” (30,5 cm) on-center
      2) Rain Bird XFS-06-18; 0.6 GPH (2,3 lph) emitters spaced 18” (45,7 cm) on-center
      3) Rain Bird XFS-09-12; 0.9 GPH (3,4 lph) emitters spaced 12” (30,5 cm) on-center

4) Rain Bird XFS-09-18; 0.9 GPH (3,4 lph) emitters spaced 18" (45,7 cm) on-center

b. Available Rain Bird XFSP Sub-Surface Copper-Colored Dripline model numbers for NON-POTABLE water systems; dual layered purple colored dripline tubing with emitter flow rates and spacing as shown:
   1) Rain Bird XFSP-06-12; 0.6 GPH (2,3 lph) emitters spaced 12" (30,5 cm) on-center
   2) Rain Bird XFSP-06-18; 0.6 GPH (2,3 lph) emitters spaced 18" (45,7 cm) on-center
   3) Rain Bird XFSP-09-12; 0.9 GPH (3,4 lph) emitters spaced 12" (30,5 cm) on-center
   4) Rain Bird XFSP-09-18; 0.9 GPH (3,4 lph) emitters spaced 18" (45,7 cm) on-center

c. Dripline tubing material and performance specifications:
   1) XFS Copper-colored, dual layered tubing conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   2) XFSP tubing; dual layered, purple in color, conforming to an outside diameter (O.D.) of 0.634 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of 0.049 inches (1,2 mm)
   3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference of the polyethylene tubing at spacing specified by model number
   4) Consistent flow rate from each installed inline emitter when emitter inlet pressure is supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)
   5) Required filtration for XF Series dripline tubing and emitters is 120 mesh (125 micron)

5. Rain Bird XF Series Blank Dripline Tubing
   a. Available model numbers for POTABLE water systems:
      1) Rain Bird XFD blank tubing, dual-layered and brown in color.
   b. Available model numbers for NON-POTABLE water systems:
      1) Rain Bird XFDP blank tubing, dual-layered and purple in color.
6. Rain Bird Easy Fit Dripline Tubing Compression Fittings
   a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
      1) Tee: MDCFTEE
      2) Coupling: MDCFCOUP
      3) Elbow: MDCFEL
      4) Adapters:

a) 1/2” (13 mm) Male pipe thread adapter: MDCF50MPT
b) 3/4” (19 mm) Male pipe thread adapter: MDCF75MPT
c) 1/2” (13 mm) Female pipe thread adapter: MDCF50FPT
d) 3/4” (19 mm) Female pipe thread adapter: MDCF75FPT
e) 3/4” (19 mm) Female hose thread adapter: MDCF75FHT

5) Flush Cap end closure for POTABLE system: MDCFCAP
6) Flush Cap end closure for NON-POTABLE system: MDCFPCAP

b. Easy Fit compression fitting material and performance specifications include:

1) Easy Fit directional fittings and flush cap fittings constructed from molded UV-resistant ABS material with Buna-N rubber seal for long-term, leak free connections
2) Easy Fit adapters constructed from UV-resistant ABS materials for use exclusively with Easy Fit Compression Fittings
3) Easy Fit Compression Fittings are intended for use with polyethylene tubing from .630" to 669" (16 mm-17 mm) OD to provide a leak-free compression fit
4) Maximum pressure loss for the Easy Fit adapters estimated to be 0.1 PSI (0,007 bar) per adapter
5) Operating pressure range for Easy Fit compression fittings and adapters is 0 to 60 PSI (0 to 4,1 bar)

(or)

7. Rain Bird XF Series Dripline Tubing Insert Fittings

a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:

1) Tee: XFF____TEE insert tee (17 x17 x 17 mm)
2) Coupling: XFF-COUP____insert coupling (17 x 17 mm)
3) Elbow: XFF-ELBOW insert elbow (17 x 17 mm)
4) Cross: XFD-CROSS insert cross (17 x 17 x 17 x 17 mm)
5) Insert Adapters:
   a) 1/2” (13 mm) Male pipe thread adapter: XFF-MA-050 [17 mm x 1/2” (13 mm) MPT]
   b) 3/4” (19 mm) Male pipe thread adapter: XFF-MA-075 [17 mm x 3/4” (19 mm)MPT]
   c) 3/4” (19 mm) Female pipe thread adapter: XFD-FA-075 [17 mm x 3/4” (19 mm)FPT]
   d) 1/2” (13 mm) Tee male pipe thread adapter: XFF-TMA-050 [17 mm x 1/2” (13 mm)MPT x 17 mm]
   e) 3/4” (19mm) Tee female pipe thread adapter: XFD-TFA-075 [17 mm x 3/4” (19 mm)FPT x 17 mm]

b. Insert fitting specifications and features include:
1) Constructed from acetyl plastic
2) Intended for use with polyethylene tubing with ID of 0.536" (13,6 mm) Operating pressure range is 0 to 50 PSI (0 to 3,5 bar)

8. Rain Bird Air Relief Valves.
a. Available model numbers, designed for compatibility with Rain Bird XF Series Dripline Tubing:
1) ARV050 Air Relief Valve; includes 1/2" (13 mm) air relief valve.

C. Rain Bird Point Source Irrigation Emission Devices
1. General Information
a. Provide low-volume point-source emission devices to efficiently deliver irrigation water at the plant root zone as indicated on construction drawings.

2. Rain Bird Single-outlet Xeri-Bug™ Emitters
a. Available model numbers with self-piercing barb inlet:
1) XB-05PC (Blue); 0.5 GPH (1,89 lph)
2) XB-10PC (Black); 1.0 GPH (3,79 lph)
3) XB-20PC (Red); 2.0 GPH (7,57 lph)
b. Available model numbers with 10-32 threaded inlet:
1) XB-05PC-1032 (Blue); 0.5 GPH (1,89 lph)
2) XB-10PC-1032 (Black); 1.0 GPH (3,79 lph)
3) XB-20PC-1032 (Red); 2.0 GPH (7,57 lph)
c. Available model numbers with 1/2" (13 mm) threaded inlet:
1) XBT-10 (Black); 1.0 GPH (3,79 lph)
2) XBT-20 (Red); 2.0 GPH (7,57 lph)
d. Single-outlet Xeri-Bug Emitter specifications and features include:
1) Available with three inlet options:
a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with manufacturer's tool.
b) 10-32 threaded inlet; Emitters with 10-32 threaded inlet allow threaded connection into PolyFlex Riser, 1032 Thread Adapter, or 1800 Xeri-Bubbler Adapter
c) 1/2" (13 mm) threaded inlet; Emitters with 1/2" (13 mm) threaded inlet allow threaded connection into 1/2" (13 mm) PVC male adapter.
2) External surfaces constructed from UV resistant acetyl materials
3) Self-flushing to minimize clogging
4) Color-coded to identify flow rate;
a) Blue emitter indicates a flow rate of 0.5 GPH (1,89 lph)
b) Black emitter indicates a flow rate of 1.0 GPH (3,79 lph)
c) Red emitter indicates a flow rate of 2.0 GPH (7,57 lph)

5) Pressure-compensating over the pressure range of 15 to 50 PSI (1,0 to 3,5 bar) with consistent flow rate of [0.5 GPH (1,89 lph)] or [1.0 GPH (3,79 lph)] or [2.0 GPH (7,57 lph)] over this pressure range

3. Rain Bird Single-outlet Pressure-Compensating Modules
   a. Available model numbers with self-piercing inlet barb:
      1) PC-05: light brown, 5 GPH (18,95 lph)
      2) PC-07: violet, 7 GPH (26,53 lph)
      3) PC-10: green, 10 GPH (37,90 lph)
      4) PC-12: dark brown, 12 GPH (45,48 lph)
      5) PC-18: white, 18 GPH (68,22 lph)
      6) PC-24: orange, 24 GPH (90,96 lph)
   b. Available model numbers with 10-32 threaded inlet:
      1) PC-05 1032: light brown, 5 GPH (18,95 lph)
      2) PC-07 1032: violet, 7 GPH (26,53 lph)
      3) PC-10 1032: green, 10 GPH (37,90 lph)
   c. Available model numbers with ½" FPT inlet:
      1) PCT-05: light brown, 5 GPH (18,95 lph)
      2) PCT-07: violet, 7 GPH (26,53 lph)
      3) PCT-10: green, 10 GPH (37,90 lph)
   d. Pressure-Compensating Module specifications and features include:
      1) Available with three inlet options:
         a) Self-piercing barb inlet; Emitters with self-piercing barb inlet permit one-step insertion into 1/2" (13 mm) or 3/4" (19 mm) drip tubing when installed with Rain Bird Xeriman tool.
         b) 10-32 threaded inlet; Emitters with 10-32 threaded inlet allow threaded connection into PolyFlex Riser, 1032 Thread Adapter, or 1800 Xeri-Bubbler Adapter
         c) ½" FPT Threaded inlet allow threaded connection to ½" PVC riser.
      2) External surfaces constructed from UV resistant acetyl materials
      3) Color-coded to identify flow rate;
         a) Tan outlet indicates a flow rate of 5 GPH (18,93 lph)
         b) Violet outlet indicates a flow rate of 7 GPH (26,50 lph)
         c) Green outlet indicates a flow rate of 10 GPH (37,85 lph)
         d) Dark brown outlet indicates a flow rate of 12 GPH (45,42 lph)
         e) White outlet indicates a flow rate of 18 GPH (68,13 lph)
         f) Orange outlet indicates a flow rate of 24 GPH (90,84 lph)
      4) Pressure-compensating over the pressure range of 10 to 50 PSI (0.7 to 3,5 bar) with consistent flow rate of [5 GPH (18,93 lph)] or [7 GPH 26,50 lph)] or [10 GPH (37,85 lph)] or [12 GPH (45,42

lph)] or [18 GPH (68,13 lph)] or [24 GPH (90,84 lph)] over this pressure range.

e. Rain Bird PC Diffuser Cap specifications and features include:
   1) Available with two color options:
      a) PC Diffuser (Black); This Diffuser Cap is to be used for Pressure-Compensating Module zones serviced by a potable water source.
      b) PC DIFF-PPL (Purple); This Diffuser Cap is to be used for Pressure-Compensating Module zones serviced by a non-potable water source.
   2) Constructed from UV-resistant polyethylene material
   3) Capable of snapping onto Rain Bird Pressure-Compensating Modules to create a bubbler effect and prevent wash out

4. Rain Bird Multi-outlet Xeri-Bug Emission Devices
   a. Available model numbers with barb inlet:
      1) XB-05-6: Blue, 0.5 GPH (1,89 lph/outlet)
      2) XB-10-6:Black, 1.0 GPH (3,79 lph/outlet)
      3) XB-20-6:Red, 2.0 GPH (7,57 lph/outlet)
   b. Available model numbers with 1/2” (13 mm) female threaded inlet:
      1) XBT-05-6: Blue, 0.5 GPH (1,89 lph/outlet)
      2) XBT-10-6:Black, 1.0 GPH (3,79 lph/outlet)
      3) XBT-20-6:Red, 2.0 GPH (7,57 lph/outlet)
   c. Multi-outlet Xeri-Bug specifications and features include:
      1) Available with two inlet options:
         a) Barb inlet; Emitters with barb inlet permit insertion into 1/2” (13 mm) or 3/4” (19 mm) drip tubing
         b) 1/2” (13 mm) threaded inlet; Emitters with 1/2” (13 mm) threaded inlet allow threaded connection into 1/2” (13 mm) PVC male adapter.
      2) Six outlet ports, barbed to retain 1/4” (6,4mm) distribution tubing
      3) External surfaces constructed from UV resistant acetyl materials
      4) Self-flushing to minimize clogging
      5) Color-coded to identify flow rate;
         a) Blue emitter indicates a flow rate of 0.5 GPH (1,89 lph) per outlet
         b) Black emitter indicates a flow rate of 1.0 GPH (3,79 lph) per outlet
         c) Red emitter indicates a flow rate of 2.0 GPH (7,57 lph) per outlet
      6) Pressure-compensating over the pressure range of 15 to 50 PSI (1,0 to 3,5 bar) with consistent flow rate of [0.5 GPH (1,89 lph)]

or [1.0 GPH (3,79 lph)] or [2.0 GPH (7,57 lph)] GPH over this pressure range

5. Rain Bird 6-outlet Manifold Emission Device
   a. Available model number:
      1) EMT-6XERI
   b. 6-outlet Manifold specifications and features include:
      1) 1/2” (13 mm) female threaded inlet
      2) Six free-flowing outlet ports, barbed to retain 1/4” (6,4 mm) distribution tubing and sealed by manufacturer with durable plastic caps removable with pliers during installation
      3) Recommended operating pressure range between 15 to 50 PSI (1,0 to 3,5 bar)
6. Rain Bird Multi-Outlet Xeri-Bird™ 8 Emission Device
   a. Available model numbers:
      1) XBD-80: Xeri-Bird™ 8 unit (includes seven removable port plugs) with filter
      2) XBD-81: Xeri-Bird™ 8 unit with eight 1 GPH (3,79 lph) Xeri-Bug (XB-10-PC) emitters factory installed and filter
   b. Xeri-Bird™ 8 specifications and features include:
      1) 1/2” (13 mm) threaded device inlet with union base nut to allow removal of the Xeri-Bird 8 body from .
      2) Eight independent ports, each capable of accepting a Rain Bird Xeri-Bug™ emitter or Rain Bird PC Module for independent flows from 0.5 to 24 GPH (1,89 to 90,96 lph), or a self-piercing barb connector (SPB-025) for unrestricted flow
      3) Eight barbed outlet ports mounted on bottom of device capable of securely retaining 1/4” (6,4 mm) distribution tubing
      4) 200 mesh (75 micron) filter, easily serviceable from top of unit.
      5) Capable of being used with retrofit pressure regulator (PRS-050-30) when pressure regulation is required at unit

D. Low Volume Broadcast Irrigation Emission Devices
   1. General Information
      a. Provide low-volume broadcast emission devices to efficiently deliver irrigation water in a short-radius wetting pattern.
   2. Rain Bird Xeri-Bubbler™
      a. Available model numbers with 1/4” (6,4 mm)barb inlet:
         1) SXB-180-025; half-circle, 5 streams
         2) SXB-360-025; full-circle, 8 streams
         3) UXB-360-025; full-circle, umbrella
      b. Available model numbers with 10-32 thread inlet:
         1) SXB-180-1032; half-circle, 5 streams
         2) SXB-360-1032; full-circle, 8 streams

3) UXB-360-1032; full-circle, umbrella

c. Available model numbers with 5” (12,7 cm) spike inlet:
   1) SXB-180-SPYK; half-circle, 5 streams
   2) SXB-360-SPYK; full-circle, 8 streams
   3) UXB-360-SPYK; full-circle, umbrella

d. Xeri-Bubbler™ specifications and features include:
   1) Three inlet connection options:
      a) 10-32 self-tapping thread
      b) 1/4” (6,4 mm) barb
      c) 5” (12,7 cm) spike
   2) Three flow pattern options:
      a) Half-circle with 5 streams
      b) Full-circle with 8 streams
      c) Full-circle umbrella pattern
   3) Flow and radius adjustment capability by turning outer cap
   4) SXB series features flow range of 0 to 13 GPH (0 to 49,2 lph)
   5) UXB series features flow range of 0 to 35 GPH (0 to 132,5 lph)
   6) Operating pressure range between 15 to 30 PSI (1,0 to 2,1 bar)

3. Rain Bird Xeri-Pop™ Micro-Spray

a. Available model numbers:
   1) XP-400X; 4-inch (101,6 mm) pop-up
   2) XP-600X; 6-inch (152,4 mm) pop-up
   3) XP-1200X; 12-inch (304,8 mm) pop-up

b. Xeri-Pop™ Micro-Spray specifications and features include:
   1) 1/4” (6,4 mm) barb inlet located in base of unit for connection to 1/4” (6,4 mm) distribution tubing
   2) Three pop-up height options:
      a) 4-inch (10,16 cm) pop-up
      b) 6-inch (15,24 cm) pop-up
      c) 12-inch (30,5 cm) pop-up
   3) Compatible with the following Rain Bird nozzles:
      a) Multi-port Series nozzles
      b) 5-series MPR plastic nozzles
      c) 5-series plastic bubbler nozzle (use in conjunction with Rain Bird PCS-series pressure compensating screen)
      d) 8-series MPR plastic nozzles
   4) External body construction using UV-resistant ABS material
   5) Self-flushing, pressure-activated wiper seal
   6) Operating pressure range between 20 to 50 PSI (1,4 to 3,5 bar). Optimum performance achieved with 40 PSI (2,8 bar) pressure regulator.

4. Rain Bird Xeri-Sprays™

a. Available model numbers:
1) XS-090; Quarter-circle, spray pattern
2) XS-180; Half-circle, spray pattern
3) XS-360; Full-circle, stream spray pattern
4) 360 ADJMST; Full-circle spray

b. Xeri-Spray™ specifications and features include:
1) 10-32 self-tapping threaded inlet
2) Four flow pattern options:
a) Quarter-circle spray pattern
b) Half-circle spray pattern
c) Full-circle spray pattern
d) Full-circle mister
3) Operating pressure range between 10 to 30 PSI (0,75 to 2,1 bar)
4) Adjustable flow and radius with integral ball valve
a) Flow adjustability between 0 to 31 GPH (0 to 117,3 lph)
b) Radius adjustability for full-circle sprays between 0 to 13.4 feet (0 to 4,1 m)
c) Radius adjustability for part-circle sprays between 0 to 10.6 feet (0 to 3,2 m)

E. Rain Bird Drip Irrigation Accessories
1. 1/4” (6,4 mm) Barb Transfer Fittings
a. Available model numbers:
1) XBF1CONN:1/4” (6,4 mm) Barb Connector
2) XBF2EL: 1/4” (6,4 mm) Barb x Barb Elbow
3) XBFTEE: 1/4” (6,4 mm) Barb x Barb Tee
b. 1/4” (6,4 mm) Barb Transfer Fittings specifications and features include:
1) Three fitting configurations:
a) Connector
b) Elbow
c) Tee
2) Designed for connections of Rain Bird XQ 1/4” (6,4 mm) distribution tubing with an ID of 0.17” (4,3 mm)
3) Barbed on one end to permit easy insertion into any 1/2” (13 mm) or 3/4” (19 mm) polyethylene tubing using a Rain Bird Xeriman® tool (XM-TOOL)
4) Constructed from UV resistant acetyl.
5) Operating pressure range between 0 to 50 PSI (0 to 3.5 bar)
2. Rain Bird Diffuser Bug Cap
a. Available model numbers:
1) DBC-025 (Black); for potable water source
2) DBC-025-PPL (Purple); for non-potable water source
b. Diffuser Bug Cap specifications and features include:

1) Barb inlet designed to fit into 1/4” (6,4 mm) distribution tubing with ID of 0.16” (4 mm)
2) Flanged shield designed to diffuse water to minimize soil erosion at emission point
3) Constructed from polyethylene material
4) Operating pressure range between be 0 to 50 PSI (0 to 3,5 bar)

PART 3 – EXECUTION

3.01 INSPECTIONS AND REVIEWS

A. Pre-construction Site Inspection
   1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities in writing to Owner’s Representative prior to beginning work. Commencement of work implies acceptance of existing site conditions.

B. Utility Locates ("Call Before You Dig")
   1. Arrange and coordinate Utility Locates with local authorities prior to construction.
   2. Repair underground utilities that are damaged during construction. Make repairs at no additional cost to contract price.

3.02 DRIPLINE EXCAVATION, TRENCHING, AND BACKFILL

A. Excavate and install pipes at minimum cover indicated in drawings or specifications. Excavate trenches at appropriate width for connections and fittings.

B. Minimum cover for dripline components (distance from top of pipe to finish grade):
   1. Buried PVC manifold and supply header pipe to dripline grid layouts: 12” (30,5 cm) to top of pipe.
   2. Buried dripline lateral pipe downstream PVC manifold and supply header pipe: 4” (10 cm) to top of pipe
   3. On-grade dripline lateral pipe downstream PVC manifold and supply header pipe: Secure to finish grade with approved tubing stakes. Install and test prior to installation of landscape fabric and mulch.

C. Backfill only after buried lines have been reviewed, tested, and approved.

D. Excavated material is generally satisfactory for backfill. Use backfill free from rubbish, vegetable matter, frozen materials, and stones larger than 2” (50 mm) in maximum diameter. Remove material not suitable for backfill. Use backfill free of sharp objects next to pipe.

E. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades. Dispose of excess backfill off site.

F. Contact Owner’s Representative for trench depth adjustments where utilities conflict with irrigation trenching and pipe work.

3.03 ASSEMBLING PIPE AND FITTINGS

A. General:
   1. Keep pipe free from dirt and debris. Cut pipe ends square, debur and clean as recommended by pipe manufacturer.
   2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

B. PVC Pipe and Fittings:
   1. Use only strap-type friction wrenches for threaded plastic pipe.
   2. PVC Solvent Weld Pipe and Fittings:
      a. Use appropriate primer and solvent cement. Join pipe in manner recommended by pipe and fitting manufacturers and in accordance with accepted industry practices.
      b. Cure for thirty (30) minutes before handling and twenty-four (24) hours before pressurizing or installing with vibratory plow.
      c. Snake pipe from side to side within trench.
   3. PVC Threaded Connections:
      a. Use only factory-formed threads. Field-cut threads are not permitted.
      b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.

C. Dripline Tubing and Fittings:
   1. Use only Rain Bird XF-Series Insert Fittings or Rain Bird Easy Fit Compression Fittings for Rain Bird XF-Series dripline tubing connections or transitions as recommended by the Manufacturer’s representative for the specific site and system conditions.
   2. Dripline Insert Fittings:
      a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.
   3. Dripline Compression Fittings:
      a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with accepted industry practices.

3.04 INSTALLATION OF DRIPLINE IRRIGATION COMPONENTS

A. Control Zone Kit Assembly:
   1. Flush mainline pipe before installing Control Zone Kit assembly.
   2. Locate where shown on drawings. Connect control wires to remote control valve wires using specified wire connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.
   3. Install a maximum of four (4) Low Flow or Medium Flow Control Zone Kits per standard rectangular valve box. Install a maximum of one (1) Medium Flow Commercial Control Zone Kits per standard rectangular valve box. Install a

maximum of one High Flow Commercial Control Zone Kits per jumbo rectangular valve box.

a. Locate valve boxes at least 12” (30,5 cm) from, and align with, nearby walls or edges of paved areas.

b. Group Control Zone Kit assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12” (30,5 cm) between valve boxes.

c. Brand controller letter and station numbers on valve box lid in 2” (50 mm) high letters.

B. Lateral Piping and Dripline Tubing:

1. Install lateral piping and dripline tubing at locations and in grid patterns as indicated on drawings and installation details, and in strict accordance with manufacturer recommendations.

2. Thoroughly flush PVC lateral piping, supply headers, and dripline tubing immediately upon installation.

C. Air Relief Valve Kit Assembly: Install at all high points in dripline tubing grid as shown and directed on drawings and installation details.

D. Flush Point Assembly: Install in flush header or at ends of each dripline zone segment as shown and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas.

3.05 PROJECT RECORD (AS-BUILT) DRAWINGS

A. Document field changes from original design and construction documents. Maintain on-site and separate from original construction documents, one complete set of documents labeled “Project Field Documents”. Keep documents current. Do not permanently cover work until accurate “as-built” information is recorded.

B. Record pipe network alterations on a daily basis. Record work that is installed differently than shown on construction documents. Record accurate reference dimensions, measured from at least two permanent reference points, of each control zone kit assembly, each dripline zone boundary, each air relief valve assembly, each flush point assembly, and other dripline irrigation components enclosed within valve box.

C. Obtain from General Contractor CADD files prior to construction completion. Duplicate information contained on “Project Field Documents” maintained on-site using technical drafting pen or AutoCAD. Label each sheet "Record Drawing".

D. Provide “Record Drawings” to Owner’s Representative. Completion of Record Drawings is required prior to final construction review at completion of irrigation system installation.

3.06 WINTERIZATION AND SPRING START-UP

A. Winterize irrigation system in fall following completion, or partial completion, of irrigation system construction. Start-up irrigation system in spring following completion,

or partial completion, of irrigation system construction. Repair any damage caused in improper winterization at no additional cost to Owner. Coordinate winterization and start-up with landscape maintenance personnel.

3.07 MAINTENANCE

A. Maintain irrigation system for duration of 30 calendar days from formal written acceptance by Owner's Representative. Make periodic examinations and adjustments to irrigation system components in order to achieve the most efficient and uniform application of water.

B. Following completion of Contractor's maintenance period, Owner will be responsible for maintaining system in working order during remainder of guarantee/warranty period, for performing necessary minor maintenance, for protecting against vandalism, and for preventing damage after landscape maintenance operation.

3.08 CLEANUP

A. Remove from site machinery, tools, excess materials, and rubbish upon completion of work.

END OF SECTION