

**SECTION 00 91 02
ADDENDUM NO. 2**

Summary

This document includes requirements that clarify or supersede portions of the Request for Proposal. This Addendum is a Contract Document.

General

The following changes, additions and deletions shall be made to the following document(s); all other conditions shall remain the same.

- A. BID FORM
N/A
- B. AGREEMENT
N/A
- C. SPECIFICATIONS

Item No.	Reference	Description
1.	Document 00 01 10	Table of Contents V.3 dated June 12, 2008, attached, supersedes V.2 dated June 4, 2008. V.3 indicates sections added or revised. Section 05 50 00 is deleted from the Table of Contents.
2.	Section 00 91 01	Addendum No. 2 is added to Volume 1 of the Specifications.
3.	Section 09 51 13 – Acoustical Panel Ceilings	Paragraph 2.2.B.1. Delete what is written and insert the following: “1. Acoustical Panel: USG Millenia® Climaplus™; Illusion Two/24 Panels; Item No. 78780. a. ASTM E1264, Type III, Form 1 or 2, Pattern G. b. Material: Mineral fiber. c. Surface Texture: Smooth texture. d. Surface Finish: White. e. Size: 24 inches by 48 inches. f. Thickness: 3/4 inch. g. Density: 1.04 pounds per square foot. h. Edge Profile: SLT Reveal, beveled edge for lay-in. i. Noise Reduction Coefficient: 0.70. j. Ceiling Attenuation Class: 35. k. Flame Spread: ASTM E1264; Class A; Flame spread 25; Smoke developed 25; (UL labeled). l. Light Reflectance: 85 percent. m. Recycled Content: 80 percent. n. Durability: Washable, Impact-Resistant, Scratch-Resistant, Soil-Resistant.”
4.	Section 09 65 00 – Resilient Flooring	Delete Section 09 65 00 – Resilient Flooring in its entirety. Insert new Section 09 65 00 – Resilient Flooring, attached, into the Project Manual.

5.	Section 09 68 16 – Sheet Carpeting	<p>A. Paragraph 2.5.A. Delete what is written and insert the following: “A. Style: Odyssey Vinyl Cushion RS/ (Vinyl Cushion) - Mark I.</p> <ol style="list-style-type: none"> 1. Color: 14520 – Ganymede. 2. Construction: Loop 3. Gauge: 1/13 inch 4. Pile Units per Inch: 8.4 5. Pile Height Average: 0.117 inch 6. Pile Yarn Weight: 20.0 oz/sq yd 7. Density Factor: 10,000 8. Yarn Size: 1245/2 9. Fiber System: 75% TDX SDN 25% TDX Nylon with Static Control and Ensure 10. Interliner: Spun Synthetic 11. Powerbond Backing System: 6 ft <ul style="list-style-type: none"> • Fusion Coat Sealant Vinyl • Backing Closed cell vinyl cushion • Weight 35.5 oz/sq yd • Density 18.5 lbs/cu ft • Thickness 0.156 inch 12. Total Weight: 81.0 oz/sq yd +/- 5 percent 13. Electrostatic Propensity: 1.4 K.V. or lower 14. Flooring Radiant Panel Test: Mean average critical radiant flux: 0.45 w/sq cm or higher 15. Smoke Density Flaming: Mean average: 450 or lower 16. Flammability: Passes 17. Warranties: 25 year wear, delamination, edge ravel, static, zippering, loss of resiliency” <p>B. Delete duplicate page 5 and page 6 of Section 09 68 16.</p>
6.	Section 09 90 00 – Painting and Coating	Modify Interior Paint Color Palette as follows:

Cañada College Interior Paint Color Palette						
color description	color name	Kelly-Moore Control #	product	sheen	notes	Formula
white	Bone	KM# OW-27	1685-121 Durapoxy	semi-gloss	ubiquitous wall color	C10 L35
white	Bone	KM# OW-27	1686-121 Durapoxy	Eggshell	ubiquitous wall color	C10 L35
light green	Khaki Green	06-439-SMT	1686-333	Eggshell	accent color	D7 J6 L40 Kx4
dusty orange	Terra Cotta	06-442-SMT	1686-333	Eggshell	accent color	B1 I8 CY30 T14 F9
medium purple	Wisteria	99-435-SSF	1010-333 Durapoxy	Eggshell	accent color	CY14 B3Y26 M3Y5 Kx6
light gray	Putty	06-435-SMT	1686-222 Durapoxy	Eggshell	accent color	B5.5 C10.25 F1.25
medium yellow	Indian Corn	06-437-SMT	1010-333	Eggshell	accent color	C32 F.125
dark brown	Bronzitone	Rustoleum	5275402	semi-gloss	interior/exterior door trim, other metal surfaces as approved	Standard Rustoleum color

7.	Section 10 28 00 – Toilet Accessories	Delete Article 1.3 – Performance Requirements – Hand Dryers in its entirety.
8.	Section 12 24 13 – Solar Roller Shades	Paragraph 2.2.A.1: Delete what is written and insert the following: “1. Shade Fabric: MechoShade 1000 Series Dense Vertical Weave ShadeCloth with 2-3 percent Openness Factor. a. Elegant 1x4 twill weave of thin yarn. b. Clean uniform control of light and heat. c. Color: 1004 Black/Brown.”
9.	Section 12 48 13 – Entrance Floor Mats	Paragraph 2.1.A: Add “Kadee Industries; www.KadeeIndustries.com to the list of manufacturers. See attached Substitution Request Form.
10.	Section 21 01 00 – Basic Fire Suppression Materials and Methods	Delete Section 21 01 00 – Basic Fire Suppression Materials and Methods in its entirety. Insert new Section 21 01 00 – Basic Fire Suppression Materials and Methods, attached, into the Project Manual.
11.	Section 22 05 12 – Plumbing Pipe and Fittings.	Delete Section 22 05 12 – Plumbing Pipe and Fittings in its entirety. Insert new Section 22 05 12 – Plumbing Pipe and Fittings, attached, into the Project Manual
12.	Section 23 00 40 – Acceptance Testing	Delete Section 23 00 40 – Acceptance Testing in its entirety. Insert new Section 23 00 40 – Acceptance Testing, attached, into the Project Manual.
13.	Section 23 05 10 – Hydronic Piping	Delete Section 23 05 10 – Hydronic Piping in its entirety. Insert new Section 23 05 10 – Hydronic Piping, attached, into the Project Manual.
14.	Section 23 05 23 – General-Duty Valves for HVAC Piping	Delete Section 23 05 23 – General-Duty Valves for HVAC Piping in its entirety. Insert new Section 23 05 23 – General-Duty Valves for HVAC Piping, attached, into the Project Manual.
15.	Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment	Delete Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment in its entirety. Insert new Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment, attached, into the Project Manual.
16.	Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment	Delete Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment in its entirety. Insert new Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment, attached, into the Project Manual.
17.	Section 23 05 53 – Identification for HVAC Piping and Equipment	Delete Section 23 05 53 – Identification for HVAC Piping and Equipment in its entirety. Insert new Section 23 05 53 – Identification for HVAC Piping and Equipment, attached, into the Project Manual.
18.	Section 23 05 93 – Testing, Adjusting and Balancing	Delete Section 23 05 93 – Testing, Adjusting and Balancing in its entirety. Insert new Section 23 05 93 – Testing, Adjusting and Balancing, attached, into the Project Manual.

19.	Section 23 07 00 – HVAC Insulation	Delete Section 23 07 00 – HVAC Insulation in its entirety. Insert new Section 23 07 00 – HVAC Insulation, attached, into the Project Manual.
20.	Section 23 09 13 – Variable Frequency Drives	Delete Section 23 09 13 – Variable Frequency Drives in its entirety. Insert new Section 23 09 13 – Variable Frequency Drives, attached, into the Project Manual.
21.	Section 23 21 05 – Hydronic Piping Systems.	Delete Section 23 21 05 – Hydronic Piping Systems in its entirety. Insert new Section 23 21 05 – Hydronic Piping Systems, attached, into the Project Manual.
22.	Section 23 31 00 – Ductwork	Delete Section 23 31 00 – Ductwork in its entirety. Insert new Section 23 31 00 – Ductwork, attached, into the Project Manual.
23.	Section 23 75 00 – Air Handling Units	Delete Section 23 75 00 – Air Handling Units in its entirety. Insert new Section 23 75 00 – Air Handling Units, attached, into the Project Manual.
24.	Section 25 55 00 – BMS	Delete Section 25 55 00 – BMS in its entirety. Insert new Section 25 55 00 – BMS, attached, into the Project Manual.
25.	Section 26 00 00 – Basic Requirements	Delete Section 26 00 00 – Basic Requirements in its entirety. Insert new Section 26 00 00 – Basic Requirements, attached, into the Project Manual.
26.	Section 26 01 00 – Basic Materials and Methods	Delete Section 26 01 00 – Basic Materials and Methods in its entirety. Insert new Section 26 01 00 – Basic Materials and Methods, attached, into the Project Manual.
27.	Section 26 08 05 – Electrical Acceptance Testing	Delete Section 26 08 05 – Electrical Acceptance Testing in its entirety. Insert new Section 26 08 05 – Electrical Acceptance Testing, attached, into the Project Manual.
28.	Section 26 09 15 – Lighting Relay Control Panel	Delete Section 26 09 15 – Lighting Relay Control Panel in its entirety. Insert new Section 26 09 15 – Lighting Relay Control Panel, attached, into the Project Manual.
29.	Section 26 20 00 – Low Voltage Electrical Distribution	Delete Section 26 20 00 – Low Voltage Electrical Distribution in its entirety. Insert new Section 26 20 00 – Low Voltage Electrical Distribution, attached, into the Project Manual.
30.	Section 26 50 00 – Lighting	Delete Section 26 50 00 – Lighting in its entirety. Insert new Section 26 50 00 – Lighting, attached, into the Project Manual.
31.	Section 27 53 13 – Central Clock System	Delete Section 27 53 13 – Central Clock System. in its entirety. Insert new Section 27 53 13 – Central Clock System, attached, into the Project Manual.
32.	Section 28 31 00 – Fire Detection and Alarm System	Delete Section 28 31 00 – Fire Detection and Alarm System in its entirety. Insert new Section 28 31 00 – Fire Detection and Alarm System, attached, into the Project Manual.

D. DRAWINGS

Item No.	Reference	Description
33.	Sheet A2.1 – First Floor New Conditions Plan	Clarify Sheet Note 13, as shown on attached drawing AD2-A3.
34.	Sheet A5.1 – Exterior Elevations	Add Exterior Elevation Note 4, as shown on attached drawing AD2-A2.
35.	Sheet A9.1 – Schedules	Modify notes in Finish Groups Table and Finish Legend Table, as shown on attached drawing AD2-A1.
36.	Sheet M0.1 – Mechanical Legends, Notes, Abbreviations & Drawing Index.	<ul style="list-style-type: none"> A. Added Plumbing Symbol List, as shown on attached drawing AD2-M1. B. Added Plumbing Symbol List, as shown on attached drawing AD2-M2. C. Added Plumbing Symbol List, as shown on attached drawing AD2-M3. D. Added Abbreviation, as shown on attached drawing AD2-M4.
37.	Sheet MD1.1 – Mechanical Demolition Floor Plans	<ul style="list-style-type: none"> A. Clarification of Demolition Scope to drawing 1, as shown on attached drawing AD2-M05. B. Clarification of Demolition Scope to drawing 2, as shown on attached drawing AD2-M06. C. Clarification of Demolition Scope, as shown on attached drawing AD2-M07.
38.	Sheet M2.1 – Mechanical Floor Plans	<ul style="list-style-type: none"> A. VFD and TCP location clarification to drawing 1, as shown on attached drawing AD2-M08. B. Thermostat numbering and point of connection to existing clarified on drawing 2, as shown on attached drawing AD2-M09. C. VFD location clarification to drawing 3, as shown on attached drawing AD2-M10. D. Device location clarification, as shown on attached drawing AD2-M11. E. Diffuser sizing table, as shown on attached drawing AD2-M12.
39.	Sheet M2.2 – Mechanical Floor Plans, Plumbing	<ul style="list-style-type: none"> A. Drafting corrections to drawing 1, as shown on attached drawing AD2-M13. B. Drafting corrections to drawing 2, as shown on attached drawing AD2-M14.
40.	Sheet M3.1 – Mechanical Single Line Diagrams	<ul style="list-style-type: none"> A. Sequence of operations added to drawing 1, as shown on attached drawing AD2-M15. B. Sequence of operations added to drawing 1, as shown on attached drawing AD2-M16. C. Sequence of operations added to drawing 1, as shown on attached drawing AD2-M17. D. Sequence of operations added to drawing 2, as shown on attached drawing AD2-M18. E. Sequence of operations added to drawing 3, as shown on attached drawing AD2-M19.

40.	Sheet M3.1 – Mechanical Single Line Diagrams (continued)	<p>F. VAV Terminal Unit Detail added to drawing 4, as shown on attached drawing AD2-M20.</p> <p>G. Duct Tapping Detail added to drawing 5, as shown on attached drawing AD2-M21.</p> <p>H. Duct Tapping Detail added to drawing 5, as shown on attached drawing AD2-M22.</p> <p>I. Added notes to drawing 6, as shown on attached drawing AD2-M23.</p> <p>J. Added notes to drawing 6, as shown on attached drawing AD2-M24.</p>
41.	Sheet M3.3 – Mechanical Details	<p>A. Added detail 7, as shown on attached drawing AD2-M25.</p> <p>B. Added detail 8, as shown on attached drawing AD2-M26.</p> <p>C. Added detail 9, as shown on attached drawing AD2-M27.</p> <p>D. Added detail 9, as shown on attached drawing AD2-M28.</p> <p>E. Added detail 10, as shown on attached drawing AD2-M29.</p> <p>F. Added detail 10, as shown on attached drawing AD2-M30.</p> <p>G. Added detail 11, as shown on attached drawing AD2-M31.</p> <p>H. Added detail 12, as shown on attached drawing AD2-M32.</p>
42.	Sheet M4.1 – Mechanical Equipment Schedules	<p>A. Plumbing Fixture Schedule Modification, as shown on attached drawing AD2-M33.</p> <p>B. Fan Schedule Modification, as shown on attached drawing AD2-M34.</p>
43.	Sheet E0.1 – Electrical Legends, Notes, Abbreviations and Drawing Index	<p>A. Deleted General Electrical Note ‘N’, as shown on attached drawing AD2-E1.</p> <p>B. Added symbol for ‘CEILING-MOUNTED GLASS BREAK SENSOR’, as shown on attached drawing AD2-E2.</p>
44.	Sheet E0.2 – Luminaire Schedule and Title 24	Revised ‘Luminaire Schedule’, as shown on attached drawing AD2-E3.
45.	Sheet ED1.1 – 1 st and 2 nd Floor Plans- Demolition	Revised General Sheet Note ‘A’ and Sheet Keynotes 5 and 7, as shown on attached drawing AD2-E4.
46.	Sheet E2.1 – 1 st and 2 nd Floor Plans- Lighting	<p>A. Revised sheet keynotes 1, 2, 3, 4, and 6, as shown on attached drawing AD2-E5.</p> <p>B. Revised electrical equipment layout. Added bi-level switching in elec/mech room, as shown on attached drawing AD2-E6.</p> <p>C. Revised emergency lighting circuiting, as shown on attached drawing AD2-E7.</p> <p>D. Revised switching in Meeting Room 8211, as shown on attached drawing AD2-E8.</p>
47.	Sheet E3.1 – 1 st and 2 nd Floor Plans – Power	A. Revised Sheet Keynotes 1, 2, and 6. Added Sheet Keynotes 7, 8, and 9, as shown on attached drawing AD2-E9.

47.	Sheet E3.1 – 1st and 2nd Floor Plans – Power (continued)	<p>B. Added Sheet Keynote 2 callout to garbage disposal/switch, as shown on attached drawing AD2-E10.</p> <p>C. Revised electrical equipment layout. Added power for TCP and DDC controllers, as shown on attached drawing AD2-E11.</p> <p>D. Added boundary to second floor to show area that is not in scope of work, as shown on attached drawing AD2-E12.</p> <p>E. Added Sheet Keynote 9 to show unistrut support for VFD, as shown on attached drawing AD2-E13.</p>
48.	Sheet E4.1 – 1st and 2nd Floor Plans – Signal	<p>A. Added Sheet Keynotes 3 and 4, s shown on attached drawing AD2-E14.</p> <p>B. Added ACAM devices as shown on attached drawing AD2-E15.</p> <p>C. Added ACAM devices as shown on attached drawing AD2-E16.</p> <p>D. Added callouts to equipment racks, as shown on attached drawing AD2-E17.</p>
49.	Sheet E5.1 – Single Line Diagram and Panel Schedules	<p>A. Revised Sheet Keynotes 2. Added Sheet Keynotes 7, 8, 9, and 10, as shown on attached drawing AD2-E18.</p> <p>B. Revised panelboard schedules, as shown on attached drawing AD2-E19.</p> <p>C. Revised single line diagram, as shown on attached drawing AD2-E20.</p>

E. CLARIFICATIONS

50. Drawing A0.5 has the fire sprinkler protection system crossed out; however the project manual lists four related Specification Sections (21 00 00, Basic Fire Suppression Requirements; 21 00 00, Basic Fire Suppression Materials and Methods; 21 06 10, Schedules for Water Based Fire-Suppression Piping and Equipment; 21 00 00, Fire Suppression Sprinkler Systems.) Are these specification sections applicable to the project? Please clarify.

Response: Fire sprinklers are not anticipated to be part of the project.

51. Please reference Detail 4 on drawing M2.1. Detail 4 describes (n) 2-1/2” CHWS/CHWR from Central Plant. Are these pipes stubbed into the building? Where is their point of connection? Please clarify.

Response: No, pipes are not already stubbed into building. Contractor is responsible for making connection to CHWS/CHWR. See District Website for chilled water as-builts, under “Reference Documents”.

52. The project specifications’ Table of Contents lists Section 05 50 00, Metal Fabrications. However, the contract documents are absent of this specification section. Please advise if this specification section 05 50 00 is applicable to the project.

Response: Section 05 50 00 is not applicable. Delete Section 05 50 00 from Table of Contents.

END OF ADDENDUM NO. 2

DOCUMENT 00 01 10

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Division 00 – Bidding and Contracting Requirements

INTRODUCTORY INFORMATION

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00 01 15	List of Drawings

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00 11 19	Instructions to Bidders V.2
00 21 14	Bid Submittal Vicinity Map
00 21 15	Project Site Campus Map
00 31 19	Reports, Surveys and Existing Conditions
00 41 00	Bid Form
00 43 10	Indemnity and Release Agreement
00 43 13	Bond Accompanying Bid
00 43 25	Substitution Request
00 43 33	Schedule of Major Equipment and Materials Suppliers
00 43 36	Subcontractors List
00 43 45	Escrow Agreement for Security Deposit
00 45 00	Bidder Certifications
00 45 14	Key Personnel
00 45 19	Non-Collusion Affidavit

CONTRACTING REQUIREMENTS

<u>Document</u>	<u>Title</u>
00 50 00	Notice to Proceed V.2
00 51 00	Notice of Award V.2
00 51 01	Notice of Intent to Award for Construction
00 52 00	Agreement
00 61 00	Construction Performance Bond
00 62 00	Construction Labor and Material Payment Bond
00 65 36	Guaranty
00 65 73	Agreement and Release of Any and All Claims

CONDITIONS OF THE CONTRACT

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00 73 00	Supplementary Conditions
00 73 17	Insurance
00 73 37	Apprenticeship Program
00 91 01	Addendum No. 1
00 91 02	Addendum No. 2

SPECIFICATIONS

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01 10 00	Summary of Work
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01 26 00	Modification Procedures <ul style="list-style-type: none"> • Cost Proposal Form
01 29 00	Measurement and Payment
01 31 19	Project Meetings
01 31 23	Web-based Project Management System
01 32 16	Progress Schedules and Reports
01 32 19	Submittal Procedures
01 35 00	Special Procedures
01 35 27	Project Labor Agreement
01 41 00	Regulatory Requirements
01 42 00	References and Definitions
01 45 23	Testing and Inspection V.2
01 51 00	Temporary Facilities and Controls
01 56 00	Site Security and Safety
01 58 00	Project Identification and Signs V.2
01 60 00	Product Requirements
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01 76 01	Existing Underground Facilities
01 77 00	Contract Closeout
01 78 39	Project Record Documents
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Volume 2

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03 30 00	Cast-in-Place Concrete

Division 04 – Not Used

Division 05 – Metals

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05 12 00	Structural Steel Framing
05 40 00	Cold-Formed Metal Framing

Division 06 – Wood and Plastics

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07 61 13	Standing Seam Roofing
07 62 00	Sheet Metal Flashing and Trim
07 65 00	Flexible Flashing
07 81 23	Intumescent Fireproofing
07 84 00	Firestopping
07 90 00	Joint Protection

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08 34 73	Sound Control Door Assemblies
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08 41 13.5	Aluminum-Framed Folding Systems
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09 22 16	Non-Structural Metal Framing
09 24 00	Portland Cement Plastering
09 30 00	Tiling
09 51 13	Acoustical Panel Ceilings
09 65 00	Resilient Flooring (Addendum No. 2)
09 68 16	Sheet Carpeting
09 84 00	Acoustical Wall Treatment
09 90 00	Painting and Coating

Division 10 – Specialties

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10 14 00	Signage
10 26 23	Protective Wall Coverings
10 28 00	Toilet Accessories
10 44 00	Fire Protection Specialties

Division 11 – Equipment

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11 31 13	Residential Equipment

Division 12 – Furnishings

<u>Section</u>	<u>Title</u>
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12 48 13	Entrance Floor Mats

Divisions 13 to 19 – Not Used

FACILITY SERVICES SUBGROUP

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Division 21 – Fire Suppression

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21 00 00	Basic Fire Suppression Requirements
21 01 00	Basic Fire Suppression Materials and Methods (Addendum No. 2)
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21 13 00	Fire Suppression Sprinkler Systems

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22 05 12	Plumbing Pipe and Fittings (Addendum No. 2)
22 05 13	Common Motor Requirements for Plumbing Equipment
22 05 23	General-Duty Valves for Plumbing Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
22 05 53	Identification for Plumbing Piping and Equipment
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23 00 40	Acceptance Testing and Documentation (Addendum No. 2)
23 05 10	Hydronic Piping (Addendum No. 2)
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 23	General-Duty Valves for HVAC Piping (Addendum No. 2)
23 05 29	Hangers and Supports for HVAC Piping and Equipment (Addendum No. 2)
23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment (Addendum No. 2)
23 05 53	Identification for HVAC Piping and Equipment (Addendum No. 2)
23 05 93	Testing, Adjusting and Balancing (Addendum No. 2)
23 07 00	HVAC Insulation (Addendum No. 2)
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23 09 13	Variable Frequency Drives (Addendum No. 2)
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23 36 00	Air Terminal Outlets
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26 08 05	Electrical Acceptance Testing (Addendum No. 2)
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26 09 21	Occupancy Sensors
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26 22 00	Dry-Type Transformers
26 50 00	Lighting (Addendum No. 2)
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<u>Section</u>	<u>Title</u>
27 00 00	Telecommunications Basic Requirements
27 05 26	Telecommunications Bonding
27 05 28	Telecommunications Building Pathways
27 08 00	Telecommunications Testing
27 11 00	Telecommunications Rooms
27 13 10	Telecommunications Backbone ISP Cabling
27 13 14	Telecommunications Backbone OSP Twisted Pair Cabling
27 15 13	Telecommunications Horizontal Cabling
27 53 13	Central Clock System (Addendum No. 2)

Division 28 – Electronic Safety and Security

<u>Section</u>	<u>Title</u>
28 00 00	Basic Security System Requirements
28 05 13	Security System Cabling
28 05 53	Security System Labeling
28 08 00	Security System Commissioning
28 13 00	Access Control & Alarm Monitoring System (ACAMS)
28 31 00	Fire Detection and Alarm System (Addendum No. 2)
	▪ Fire Alarm System Cut Sheets

SITE AND INFRASTRUCTURE SUBGROUP

Division 30 – Not Used

Division 31 – Not Used

Division 32 – Exterior Improvements

<u>Section</u>	<u>Title</u>
31 63 29	Cast-in-Place Drilled Piers

Division 33 – Not Used

END OF DOCUMENT

SECTION 09 65 00**RESILIENT FLOORING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes the following:
 - 1. Slip Resistant Sheet Vinyl Safety Flooring.
 - 2. Resilient base.
 - 3. Installation accessories.
 - 4. Calcium chloride concrete moisture testing.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 07 26 00 - Concrete Vapor Control Barrier: Moisture Remediation.

1.2 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. ADAAG - Americans with Disabilities Act (ADA):
 - 1. Accessibility Guidelines for Buildings and Facilities.
- C. ASTM International:
 - 1. ASTM D 2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - 2. ASTM E 648/NFPA 253 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - 3. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 4. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - 5. ASTM F 970 - Standard Test Method for Static Load Limit.
 - 6. ASTM F1482 - Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring.
 - 7. ASTM F1861 - Wall Base: Rubber and Vinyl Plastic.
 - 8. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 9. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - 10. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- D. Resilient Floor Covering Institute (RFCI)
 - 1. RFCI Standard Slab Moisture Test Method (Calcium Chloride Method).
- E. Bay Area Air Quality Management District: www.baaqmd.gov
 - 1. BAAQMD 8-51 – Regulation 8, Rule 51 – Adhesive and Sealant Products.
- F. Calcium Chloride Test developed by the Rubber Manufacturer's Association.

- G. CCR - California Code of Regulations, Title 24, Part 2, California State Accessibility Standards.
- H. Federal Specifications:
 - 1. FS RR-T-650 – Treads, Metallic and Non-metallic, Non-skid.
 - 2. FS SS-T-312b – Tile, Floor: Asphalt, Rubber, Vinyl, Vinyl Composition.
- I. International Standards Organization:
 - 1. ISO 9001: 2000 Certification.
 - 2. ISO 14001: 2004 Certification.
- J. National Fire Protection Association:
 - 1. NFPA 253 – Test Method for Critical Radiant Flux of floor covering Systems Using a Radiant Energy Source.
 - 2. NFPA 258 – Recommended Practice for Determining Smoke Generation of Solid Materials.
- K. South Coast Air Quality Management District:
SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide slip resistant sheet vinyl safety flooring which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.4 SUBMITTALS

- A. Section 01 32 19 – Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's current printed product literature, specifications, installation instructions, and field reports.
- C. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories, including but limited to the following:
 - 1. Submit a cut diagram indicating seam locations and roll direction. Use mitered seam layouts for corners when changing directions 180 degrees (e.g. when running material down corridors which bisect at a right angle), unless approved otherwise.
- D. Samples: Submit duplicate 12 inch x 12 inch sample pieces of sheet material, and 12 inch long sample pieces of rubber base.
- E. Quality Assurance Submittals: Submit the following:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 2. Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
 - 3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 77 00 - Contract Closeout: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

Include precautions against cleaning materials and methods detrimental to finishes and performance.

- C. Warranty: Warranty documents specified herein.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
1. Training: Installer who has attended an Altro safety flooring installation training clinic.
- B. Regulatory Requirements: Provide slip resistant sheet vinyl safety flooring in compliance with the following:
1. Americans with Disabilities Act Architectural Guidelines (ADAAG).
 2. Occupational Safety & Health Administration (OSHA).

1.7 MOCKUP

- A. Install at project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Architect's acceptance of finish color, texture and pattern, and workmanship standards.
- B. Construct mockup, 10 feet by 10 feet.
- C. Locate where directed by Architect.
- D. Upon approval, this test installation shall then be considered the standard of quality and basis of comparison for the balance of the project.
- E. Maintain mock-up during construction period for workmanship comparison; remove and legally dispose of mock-up when no longer required; OR
- F. Incorporate accepted mockup as part of Work, upon Owner's approval.
- G. Areas found to be deficient by specification standards or application procedures shall be repaired/replaced at contractor's expense.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 31 19 – Project Meetings.
- B. Convene minimum one week prior to commencing work of this section.
- C. Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.9 DELIVERY, STORAGE & HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver, store and handle resilient flooring materials in accordance with Section 01 60 00 - Product Requirements
- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- D. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
- E. Store rolls in dry locations. Stand rolls on end. Protect and secure rolls from falling.

1.10 WASTE MANAGEMENT AND DISPOSAL

- A. Deposit all packaging materials in appropriate container on site for recycling or reuse.
- B. Avoid using landfill waste disposal procedures when recycling facilities are available.
- C. Keep all discarded packaging away from children.

1.11 PROJECT CONDITIONS

- A. Temperature Requirements: If storage temperature is below 65 degrees F, the Altro safety flooring product must be moved to a warmer place and allowed to reach this temperature before unrolling or installation. The room temperature must not be below 65 degrees F and the floor temperature 50 degrees F. For further information, refer to current Installation Guide.
- B. Maintain air temperature and structural base temperature at flooring installation area between 65 degrees F and 80 degrees F for 48 hours before, during and 24 hours after installation.

1.12 WARRANTY

- A. Section 01 77 00 – Contract Closeout: Requirements for warranties.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
- C. Warranty Period for Altro Maxis Suprema shall be 7 years commencing on Date of Substantial Completion.

1.13 EXTRA MATERIALS

- A. Section 01 77 00 – Contract Closeout: Spare parts and maintenance products.
- B. Extra Materials: Deliver to owner extra materials from same production run as Products installed. Package products with protective covering and identify with descriptive labels.
 - 1. Quantity: Furnish 25 square feet of flooring and 10 LF of base of each type and color specified.
 - 2. Delivery, storage and protection: Comply with owner's requirements for delivery, storage and protection of extra materials.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer:
 - 1. Altro. 467 Forbes Boulevard, South San Francisco CA 94080 Toll-free: 800.941.1696 Tel: 650.941.1696 Fax: 650.941.2961.; E-mail: info@altrofloors.com Web Site: www.altrofloors.com.
 - 2. Substitutions: Not permitted. Altro is District Standard.

2.2 SAFETY FLOORING

- A. Slip Resistant Sheet Vinyl: To ASTM F1303, Type 2, Grade 1, sheet vinyl flooring with moisture resistant backing Class A. Static coefficient of slip resistance in excess of 0.6 when tested in accordance with ASTM D2047, AltroSan™ integrated bacteriostat.
- B. Acceptable material: Altro Maxis Suprema (measurements and product weights given below are approximate):
 - 1. Thickness: 0.08 inch (2.0 mm).
 - 2. Roll Width: 6' - 7" (2 m).
 - 3. Roll Length: 66 feet (20 m).
 - 4. Roll Weight: 220 lb.
 - 5. Slip Resistance (Dry): 0.6.
 - 6. Color: SU2019 "UII".

2.3 RESILIENT BASE

- A. Manufacturers:
 - 1. Burke Mercer.
 - 2. Substitutions: Not permitted. Burke is District standard.
- B. Base: ASTM F1861, Group 1 rubber; Type TS (vulcanized thermoset rubber) Style B (coved) as shown on drawings; top set.
 - 1. Height: 4 inch.
 - 2. Thickness: 0.125 thick.
 - 3. Finish: Matte.
 - 4. Length: Roll.
 - 5. Accessories: Premolded external corners, internal corners, and end stops.
 - 6. Color: 523 – Black Brown.

2.4 EDGING STRIPS

- A. General: Specified products are manufactured by BurkeMercer Products Co., Inc.; color as selected by Architect.
- B. Alternate Manufacturer: Comparable products manufactured by the Johnsonite Division of Duramax, Inc., or accepted equal.
- C. Resilient Flooring to Carpet: Model No. 152 or Model 710.
- D. Resilient Flooring to Concrete: Model No. 170.
- E. Resilient Flooring to Ceramic Tile Transition: Model No. 365 Cerco Edge T, with No. 970/980/990 Track.
- F. Ceramic Tile to Carpet: Model No. 150 Tile-Carpet Joiner.
- G. Tile Reducer: Model No. 633 Tile Reducer.

2.5 ACCESSORIES

- A. Vinyl welding rod: Acceptable material:
 - 1. Altro weld rod
- B. Gulley edge: Acceptable material, vinyl, sized to suit application:
 - 1. Altro Gulley Edge GE 35/25, GE 35RE, GE 25RE.

- C. Joint cover strip: Acceptable material, vinyl, sized to suit application:
 - 1. Altro Joint Cover Strip EJC75/20, EJC50/20, EJC75/32.
- D. Acrylic Adhesive: For dry areas with no spillage, use Ecofix, a one-part, water-based, acrylic adhesive as recommended by manufacturer.
- E. Polyurethane Adhesive: For areas subjected to spillage, extreme temperature changes or heavy rolling loads, use Altrofix 30 or 300, a two-part resin-based polyurethane adhesive.
- F. Subfloor Filler and Leveler: Use only gray Portland cement-based underlayments, and patching compounds. Use for filling cracks, holes or leveling. White gypsum materials are not acceptable. Contact Altro for more information and recommendations.
- G. Metal edge strips:
 - 1. Aluminum extruded, smooth, mill finish, with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

2.6 SOURCE QUALITY

- A. Source Quality: Obtain safety flooring products from a single manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog, installation instructions and product label instructions for installation.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 SUBFLOOR PREPARATION

- A. Remove ridges and bumps.
- B. Apply subfloor filler to low spots and cracks to achieve floor level to a tolerance of 1:1000, allow to cure. Never install Altro flooring over gypsum-based toppings, underlayments, leveling or patching compounds.
- C. Meet ASTM F710 Standard for Concrete or other monolithic floors.
- D. Prepare and seal porous and powdery concrete surfaces in accordance with flooring manufacturer's written instructions.
- E. Ensure concrete slopes to drains and other floor sinks.
- F. Remove dust, old adhesive, paint, dirt, wax, sealer and foreign matter from existing surfaces.

3.4 PREPARATION

- A. Safety flooring shall be installed over concrete subfloors conforming to ASTM F710.

- B. Maintain air temperature and structural base temperature at flooring installation area between 65 degrees F and 80 degrees F for 48 hours before, during and 24 hours after installation.
- C. Perform moisture tests on concrete floors regardless of the age or grade level. Verify concrete substrate is dry in accordance with the RFCI Industry Standards Slab Moisture Test Method (Calcium Chloride Method), in strict accordance with instructions.
- D. Perform moisture condition test in each major area. A minimum of 1 test per 1000 sq ft, prior to installation. Moisture emissions from concrete subfloors must not exceed 3 lbs per 1000 sf per 24 hours for acrylic adhesive and 5lbs for polyurethane adhesive via the Calcium Chloride Test Method (ASTM F1869). If subfloor moisture exceeds the allowable maximum for installing Altro flooring, please call your local Altro distributor for advice.
- E. Conduct moisture tests around room perimeter, at columns and where moisture may be evident.
- F. Conduct relative humidity testing per ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Slab Using in situ Probes:
 - 1. This test method covers the quantitative determination of percent relative humidity in concrete slabs for field or laboratory test.
 - 2. Conduct one test for every 1,000 square feet (minimum 3 tests) to ensure concrete does not exceed 85 percent internal relative humidity.
- G. Perform alkalinity testing per ASTM F710 to ensure pH levels of concrete subfloor surface do not exceed pH 9.9. Concrete must be neutralized if above pH 9.9.
- H. General Contractor shall be responsible for insuring independent inspection of items 3.4.C, 3.4.D, 3.4.E, 3.4.F, and 3.4.G 1, 2 above. Contractor shall verify in writing to the Owner, Architect, and subcontractor, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions: Reference Section 01 45 23.
- I. Contingency for High Moisture Readings: If at the time of testing the moisture readings are in excess of manufacturer's recommendations, the Contractor shall proceed with application of concrete vapor control barrier as specified in Section 07 26 00.
- J. Moisture Remediation: Basic Steps as follows:
 - 1. Removal of all floor coverings, adhesive residue, curing compounds, parting compounds or other surface contaminants by mechanical means (shot-blasting, or other suitable method).
 - 2. Identification and treatment of all cracks and joints, by the sealer manufacturer's approved methods.
 - 3. Application of the sealer (Must be a product designed and warranted for the purpose of controlling excessive concrete moisture vapor emission and the alkali it may carry).
 - 4. Application of a sacrificial cementitious topping to act as a substrate for the installation of resilient floor coverings.
- K. Do not proceed with work until results of moisture condition and/or pH tests are acceptable.
- L. Underlayment and Patching Compounds: Use only grey colored Portland cement based underlayments; patching compounds are used for filling cracks, holes and leveling. White gypsum materials are not acceptable.

3.5 INSTALLATION – SAFETY FLOORING

- A. Safety Flooring Installation: Install Altro safety flooring in accordance with the current published Altro Installation Guide. Seams shall be heat welded with Altro Weldrod™ only.

Failure to install Altro safety flooring in accordance with recommended procedures will void the Altro Limited Product Warranty.

- B. Drains: Fit Altro safety flooring and mechanically fasten to drain outlets to ensure a permanent, watertight installation.
 - 1. New Round Drains: Install round flash clamping ring type drains to accommodate Altro safety flooring. Install drains to fit flush with surrounding floor surface. Acceptable drain manufacturers and drain types include Wade FC-1100. Please refer to Altro's current Installation Guide for approved drain manufacturers and styles.
 - 2. Existing Drains: When existing drains are to be used, provide mechanically fastened stainless steel drain rings over all round drain outlets. Fit rings over slip resistant sheet vinyl safety flooring and permit inside diameter that will allow clean out plate to be removed after installation. Drill into concrete to accommodate lead or plastic anchors. Screw drain rings to create a tight seal with beveled head stainless steel screws.
 - 3. Square and Rectangular Drains and Floor Sinks: Install Altro Gully Edge GE25RE or GE35RE around perimeter of drain which has been set in concrete in accordance with Altro Installation Guide. Do not use Altro Gully Edge around drains set in wood floors. Provide stainless steel strips, mechanically fastened with stainless steel screws. Use stainless steel strips in other areas where it is not practical to use Altro Gully Edge.
- C. Coved Installation: Where Altro safety flooring is coved up wall surfaces and other abutments, installation shall be in accordance with Altro safety flooring Installation Guide using the following accessories:
 - 1. Top set cove base: Install in accordance with manufacturer's instructions.
 - 2. Reducer strip - Reducer strip GE25RE/GE35RE where Altro safety flooring will not adjoin other materials or surfaces.

3.6 INSTALLATION - BASE

- A. Fit joints tight and make vertical. Maintain minimum measurement of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- D. Install base on solid backing. Bond tight to wall and floor surfaces.
- E. Scribe and fit to door frames and other interruptions.
- F. Install base at casework where occurs in rooms scheduled for rubber base.

3.7 FIELD QUALITY REQUIREMENTS

- A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - 1. Site Visits: Minimum of one site visit of two hour duration.

3.8 CLEANING

- A. Section 01 74 00 – Cleaning: Final cleaning.

- B. Cleaning: Remove temporary coverings and protection of adjacent work areas.
 - 1. Repair or replace damaged installed products.
 - 2. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
 - 3. Remove construction debris from project site and legally dispose of debris.

3.9 PROTECTION

- A. Cover and protect finished installation from damage from other trades using a non-staining, temporary floor protection system, such as a reusable textured plastic sheeting.
- B. Protection:
 - 1. Protect the newly installed flooring from foot traffic for 24 hours and heavy rolling traffic for 72 hours.
 - 2. Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 22 05 12**PLUMBING PIPE AND FITTINGS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included:
1. Materials, installation and testing of pipe, tubing and fittings.
 2. Refer to Specification Sections for each system medium (i.e., plumbing, hydronics, gas, and the like), for pipe application.

1.02 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping products of types and sizes required.
 2. Welding Qualification: Qualify welding procedures, welders and operators in accordance with ANSI B31.9 for shop and project site welding of piping work.
- B. Manufacturer's Inspection: Inspect flanges, fittings and field applied welds in accordance with manufacturer's standard written quality control procedure in accordance with the following techniques:
1. Visual Method: Comply with MSS SP-55 except as otherwise indicated.
 2. Radiographic (X-Ray) Method: Employ wherever recommended or required for pressurized piping systems.

1.03 SUBMITTALS

- A. Piping Materials List: Provide a typewritten list which schedules the piping materials to be used for each system as a function of applicable nominal pipe size ranges. Arrange schedule in outline form for each specific piping system, e.g., "Domestic Water System," "Soil, Waste, and Vent Piping System," and the like. Include ASTM, ANSI or other numbers and other data as necessary to demonstrate compliance with requirements.
- B. Test Procedure: Submit a typewritten checklist type of testing procedure indicating testing medium (i.e., water, air, nitrogen, and the like), pipe service, pipe and fitting type and classification, test pressure, pass/fail criteria and any other pertinent data.

PART 2 - PRODUCTS**2.01 PIPING - GENERAL**

- A. Provide pipe, tube and fittings of the type, fitting requirements, grade, class, size and weight indicated or required for each service, as indicated in other Division 22 Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

2.02 STEEL PIPE

- A. ASTM A53, Black Welded or Seamless, Grade B: Schedule as specified.

- B. ASTM A135, Electric Resistance Welded, Grade B: Black, unless otherwise indicated, schedule as specified.

2.03 COPPER TUBE

- A. Temper: Annealed (hard drawn).
- B. Water Service: ASTM B88, Type as indicated for each service.
- C. Drain, Waste, and Vent (DWV): ASTM B306.

2.04 CAST IRON PIPE

- A. ASTM A74, hub-and-spigot, service weight.
- B. ASTM A888/CISPI 301 hubless, including coupling assembly.

2.05 FITTINGS FOR STEEL PIPE

- A. General: Flanges, fittings, unions and other products, mark in accordance with MSS SP-25.
- B. Welding Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
- C. Branch Connections: From mains or headers 2-1/2 inches or larger, welded tees or forged welding outlets.
- D. Welding Outlets: "Weldolets" or "Threadolets" equivalent to Bonney Forge. Use forged welding outlets wherever branch line is at least 1 nominal pipe size smaller than local main or header.
- E. Threaded Fittings: ANSI B2.1, ASTM A47, 150 PSI rating, except where otherwise specified, prevailing codes or requirements or Specifications dictate use of 300 PSI rating. Fabricate from standard malleable iron with dimensions conforming to ANSI B16.3.
 - 1. Fitting requirements for galvanized steel piping systems to be the same as for black steel pipe except each to have galvanized coating.
 - 2. Fittings for waste, vent and drainage piping to be drainage pattern type.
- F. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in the USA. Flanges which have been machined, remade, painted, or are nondomestic origin are not acceptable. Provide raised or full face ends wherever indicated or required.
- G. Unions: ANSI B16.39, ASTM A47, and be fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads: ANSI B2.1.
- H. Fasteners: Semi-finished carbon steel bolts and hex nuts conforming to ASTM A307. Threads and Dimensions: ANSI B1.1 and B18.2.
- I. Threaded Pipe Plugs: ANSI B16.14.
- J. Thread Lubricant: RectorSeal No. 5 or Slic-tite Teflon Paste.

2.06 FITTINGS FOR COPPER TUBE

- A. Wrought copper/bronze solder joint fittings complying with ANSI B16.22.
- B. DWV Service:
 - 1. Cast Copper Solder Joint Drainage Fittings: ANSI B16.23.
 - 2. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29.

2.07 FITTINGS FOR CAST IRON PIPE

- A. Hubless Cast Iron Drainage Pipe Fittings: CISPI 301 as manufactured by ABI, Charlotte or Tyler with stainless steel clamp assemblies.
 - 1. Manufacturers for heavy-duty or below grade applications meeting FM-1680: Husky SD4000 or Clamp-All high torque couplings.
 - 2. Manufacturers for standard duty applications: Anaco, Mission, or Tyler.
- B. Cast Iron Hub-and-Spigot Drainage Pipe Fittings: Match drainage pipe units, ASTM A74. Fitting joints: Positive seal compression type gaskets, ASTM C564.

2.08 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Insulating (Dielectric) Unions: ~~Standard units recommended by manufacturer for use in the service indicated, which isolate ferrous from nonferrous piping, and prevent galvanic corrosion action. Minimum rated "flashover" voltage: 600 volts. Watts 3000 Series. Provide insulated flanges for flanged piping system connection to dissimilar metals.~~ **Under no circumstances shall dielectric unions or dielectric pipe nipples be used on heating hot water, domestic and chilled water on piping applications, exterior and interior. To isolate ferrous from nonferrous piping, and prevent galvanic corrosion action, high-grade brass nipples and brass unions at transition points.**
- B. Welding Materials: Comply with Section 2-C of ASME Boiler Code, as applicable.
- C. Tin-Antimony Soldering Materials: ASTM B13.
- D. Gaskets for Flanged Joints: ANSI B16.12; full faced for cast iron flanges; raised face for steel flanges, unless otherwise indicated or recommended by manufacturer. Gaskets: Minimum 1/8-inch thick fabricated from nonasbestos bases.
- E. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-O" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations conform to accepted published procedures, i.e., UPC Installation Standard 3-75 and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited.

2.09 UNIONS

- A. Steel Pipe Union: 150 PSI malleable iron, brass to iron seat, ground joint, black or galvanized to match pipe.
- B. Copper Pipe Union: 200 PSI working pressure. Bronze body, solder or grooved ends. Pipes 2 inches and under use ground joint, pipes 2-1/2 inches and larger use flanged face or grooved ends.
- C. Insulating Unions: 250 PSI working pressure. Pipe ends and material to match piping.

Electric current below 1 percent of galvanic current. Gasket material as recommended by manufacturer. Epcor approved.

2.10 ESCUTCHEONS

- A. Brass material, chrome plated finish. Size sufficient to cover pipe openings through wall, floor or ceiling. Set screw or spring to secure to pipe. Coordinate opening sizes.

2.11 ACCESS PANELS

- A. Provide flush mounting access panels as required for service of cleanouts, valves, and the like, and other items requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum 24x24 (or required and approved size). Wall access panels to be minimum 12x12 (or required and approved size).
- B. Manufacturers: Milcor, Karp, Elmdor, In-Ryko, Acudor, or approved. Provide two keys for each set of locks provided.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms, and other electrical or electronic equipment spaces and enclosures. Within equipment rooms, provide minimum 3 feet lateral clearance from sides of electric switchgear panels. Do not route piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such items.
- B. Installation/Coordination:
 - 1. General: Comply with basic requirements of Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each route with a minimum of joints and couplings, but with adequate and accessible unions or flanges for disassembly, maintenance, and replacement of valves and equipment. Reduce sizes by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance. Comply with ANSI B31.9 Code for Pressure Piping.
 - 2. Installed piping not to interfere with maintenance of equipment, opening of doors or other moving parts nor be directly above or near any portion of electrical equipment.
 - 3. Support piping such that connected equipment and flanges do not bear weight of piping.
 - 4. Adequately support vertical lines at their bases or by a suitable hanger placed in horizontal line near the riser or, preferably, by a base fitting set on a pedestal.
 - 5. Piping not to be suspended or supported by pumps. Apply no force to pumps by connecting pipes. After final pipe adjustments and initial operational verification of the pumps, recheck alignment of pumps and realign as required.
 - 6. Piping systems are to be installed to drain. Provide properly sized drain valves at low points.
 - 7. Ream pipes after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect open ends from foreign matter. Use temporary plugs or other approved methods for opening and closure.
 - 8. Remake or replace defective, leaking or otherwise unsatisfactory joints or material. Peening, caulking, or dopping of piping is not permitted.

9. Install piping to prevent stresses and strains to piping and hangers and supports due to expansion or contraction and building settlement. Provide proper loops, guides, offsets, anchor points, or expansion joints. Verify with anticipated settlement or shrinkage of building. Verify construction phasing of project, type of building construction products and type for coordinating installation of piping systems. Include provisions for servicing and removal of equipment without dismantling piping.
10. Piping Systems Routing Within Unconditioned Spaces, Plenums, Chases, or Cavities:
 - a. Unless absolutely unavoidable, route fluid filled and (or) pressurized piping systems on the "warm" side of local building wall, roof, or ceiling thermal insulation batts, boards, or blankets as near to heated space as practical.
 - b. Whenever such routing as described above is entirely impractical or impossible, provide heat tracing systems to piping, wherever necessary. Inform Architect before proceeding.
11. Expansion and Flexibility: Install work with due regard for expansion, contraction, and building settlement to prevent damage to the piping, ductwork, equipment and the building and its contents. Provide piping offsets, loops, approved type expansion joints, anchors or other means to control pipe movement, to minimize pipe forces and effects of building settlement.
12. Corrosion Control:
 - a. Underground Steel Piping Corrosion Protection: Factory wrap uninsulated underground steel piping systems with protective coating composed of a coal-tar saturated wrapping tape over a 20 mil thick coal-tar epoxy coating, equivalent to "Republic X-Tru-Coat." Wrap joints spirally with a minimum overlap of 1/2 tape width. Extend wrap not less than 3 inches above grade. . Provide tinker test to check for holidays. Provide cathodic protection to meet requirements of NACE Standard RP0169-2002.
 - b. Install hot water heating vessels with a stainless steel fitting at tank and a dielectric fitting on both supply and discharge sides of hot water tanks.
13. Pipe Sleeves:
 - a. Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
 - b. Floor Sleeves (Except DWV Piping at Slab on Grade): Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1 inch above finished floor. Caulk pipes passing through floor with nonshrinking grout or approved caulking compound. Provide "Link-Seal" Type S sleeve sealing system for slab on grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 - c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL approved fire-rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.

14. Conform with applicable codes and industry standards.
 15. Install uninsulated piping so that unrestrained direct contact with the structure or other system installations is avoided. Where contact with or passage through building or structural features cannot be avoided; firmly anchor piping to, or isolated from, the structure to prevent noise transmission and occurrence of physical damage. Install piping to be insulated with adequate clearance around piping to allow for placement of full thickness insulating material.
- C. Pressure Piping Routing:
1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
 2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 3. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch wherever furring is indicated for concealment of piping. Allow for insulation thickness, if any. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
 4. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
- D. Preparation:
1. Cast Iron Soil Pipe: Conform with state plumbing code and standards, CISPI recommendations and applicable adopted code amendments.
 2. Hubless Cast Iron Joints: Comply with CISPI HSN utilizing calibrated torque wrenches for tightening bands to manufacturer's recommended settings.
 3. Unions:
 - a. Insulating (Dielectric) Unions: Comply with manufacturer's instructions for installing unions wherever piping of dissimilar metals are adjoined. Install unions in manner which will prevent galvanic action and inhibit corrosion.
 - b. Standard Unions: Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
 4. Copper Tubing:
 - a. Remove burrs from and clean outer surface of tube ends and inner surface of fittings.
 - b. Copper-Soldered: Make soldered joints for copper tubing and fittings with code approved solder alloys meeting ASTM and ANSI standards and listings. Solder-paste-flux combination fillers are not approved. Installations to conform to accepted published procedures, i.e., UPC IS 375, IS 21-80 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Apply flux as recommended by manufacturer. Allstate Silver Bearing Solder 430 or other approved solder alloys which do not contain lead or cadmium.

- c. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-0" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations to conform to accepted published procedures, i.e., UPC IS 3-75 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Remove bonnets and nonmetallic seats on valves and cool body with damp cloth while soldering or brazing. Remove excess flux from completed joints in accordance with manufacturer's instructions and code standards.
 - d. Copper-Rolled Joints: Pipe ends clean and free from indentations, projections and roll marks in the area from pipe end to rolled area for proper sealing of gasket. Apply a thin uniform coat of nonpetroleum-based lubricant to the gasket, coupling or housing by brush or hand. Place the gasket over one pipe end, the pipe ends aligned and brought together, and the gasket positioned between rolled area and pipe ends. Assemble the coupling housing over the gasket with housing keys engaging both rolled areas. Insert the bolts and nuts started, uniformly tighten until the housing bolt pads are firmly together, metal to metal.
 - e. Pressurized Service:
 - 1) Unless otherwise indicated, wrought copper/bronze solder joint fittings complying with ANSI B16.22.1995.
 - 2) Copper Tube Unions: Standard products as recommended by manufacturer for use in the service. Rated at 150 percent design operating pressure.
 - 3) Mechanically Formed Tee Connections:
 - a) Form mechanically extracted collars in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Fully adjustable collaring device to ensure proper tolerance and complete uniformity of the joint.
 - b) Notch the branch to conform with the inner curve of the run tube and dimpled to ensure penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube.
 - c) Braze joints in accordance with the Copper Development Association Copper Tube Handbook using B-cup series filler metal. Note: Soft soldered joints will not be permitted.
- E. Cross-Linked Polyethylene Tubing and Fittings:
- 1. Tubing Installation Under Concrete Slab:
 - a. Install tubing in excavated ditch below bottom of Concrete slab. Backfill/encase tubing with sand or pea gravel.
 - b. When making 90 degree bends below the slab, use metallic 90 degree bend supports or 90 degree elbows (one size larger than nominal tubing).
 - 2. Tubing Installation Through Wall or Overhead:
 - a. Allow tubing slack of 1/8 to 3/16 inch per lineal foot to accommodate thermal expansion. Do not pull tubing tight during installation.
 - b. Do not rigidly anchor tubing.
 - c. Protect tubing passing through hollow masonry walls or metal studs with sleeves or grommets.
 - d. Protect tubing from nail or screw damage with suitable steel plate protectors.

3. Tubing Supports:
 - a. Use plastic pipe supports or supports designed for use with plastic tubing.
 - b. Place horizontal support every 32 inches for 3/8-, 1/2-, 3/4- and 1-inch tubing.
 - c. Provide vertical support at every floor with a mid-story guide placed between floors.
 4. Joints and Connections:
 - a. Square cut tubing ends, free of burrs or debris, before connection is made.
 - b. Make fittings and connections in compliance with manufacturer's recommendations.
 - c. Make transition joints with manufacturer approved fittings only.
 5. Fire Wall, Floor or Ceiling Penetrations:
 - a. Firestopping system shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 in a configuration that is representative of field conditions.
 - b. Use firestop material compatible with tubing as specified herein.
 6. Fixture Outlet Rough-In: Provide Type "L" copper tube stubout ells and copper stubout brackets.
 7. Inspection and Testing: After completion of any section of the installation, there shall be no visible signs of leakage, cracks, gouges or excess debris.
- F. CPVC (Chlorinated Polyvinyl Chloride) Pipe and Fittings
1. Visually inspect pipe and pipe ends before making a joint. Any damaged pipe ends should be removed. Discard at least 2 inches of pipe beyond any visible cracking.
 2. Use an approved tool to cut pipe. Pipe must be cut square to provide maximum glue bonding area.
 3. Deburr end of pipe.
 4. Use two step glue process, primer and glue. Use an applicator that is approximately one-half the diameter of the pipe being joined. Apply a light, even coating of primer to end of pipe and fitting socket. Apply even coat of cement to end of pipe and fitting socket. Complete the joint by rotating pipe 1/4 to 1/2 turn while inserting the pipe into the fitting, hold in place 5 to 10 seconds. Provide installation per manufacturer's recommendations and code installation standards.
 5. Plastic to Metal (Brass) Transitions: Use only brass threaded female adapters to plastic adapters. Do not over torque. Use Teflon tape as a sealant.
 6. Hang strap pipe/tubing loosely to allow for thermal expansion. Do not use metal straps with sharp edges. Provide hanger/support spacing per manufacturer's recommendations and code installation standards.
 7. Expansion/Contraction: Provide expansion and contraction compensation per manufacturer's recommendations and code installation standards.

3.02 FIELD QUALITY CONTROL

- A. Inspection:
1. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
 2. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect. Remove cracked or dented units and replace with new units.

3.03 ADJUSTING AND CLEANING

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of painting, insulation, or coatings, if any. Comply with the preparation requirements of Section 22 05 53, Identification for Plumbing Piping and Equipment, and Section 22 07 00, Plumbing Insulation, as applicable. Flush out water filled or drainage piping systems with clean water, and flush other piping systems with dry air or nitrogen after completing required tests. Inspect each segment of each system for completion of joints, supports, and accessory items.
- B. Inspection: Inspect pressurized piping in accordance with the procedures of ANSI B31.9.

3.04 PROTECTION

- A. Protect piping from damage. Replace damaged items with new.

3.05 ESCUTCHEONS

- A. Install on exposed pipes passing through walls or floors, and on fixture stops and waste connections to wall.

3.06 ACCESS PANELS

- A. Install wall and ceiling access panels to provide access to concealed valves, fans, motors, shock arrestors, coils and other mechanical items needing service. Provide access panels at locations required or specified herein. Coordinate locations/sizes of access panels with Architect prior to work.

END OF SECTION

SECTION 23 31 00**DUCTWORK****PART 1 - GENERAL****1.01 SUMMARY**

- A. Materials, installation and testing of HVAC ductwork and accessories, including the following:
 - 1. Heating and air conditioning supply and return systems.
 - 2. Outside air systems.
 - 3. Exhaust systems.
 - 4. Ductwork hangers.
 - 5. Plenums.

1.02 QUALITY ASSURANCE

- A. Unless otherwise noted, where the Specification refers to SMACNA in reference to sheet metal or flexible ductwork, this refers to HVAC Duct Construction Standards, Metal and Flexible, latest edition, as published by SMACNA.
- B. Unless otherwise noted, where the Specification refers to TIMA in reference to fiberglass ductwork, this refers to Fibrous Glass Duct Construction Standards, latest edition, as published by TIMA.
- C. Provide duct systems per CMC, latest edition, and all referenced standards.
- D. Have available at the project field office a copy of the referenced standards.

1.03 SUBMITTALS

- A. Provide shop drawings for duct materials, flues.
- B. Submit duct pressure testing reports. Provide individual reports for each AHU duct system.

1.04 AIR DISTRIBUTION DUCT SYSTEM

- A. General: All ductwork, including collars, register boxes, fire dampers, exhaust fans, ventilation louvers, roof vents and screens, as well as all dampers and any other miscellaneous items not specifically mentioned but necessary for a complete installation. Apply the latest standards of SMACNA and ASHRAE with respect to sheet-metal gauge and general construction for round and rectangular ducts.

PART 2 - PRODUCTS**2.01 GALVANIZED SHEET-METAL DUCTWORK**

- A. General: CMC ~~IMG~~ Duct Construction Standards, latest edition, or latest edition of ASHRAE Guide Table. 1-1/2 ounce galvanizing per square foot, both sides.

2.02 FLEXIBLE DUCTS

- A. General: Comply with CMC, latest edition, Class 0 or Class 1.

- B. Standard factory fabricated product, construct an inner wall of impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix. Cover the assembly with fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier. UL 181 listed Class 1 flexible air duct material. Overall thermal transmission no more than 0.25 (BTU/in)/(hr/sq.ft./deg. F) at 75F differential, per ASTM C335. Vapor transmission value no more than 0.10 perm, per ASTM E96. Rated for a minimum of 4-inch w.g. positive pressure and 1-inch w.g. negative pressure.
- C. Air friction correction factor of 1.3 maximum at 1000 FPM. Working air velocity of at least 2000 FPM. Flame spread rating no more than 25. Smoke development rating no more than 50 as tested per ASTM E84. Must have cataloged data on insertion loss characteristics, minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter and 500 Hz.
- D. Manufacturers: J. P. Lamborn Co., Norflex, Clevaflex, Genflex, Atco, Flexmaster, Thermaflex, or approved.

2.03 FACTORY FABRICATED METAL ROUND AND FLAT OVAL DUCTWORK

- A. General: Provide per CMC Duct Construction Standards, latest edition, and ASTM A527 Class 0. Round sheet metal, spiral lock seam type. Fittings: Same construction as the duct. Tap in fittings not allowed. Duct sealer: Specifically formulated for sealing field joints for round spiral lock-seam duct systems.

2.04 SHEET-METAL DUCT SEALER

- A. Hardcast "Duct-Seal 321" or United McGill. Indoor/outdoor, low VOC (<20 GPL), water based with fiber reinforcement.

2.05 PREFABRICATED DUCT JOINTS

- A. Manufactured flanged traverse rectangular and round duct joints.
- B. Manufacturers: Ductmate, Mez, Ward Duct Connectors, Lockformer TDC, or approved.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout as required to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, such alterations not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or run as shown on the Contract Drawings. Make such determination by Architect. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.
- B. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings construction per SMACNA.
- C. Connect duct assemblies such as ductwork, plenums, etc., and operating machines or mechanisms such as fans, air conditioners, etc., with flexible connections per Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.

- D. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
- E. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
- F. Install single thickness turning vanes in square throat rectangular elbows and in tees. Provide 3/4-inch trailing edge on turning vanes, turned slightly past parallel to the duct.
- G. Duct sizes indicated are free inside dimensions including where internal lining is shown.
- H. Provide galvanized sheet-metal duct material for all ducts unless otherwise indicated or specified.
- I. Provide temporary closures of open ducts during construction to prevent dust and debris from entering the system.
- J. Flexible Duct:
1. Install flexible duct with bend radius equal to 1.5 times the diameter. Minimum length 2 feet. Maximum length 5 feet, unless noted otherwise.
 2. Provide round neck grilles/diffusers or square-to-round transitions. No flex duct connections directly to square neck allowed.
 3. Flex duct allowed only for vertical drops to diffusers. Maximum offset angle from vertical: 30 degrees.
 4. Approved for use on supply ducts only; not allowed for return or exhaust.
 5. Flex duct allowed in concealed spaces above lay-in ceilings only.
- K. Fabricate ductwork and all sheet metal work of prime grade, lock forming quality steel in accordance with the current issues of the ASHRAE "Guide" and SMACNA standards and installed in strict conformance with SMACNA standards.
- L. Submit shop drawings for approval for all ductwork. All ductwork to be sheet metal, ~~unless specifically authorized as ductboard or other material.~~
- M. Construct ductwork upstream of VAV boxes for [4]-inch pressure class; downstream duct [1]-inch pressure class. All other duct [2]-inch pressure class.
- N. Round spiral duct and fittings or where required due to available clearances, use flat oval ductwork and fittings upstream of terminal units manufactured by United Sheet Metal, Rolok or approved in accordance with ASTM A527.
- O. Seal all joints and seams in supply, exhaust, and return air ductwork and plenums.
- P. Fabricate ductwork and plenums with a smooth inside surface and support and brace to prevent sagging and vibration at any time. Provide galvanized steel angles for reinforcing and bracing.
- Q. Joints:
1. Carefully cut and trim all joints and seams in fabricated ducts and fitting to form a closed joint with no portion of the duct or fitting protruding into the air stream.
 2. Seal all joints in sheet-metal ducts in concealed locations (such as enclosed ceiling spaces) with Hardcast joint sealant system applied in accordance with manufacturer's recommendations, or use Ductmate-type joints.
 3. Seal all joints in sheet-metal ducts in exposed locations with sealant system applied in accordance with manufacturer's recommendations. Wipe off excess sealer on duct to give a clean finish, or use Ductmate-type joints.
 4. ~~To connect sheet-metal ductwork to fiberglass ductboard, use Hardcast only.~~

5.4. Standard gray duct tape not allowed.

- R. All fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
- S. Crimp flat duct surfaces diagonally or beaded regardless of size, unless acoustically lined.
- T. Fabricate all duct size transitions with a slope of not more than 1 foot to 5 feet where possible, but in no case more than 1 foot in 3 feet.
- U. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width. Where necessary, square elbows may be used, with maximum available inside radius and with fixed single thickness curved vanes, with trailing edge extended 3/4 inch.
- V. Provide flexible connectors at connections to all equipment, in ducts crossing building expansion joints and may be used at connections of dissimilar metals. Flexible Connections: Minimum 16 ounce airtight "Ventglass" noncombustible fabric with fire retardant neoprene coating on outside, fastened with bolted galvanized steel bands. Maintain a minimum 1-inch space between the connecting surfaces.
- W. Duct Hangers and Supports:
1. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 sq.ft. with galvanized strips of No. 16 USS gauge steel 1 inch wide, and all larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at 8 feet on center, as detailed.
 2. Anchor all ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps to roof deck. Do not support ducts from other ducts or piping.
 3. For round sheet-metal ducts, provide duct support in accordance with SMACNA Guidelines. Verify type of building construction.
 4. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.
 5. Do not install duct stiffeners on interior (air side) of unlined ductwork; install on exterior only or on interior of ductwork with duct liner.
 6. Seismic Restraint: Brace all ductwork against lateral movement as detailed in document "Seismic Restraint Manual Guidelines for Mechanical Systems" as published by SMACNA.
- X. Ductwork not to be supported from the roof deck. Hang ducts from beams, joists or supplementary structural members ~~provided by Contractor~~. Do not hang ductwork from joist bridging or from other ducts.
- Y. Although not necessarily indicated on the Drawings, provide turning vanes at all mitered elbows, opposed blade balancing dampers with locking quadrants at branch ducts, volume extractors and any other applicable devices necessary for minimum duct resistance and proper system air balancing. Sufficiently stiffen all dampers to prevent noise or vibration and in no case be lighter than 20 gauge steel. Provide with accessibly located adjuster, manufactured by Young Regulator Co., Parker Kalon Corporation, or approved.
- Z. Construct all exterior ductwork or ductwork which is otherwise exposed to weather watertight.
- AA. Increase the size of all sheet-metal ducts as required to accommodate insulation lining.

- BB. Locate access doors in ductwork as required for service of fire dampers, automatic dampers and other items requiring maintenance or inspection.
- CC. Paint inside surface of all bare ductwork which is visible through face of grilles with flat black paint ~~for all ceilings 12 feet and lower.~~

3.02 DUCTWORK PRESSURE TESTING

- A. Provide air pressure testing of concealed ductwork systems (testing is not required for ductwork exposed to air conditioned space). Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved.
 - 1. Test at positive static pressure for 5 minutes with maximum air leakage not to exceed 1 percent of rated flow.
 - 2. Testing machine: Meet requirements of SMACNA standards. Pacific Air Products "Port-O-Lab," Rolok, United Sheet Metal, or approved.
 - 3. Test supply systems prior to connecting VAV boxes.
 - 4. Perform all tests in the presence of Owner's Representative. Give 48 hours advance notice before commencement of each test.
 - 5. Test ductwork systems in sections as large as possible and record all test results according.
 - 6. Coordinate testing with ceiling installation.
 - a. Provide sheet-metal plates and install between each duct test section (applies to main-to-main fittings, branch-to-branch fittings and main-to-branch fittings). At each plate location, fabricate joint with Ductmate. Insert 14 gauge sheet metal between Ductmate using a neoprene gasket on both sides of metal plate.
 - b. Leave plates in place until isolated section has been tested and approved by Owner's Representative.
 - c. Once sections have passed test, remove plates and reattach Ductmate joints. After fan unit is running, test joint for leakage by using a mixture of soap and water. If any noise or bubbling occurs, reseal joint. Owner's representative to witness this procedure.
 - 7. Test duct at 1-1/2 times the design air pressure. Seal any audible leaks.

3.03 MOUNTING FOR SIDEWALL GRILLES AND REGISTERS

- A. All mounting heights indicated on Drawings from finish floor to lower edge of grille or register. Exception: If note on Drawings states for example "Down 6 inches," this indicates measurement from ceiling to top edge of grille or register.
- B. Install all sidewall return air grilles for "sight-tight" visibility at eye level (position blades to obscure visibility from floor level).

3.04 GRILLE AND EXPOSED DUCT CLEANING

- A. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out all accumulation of particles from grilles and diffusers prior to acceptance.
- B. Clean exterior surface of all ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured condition.

- C. All exposed duct and grilles shall remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

END OF SECTION

SECTION 23 21 05**HYDRONIC PIPING SYSTEMS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials, installation, and testing of:
1. Pipes and pipe fittings for chilled water, heating water, and drain valves.
 2. Valves.
 3. Hydronics specialties, including the following:
 - a. Manual air vent valves.
 - b. Automatic air vent valves.
 - c. Automatic flow control valves.
 - d. Pressure independent valves
 - ~~e.~~ Gauges.
 - ~~f.~~ Instrument probe fittings.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of components of types and sizes required.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe, pipe fitting, valve, hydronic specialty, chemical, and component.
- B. Submit Piping Schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- C. Maintenance Data: Submit maintenance data and parts list for all components. Include this data, product data, and certifications in maintenance manual.
- D. Certificates of Compliance: Submit letters of certification stating that the piping as submitted per the Piping Schedule is in compliance with the standards of compliance as specified.

1.04 PRODUCT HANDLING

- A. Provide factory applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage, and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Store components inside and protected from weather.
- C. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, weatherproof wrapping.
- D. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packing with durable, waterproof wrapping.

PART 2 - PRODUCTS**2.01 PIPE AND FITTINGS**

- A. General: Provide pipe, tube and fittings of the type, fitting requirements, grade, class, size and weight indicated or required for each service. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards. All piping in a given size range of same type.
- B. Service:
1. Chilled Water (Above Grade):
 - a. Pipe Sizes 2-1/2 Inches and Larger:
 - 1) Steel, black, Schedule 40 with welded, flanged, or grooved Victaulic.
 - 2) Copper tubing, Type K or L, with brazed fittings, or grooved Victaulic.
 - b. Pipe Sizes 2 Inches and Smaller:
 - 1) Steel, black, Schedule 40 with welded or threaded fittings.
 - 2) Copper tubing, Type K or L, with soldered fittings (95/5 solder).
 - 3) Pressfit system.
 2. Heating Water (Above Grade):
 - a. Pipe Sizes 2-1/2 Inches and Larger:
 - 1) Steel, black, Schedule 40 with welded, flanged.
 - 2) Copper tubing, Type K or L, with brazed fittings.
 - b. Pipe Sizes 2 Inches and Smaller:
 - 1) Steel, black, Schedule 40 with welded or threaded fittings.
 - 2) Copper tubing, Type K or L, with soldered fittings (95/5 solder).
 - 3) Pressfit system.
 3. Drain Pipe:
 - a. Steel, black, Schedule 40, threaded fittings.
 - b. Copper tubing, M, soldered fittings (95/5 solder).
- C. Steel Drain Pipe: ASTM A53, Schedule 40, Galvanized or black.
- D. Copper Tube - Temper: Provide Type "K" hard drawn temper unless otherwise directed.

2.02 VALVES

- A. General: Provide end connections which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is installer's option.
- B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

2.03 MANUAL AIR VENT VALVES

- A. Manufacturers: Armstrong, Bell & Gossett, Hoffman, Spirax Sarco, or approved.
- B. Operated manually with screwdriver or thumbscrew, 1/8-inch NPS or 1/4-inch NPS connection as required.

2.04 AUTOMATIC AIR VENT VALVES

- A. Manufacturers: Taco Hy-Vent, Bell & Gossett, Hoffman, or approved for branch lines. Hoffman 78 or approved at air separators, mains, in mechanical rooms.

- B. Float type with pressure rating equal to or greater than the system in which it is installed.

2.05 AUTOMATIC FLOW CONTROL VALVES

- A. General: Pressure independent design, constructed to provide constant flow over a range of differential pressures, with field adjustable control point.
- B. Accuracy: Plus or minus 5 percent.
- C. Flow Characteristic. Smooth, continuous curve, void of abrupt changes over the entire range of operation.
- D. Construction: Brass body, EPDM O-ring seals, abrasion resistant and non-corrosive thermoplastic cartridge, 1/8-inch pressure ports.
- E. Flow adjustment: External adjustment via removable key and numeric dial indicator. Indicator reading to match manufacturer's data chart for calibration and flow reading.
- F. Pressure/Temperature Rating: 230 PSIG/248F.
- G. Manufacturer: Griswold Flowcon SH or approved.

2.06 STRAINERS

- A. Manufacturers: Mueller, Armstrong, Keckley, Hoffman, Hayward, Wheatley, or approved.
- B. General: Full line size strainers with ends matching connecting piping materials, machined screen seats, gasketed cap, blow off outlet, minimum 2-1/2 to 1 open area ratio, and Type 304 stainless steel screens with 1/16-inch diameter holes.
- C. Y-Strainers:
 1. Copper Pipe Installations: Mueller 352-1/2.
 2. Steel Pipe Installations: Mueller 11.

2.07 THERMOMETERS

- A. Manufacturers: Ashcroft, Trerice, Weiss, Palmer, Marshaltown, Weksler, or approved.
- B. 3-inch diameter bimetal dial thermometer, stainless steel case, white dial, black numbers, 4-inch stainless steel stem, brass separable socket. Back or bottom connections as required.

Service	Range
Heating Water	50 to 300F
Chilled Water	0 to 120F
Condenser Water	50 to 150F

2.08 THERMOMETER WELLS

- A. Manufacturers: Same as thermometers.
- B. Brass or stainless steel, pressure rated to match piping system design pressure. Provide extensions for insulated piping of length required to extend above insulation used at each location. Provide cap nut with chain fastened permanently to thermometer well.

2.09 PRESSURE GAUGES

- A. Manufacturers: Amtek/U.S. Gauge, Ashcroft, Palmer, Marshalltown Instruments, Terrice, Weiss, Weksler, or approved.
- B. Type: General use, 1 percent accuracy, ANSI B40.1, Grade A, phosphor bronze bourdon type, bottom connection.
- C. Case: Drawn steel or brass, glass lens, 4-1/2-inch diameter.
- D. Connector: Brass with 1/4-inch male NPT.
- E. Scale: White coated aluminum, with permanently etched markings.
- F. Range:
 - 1. Pump Suctions: 30-inch Hg - 60 PSI.
 - 2. Water: 0 - 100 PSI.

2.10 INSTRUMENT PROBE FITTINGS

- A. Manufacturers: Pete's Plug, or approved.
- B. Brass or stainless steel body and cap, high pressure rated, valve material neoprene, Nordan or Viton to suit temperature range, 1/4 inch or 1/2-inch NPT tailpiece.

2.11 EXPANSION JOINTS

- A. Manufacturers: Flexonics, Mason Industries, Amber-Bush, Metraflex, or approved.
- B. Furnish and install controlled flexing expansion joints where shown or required. Expansion Joints: Minimum of 150 PSI working pressure.
- C. For copper piping, 3/4 inch through 3 inches, use Type HB, 1-3/4-inch traverse two-ply stainless steel bellows, traveling nipple extended through bellows and guided each end, integral shroud, screwed steel ends.
- D. For steel piping, 1-1/2 inches through 8 inches externally pressurized. 4-inch traverse, 150 PSI working pressure, stainless steel bellows, 150 PSI flanged ends, furnish insulation shroud.

2.12 PIPE GUIDES

- A. Manufacturers: Flexonics "Flexon," Mason Industries, Amber-Bush, Metraflex, or approved.

2.13 PIPE ANCHORS

- A. Manufacturers: Flexonics, Mason Industries, Amber-Bush, Metraflex, or approved.

2.14 ACCESS PANELS

- A. Provide flush mounting access panels as required for service of fire dampers, cleanouts, valves, and the like, and other items requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum 24x24 (or required and approved size). Wall access panels to be minimum 12x12 (or required and approved size).

- B. Manufacturers: Milcor, Karp, Elmdor, In-Ryko, Acudor, or approved. Provide two keys for each set of locks provided.

PART 3 - EXECUTION

3.01 HYDRONICS SPECIALTIES INSTALLATION

- A. Manual Vent Valves: Install on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated. Provide manual vents of 1/8 inch in size in pipes through 2 inches in diameter, and vents of 1/4 inch size in pipes 2-1/2 inches and larger.
- B. Installation of Temperature Gauges:
 - 1. Install in vertical upright position, tilted so as to be easily read at floor.
 - 2. Glass Thermometers: Install at the following locations, and elsewhere as indicated: At inlet and outlet of each hydronic coil.
 - 3. Thermometer Wells: Install in piping in vertical upright position. Fill well with oil or graphite, secure cap.
- C. Installation of Pressure Gauges:
 - 1. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.
 - 2. Locations: Install in the following locations, and elsewhere as indicated:
 - a. Provide at inlet and outlet of each hydronic coil.
- D. Expansion Joints: Provide where required to allow pipe expansion due to thermal stresses. Provide locations per manufacturer's recommendations. Provide a pipe guide on each side of each expansion joint, located per manufacturer's recommendations. Provide guides in addition to all other pipe supports and hangers. Do not use guides in lieu of supports or hangers required per Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.

3.02 AIR VENTS

- A. Automatic: Furnish and install automatic air vents at all high points of the water systems and as otherwise required. Vents: 3/4 inch with 1/2-inch IPS drain piping to the nearest floor drain or other approved location. Provide a gate valve and union ahead of all automatic air vents.
- B. Manual Vents (Where no Floor Drain or other Acceptable Location Exists): Provide 10-inch length of 1/4-inch copper tube with 180 degree bend down to discharge into hand-held bucket.

3.03 GAUGE ADJUSTING AND CLEANING

- A. Adjust faces of meters and gauges to proper angle for best visibility.
- B. Clean windows of meters and gauges and factory finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.04 PIPE TEST

- A. General:
 - 1. Make all tests in presence of Architect or authorized representative.
 - 2. Make test before pipes are concealed.

3. Fill system and remove air from system at least 24 hours before test begins.
 4. Correct leaks in screwed fittings by remaking the joint. Cut out and reweld leaks in welded joints; caulking is not permitted.
- B. Water Piping: Apply test pressure 125 PSI and maintain for 1 hour with no visible leaks and no appreciable drops after the test pump has been disconnected.

3.05 PIPE GUIDES

- A. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
- B. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of all expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

3.06 PIPE ANCHORS

- A. Furnish and install pipe anchors where shown or required to prevent pipe movement. If fabricated, construct anchors of steel plate, 3/4-inch minimum thickness, securely welded to pipe with two steel plates, stiffeners and bolted to structure.

3.07 ACCESS PANELS

- A. Install ceiling or wall access panels to provide access to concealed valves, fans, motors, fire dampers, terminal units, coils and other items needing service. Provide access panels at locations required or as specified herein. Coordinate locations/sizes of access panels with Architect prior to work.

~~B. Where access panels are for service of fire, fire/smoke, or smoke dampers, stencil the words "Fire Damper," "Fire/Smoke Damper," or "Smoke Damper" in 1/2-inch-high capital letters on the outside of the panels.~~

END OF SECTION

SECTION 23 09 13**VARIABLE FREQUENCY DRIVES****PART 1 - GENERAL****1.01 SUMMARY**

- A. Materials and installation for a complete adjustable frequency motor drive consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor. Design drive specifically for variable torque applications.
- B. Variable Frequency Drive (VFD): Provided by Section **“Controls.” 22 55 00.**

1.02 QUALITY ASSURANCE

- A. It is required that the drive manufacturer have an existing:
 - 1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
 - 2. An independent service organization.
 - 3. A parts stocking depot local to the installation site.
- B. Manufacturers: A firm engaged in the production of this type of equipment for a minimum of 10 years.
- C. Referenced Standards:
 - 1. IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - 2. UL 508, Industrial Control Equipment.
 - 3. NEMA: ICS 6, Industrial Controls and Systems Enclosures.
 - 4. IEC 801-2, 801-4, 255-4.
- D. Testing: Test all printed circuit boards and bummed in before being assembling into the completed VFD. Subject VFD to a preliminary functional test, minimum 8-hour burn-in, and computerized final test at 104F (40C), at full rated load.
- E. Qualifications:
 - 1. VFDs and options to be UL listed as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
 - 2. C-UL listed or CSA approved.

1.03 SUBMITTALS

- A. Include the following information:
 - 1. Outline dimensions.
 - 2. Weight.
 - 3. Typical efficiency versus speed graph for variable torque load.
 - 4. Compliance to IEEE 519, harmonic analysis for job site including total voltage harmonic distortion and total current distortion.
 - a. Provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5 percent size. Input line filters provided as required by VFD manufacturer to ensure compliance with IEEE Standard 519.
 - b. Prior to installation, provide the estimated total harmonic distortion (THD) caused by the VFDs. Based results on a computer aided circuit

- simulation of the total actual system, with information obtained from the power provider and the user.
- c. If the voltage THD exceeds 5 percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.04 WARRANTY

- A. Warranty ~~12-24~~ months from the date of certified start-up. Include all parts, labor, travel time, and expenses.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

- A. **Each VFD shall be configured to communicate through the local area network utilizing protocol compatible with the computerized building automation and control system, see section 255 55 00.**
- B. **The points shown on control drawings schematic shall be hardwired.**
- C. **All VFDs to have a complete factory wired bypass system consisting of an output contactor and bypass contactor.**
- D. **All VFDs are provided by the BMS contractor**
- E. **The drive manufacturer shall supply the drive and all necessary controls as herein specified. Alternate manufacturers of VFDs other than the basis of design shall be prior approved by Owner's Representative and comply fully with these specifications. Approval does not relieve supplier of specification requirements, except where request for submittal to Owner's Representative identifies specifically any variances from these specifications. Alternate manufacturers of VFDs require Owner's Representative's written approval.**
- F. **Specific electrical requirements (i.e., horsepower and electrical characteristics, etc.) are specified within the individual equipment specification sections and as scheduled on the drawings.**
- G. **All VFDs shall be provided by the BMS contractor unless otherwise noted on drawings. The drives shall be programmed per the specification and Sequences of Operation and start-up performed by the drive manufacturer's representative. The drive manufacturer's representative shall provide all necessary assistance to the Division 25 55 00 contractor in connecting the drive to the control network, mapping the control points, data transfer, installation and start-up commissioning.**
- H. Design: Solid state, with a Pulse Width Modulated (PWM) output waveform enclosed in a NEMA 1 enclosure, completely assembled and tested by manufacturer. Employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device drive efficiency: 97 percent or better at full speed and full load. Fundamental power factor: 0.98 at all speeds and loads. Unit designed to feed two motors simultaneously.
- I. Specifications:
1. Input 440/450/480/500VAC plus or minus 10 percent (capable of operation to 550VAC), 3 phase, 48 to 63Hz or Input 208/220/230/240VAC plus or minus 10 percent, 3 phase, 48 to 63Hz.

2. Output 0 - Input Voltage, 3 phase, 0 to 500Hz for drives up to 75 HP; 0 to 120Hz for drives over 75 HP.
3. Environmental Operating Conditions: 0 to 40C at 3kHz switching frequency, 0 to 3300 feet above sea level, less than 95 percent humidity, noncondensing.
4. Enclosure rated Type 1.

J. Standard Features:

1. Provide all VFDs with the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control (start/stop, forward/reverse, and speed adjust), for setting all parameters, and for stepping through the displays and menus.
2. Fault Mode on Loss of Input:
 - a. Displaying a fault
 - b. Running at a programmable preset speed as selected by user.
3. Utilize English digital display (code numbers are not acceptable). Digital Display: A 40 character (2 line by 20 characters/line) LCD display, backlit to provide easy viewing in any light condition, adjustable contrast to optimize viewing at any angle display. All set-up parameters, indications, faults, warnings and other information in words to allow the user to understand what is being displayed without the use of a manual or cross reference table.
4. Utilize preprogrammed application macro's specifically designed to facilitate start-up. Provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
5. Automatic restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts to be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs to count down on the display to warn an operator that a restart will occur.
6. Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
7. Automatic extended power loss ride-through circuit.
8. Customer terminal strip isolated from the line and ground.
 - a. Prewired three-position Hand-Off-Auto switch and speed potentiometer. When in "Off" the VFD will be stopped. When in "Auto" the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
9. Current Limit Circuits to Provide Trip Free Operation:
 - a. Slow current regulation limit circuit adjustable to 125 percent (minimum) of the VFDs variable torque current rating. Adjustment made via the keypad, and displayed in amps.
 - b. Rapid current regulation limit adjustable to 170 percent (minimum) of the VFDs variable torque current rating.
 - c. Current switch off limit fixed at 255 percent (minimum, instantaneous) of the VFDs variable torque current rating.
10. Overload Rating: 110 percent of its variable torque current rating for 1 minute every 10 minutes, and 140 percent of its H torque current rating for 2 seconds every 15 seconds.
11. DC Line Reactor to reduce the harmonics to the power line.
12. Optimized for a 3 kHz carrier frequency to reduce motor noise.
13. Manual speed potentiometer or keypad as a means of controlling speed manually.

K. Adjustments:

1. Five programmable critical frequency lockout ranges.
2. PI Setpoint controller.
3. Two programmable analog inputs for reference for PI controller. Analog Inputs: include a filters; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal.

4. Six programmable digital inputs for maximum flexibility in interfacing with external devices.
 5. Two programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current.
 6. Two independently adjustable accel and decel ramps. Ramp times adjustable from 1 to 1800 seconds.
 7. The VFD to ramp or coast to a stop, as selected by user.
- L. Display: The following operating information displays to be standard on the VFD digital display.
1. Output frequency
 2. Motor speed (RPM, percent or engineering units)
 3. Motor current
 4. Calculated motor torque
 5. Calculated motor power
 6. Output voltage
 7. Analog input values
 8. Keypad reference values
 9. Elapsed time meter
 10. kWh meter
- M. Protection Circuits: In the case of a protective trip, stop the drive and announce the fault condition.
1. Overcurrent trip 315 percent instantaneous (225 percent RMS) of the VFDs variable torque current rating.
 2. Overvoltage trip 130 percent of the VFD's rated voltage.
 3. Undervoltage trip 65 percent of the VFD's rated voltage.
 4. Overtemperature plus 70C (ACH 501); plus 85C (ACH 502).
 5. Ground Fault either running or at start.
 6. Adaptable Electronic Motor Overload (I2t).
- N. Speed Command Input Via:
1. Keypad.
 2. Two analog inputs, each capable of accepting a 0 to 20mA, 4 to 20mA, 0 to 10V, 2 to 10V signal. Analog inputs programmable filter to remove an oscillation of the reference signal. Minimum and maximum values (gain and offset) adjustable within the range of 0 to 20mA and 0 to 10V.
- O. Accessories:
1. Door interlocked thermal magnetic circuit breaker disconnect handle, through-the-door type, and padlockable in the "Off" position.
 2. Fire alarm system control interlocks for "seize control" and "on/off."
 3. Two motor winding thermistor inputs to shut drive down if either motor registers overload.
 4. Refer to Division 28 fire alarm drawing for connection details.
 5. Fused disconnects for each motor.
 6. Trouble output contact.
 7. Output filter to provide for wave shaping.
 8. Provide 5 percent impedance 3 phase line reactor on the input side of the VFD.
- P. Manufacturers: Siemens, General Electric, Danfoss, Yaskawa, Mitsubishi, ABB, or approved.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordinate with installers of power and control wiring.
- B. **Installation shall be the responsibility of the Division 25 55 00 contractor. Install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.**
- C. **Power wiring shall be completed by a licensed electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual. Existing motor contactors shall be removed from MCC and existing HOA switches shall be removed and blanked off. Existing smoke shutdown wiring shall be relocated to safety shutdown terminal strip of VFD.**

3.02 START UP

- A. Provide certified factory start-up for each drive by a factory-authorized service center. Provide a certified start-up form for each drive.
- B. Test unit operation in all modes of operation.

END OF SECTION

SECTION 23 07 00**HVAC INSULATION****PART 1 - GENERAL****1.01 SUMMARY**

- A. Piping and Equipment Insulation: Materials and installation of insulation, jackets and accessories for the following applications:
 - 1. Chilled water piping systems.
 - 2. Heating water piping systems.
- B. Ductwork Insulation: Materials and installation of duct insulation including the following applications: Air conditioning and heating ductwork.

1.02 QUALITY ASSURANCE

- A. Qualification of Workers: Use proficient journeyman insulators and supervisors in the execution of this portion of the work to ensure proper and adequate installation of insulation throughout. A firm with at least 5 years successful installation experience on projects with installations similar to that required for this project.
- B. Compliance with Specifications:
 - 1. Whenever required during progress of the work, furnish proof acceptable to the Owner that items installed are equal to or exceed requirements specified for this work.
 - 2. In the event such proof is not available, or is not acceptable to the Owner, the Owner may require the Contractor to remove the item or items and replace with material meeting the specified requirements and to repair damage caused in the removal and replacement, at no additional cost to the Owner.
 - 3. Install per manufacturer's written instructions.
 - 4. As a minimum, comply with appropriate state energy code or other applicable codes.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of insulation, jacket, glue, paint, fitting cover, and accessory. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each piping, equipment and duct system requiring insulation.

1.04 PRODUCT HANDLING

- A. Protection: Use means necessary to protect insulation materials before, during and after installation.
- B. Replacements: In the event of damage, immediately make repairs and replacements necessary.

1.05 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a flame spread of 25, fuel contributed of 50 and smoke developed of 50 as tested by ASTM E84 (NFPA 255) method.

- B. Test pipe insulation in accordance with the requirements of UL "Pipe and Equipment Coverings R5583 400 8.15."
- C. Test duct insulation in accordance with ASTM E84 and bear the UL label.

1.06 LINING MATERIALS

- A. Materials to be mold-, humidity-, and erosion-resistant surface that meets the requirements of UL 181.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Piping: Armacell LLC Armaflex, Certainteed, Imcoa, Johns Manville, Knaufl, Nomaco, Owens-Corning, PPG, or approved.
- B. Ductwork: Armacell LLC Armaflex, Certainteed, Johns Manville, Knaufl, Owens-Corning, PPG, or approved.

2.02 TYPE 1, FIBERGLASS PIPE INSULATION

- A. Glass Fiber: ASTM C547; rigid molded, noncombustible.
 - 1. Thermal Conductivity Value: 0.27 at 75F.
 - 2. Maximum Service Temperature: 850F.
 - 3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.

2.03 TYPE 5, PLASTIC PIPE INSULATION

- A. Flexible unicellular polyolefin foam insulation complying to ASTM C534, ASTM E84 (25/50), UL 723 (25/50). Thermal conductivity of 0.24 (BTU/in)/(hr/sq.ft./deg. F) at 75F. Preslit longitudinal seam. Imcoa, or approved.

2.04 TYPE 7, FLEXIBLE FIBERGLASS BLANKET

- A. ASTM C553, Type 1, Class B-2; flexible blanket.
- B. 'K' Value: 0.27 at 75F installed.
- C. Density: 0.75 lb./cu.ft.
- D. Vapor Barrier Jacket: FSK aluminum foil reinforced with fiberglass yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.05 TYPE 8, DUCT LINER

- A. ASTM C1071; flexible blanket.
- B. 'K' Value: ASTM C518, 0.25 at 75F.
- C. Noise Reduction Coefficient: 0.65 or higher based on "Type A mounting."
- D. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM

- E. Adhesive: UL listed waterproof type.
- F. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
- G. Mold-, Humidity-, and Erosion-Resistant Surfaces: UL 181.

2.06 JACKETING

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.
- B. Canvas Jacket: UL listed fabric, 6 oz/sq.yd., plain weave cotton treated with dilute fire retardant lagging adhesive.

~~C. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.~~

~~D. Stainless Steel Jacket: Type 304 stainless steel, 0.010 inch, (smooth/corrugated) finish.~~

2.07 ACCESSORIES

- A. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.
- B. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- C. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide nonwater soluble treatments.

2.08 PIPE FITTING INSULATION COVERS

- A. PVC preformed molded insulation covers. Zeston, or approved.

2.09 DUCT INSULATION ACCESSORIES

- A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.10 DUCT INSULATION COMPOUNDS

- A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Do not apply insulation until pressure testing of the ducts has been completed. Do not apply insulation until the duct has been inspected.

- B. Examine areas and conditions under which duct insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and dry surfaces to be insulated.

3.03 INSTALLATION

- A. Insulation: Continuous through walls, floors, partitions except where noted otherwise.
- B. Piping and Equipment:
 - 1. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that the insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until the piping has been leak tested and has passed such tests. Do not insulate chiller manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
 - 2. ~~Cover insulation on pipes above ground, outside of buildings, with aluminum jacketing. Position seam on bottom of pipe.~~
- C. Ductwork:
 - 1. Install insulation in conformance with the manufacturer's recommendations to completely cover the duct.
 - 2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
 - 3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form a complete unbroken vapor seal over the insulation.
 - 4. Coat staples and seals with vapor barrier coating.
 - 5. Cover breaks in the jacket material with patches of the same material as the vapor barrier. Extend the patches not less than 2 inches beyond the break or penetration in all directions and secure with adhesive and staples. Seal staples and joints with brush coat of vapor barrier coating.
 - 6. Fill jacket penetrations, i.e., hangers, thermometers and damper operating rods, and other voids in the insulation with vapor barrier coating. Seal the penetration with a brush coat of vapor barrier coating.
 - 7. Seal and flash insulation terminations and pin punctures with a reinforced vapor barrier coating.
 - 8. Continue insulation at fire dampers up to and including those portions of the fire damper frame which are visible at the outside of the rated fire barrier. Insulation terminations at fire dampers in accordance with the above.
 - 9. Do not conceal duct access doors with insulation. Install insulation terminations at access doors in accordance with the above.
 - 10. Duct Liners: Install mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with a continuous 100 percent coat of adhesive. For widths over 20 inches, additionally secure the liner with mechanical fasteners 15 inches on center. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Keep duct liner clean and free from dust. At completion of project, vacuum duct liner if it is dirty or dusty. Cut studs off near washers. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

11. Duct Wrap: Cover supply air ducts except ducts internally lined. Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2 inches. Adhere insulation with 4-inch strips of insulating bending adhesive at 8 inches on center. On ducts over 24 inches wide, additionally secure insulation with suitable mechanical fasteners at 18 inches on center. Circumferential and longitudinal joints stapled with flare staples 6 inches on center and covered with 3-inch-wide, foil reinforced tape.

3.04 PROTECTION AND REPLACEMENT

- A. Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

3.05 FIBERGLASS INSULATION

- A. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate the vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
- B. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.

3.06 PIPING SURFACES TO BE INSULATED

Item to be Insulated:	System Type:	Insulation	Pipe Size:	Insulation Thickness:
Aboveground heating and piping.	1, 5		Runouts up to 2" All others	1" 1-1/2"
Chilled, heating water valves.	5		N/A	1"
Aboveground chilled, heating in Mechanical Room	1, 5		<2" 2-1/4 to 6" 6"	1-1/2" 2" 2-1/2"
Condensate drain piping.	1, 5		all	1/2"

Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

3.07 DUCTWORK SURFACES TO BE INSULATED

Item to be Insulated:	System Type:	Insulation	Duct Size:	Insulation Thickness:
Supply ductwork (where duct is not specified to be lined).	7		all	1-1/2"
Supply and return ductwork (in Mechanical Room).	7		all	2"
Supply ductwork (where duct is specified to be lined)	8		all	1"

Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

~~**3.08 INSULATED PIPE EXPOSED TO WEATHER**~~

~~A. Where piping is exposed on roof, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Provide heat tracing on piping subject to freezing.~~

3.093.08 FLEXIBLE ELASTOMERIC TUBING

- A. Slip insulation over piping or if piping is already installed, it should be slit and snapped over the piping. Joints and butt ends must be adhered with 520 adhesive.

3.103.09 INSULATION SHIELDS

- A.B. Provide full size diameter hangers and shields (18 gauge minimum) for cold piping. Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2 inches and larger (~~steam and~~ cold piping).

END OF SECTION

SECTION 23 05 93**TESTING, ADJUSTING AND BALANCING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials, equipment and labor required for testing, adjusting, and balancing work required by this Section, including air, hydronic systems, and associated equipment and apparatus. The work consists of setting speed and volume (flow) adjustments, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

1.02 Scope of work

- A. Testing, adjusting, and Balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by a certified third party independent of the Contractor who specializes in testing, adjusting, and balancing of heating, ventilating, air-moving equipment and hydronic systems and has a minimum of 5 years experience in this specialty.
- B. Make changes or replacements to the sheaves, belts, dampers, valves, etc. required for the correct balance as advised the TAB Firm, at no additional cost to the Owner.
- C. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, provide access as requested by the TAB Firm. Correct equipment malfunction encountered during the balancing process.
- D. Complete TAB services prior to Owner occupancy.

1.03 QUALIFICATIONS

- A. Perform work of this Section by a firm certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC).
- B. Do work of this Section under the direct supervision of a person who has passed written and practical NEBB or AABC examinations for testing, adjusting, and balancing of air and hydronic systems.

1.04 QUALITY ASSURANCE

- A. Codes and Standards:
1. NEBB Compliance: Comply with NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus; or comply with AABC's Manual MN-1, "AABC National Standards," as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.
 2. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting and balancing, except as otherwise indicated.

- B. Personnel: TAB personnel used on the project will be employees of the Test and Balance Agency. Perform TAB work under the direct supervision of the NEBB or AABC Certified Test and Balance Supervisor.
- C. Instrumentation:
 - 1. List in balance report instrument description, serial number, and date of calibration.
 - 2. Use instruments calibrated no longer than 1 year prior to report submission.

1.05 SUBMITTALS

- A. Procedures: Submit certified test reports, signed by TAB supervisor who performed TAB work.
- B. Qualification Statements: Submit company's certification documents including Contractor Certification and Supervisor certification.
- C. Report Forms:
 - 1. Submit copies of report forms to Architect within 30 days of award of the Contract by Owner prior to commencement of testing and balancing work at the site.
 - 2. Provide 8-1/2- by 11-inch paper for looseleaf binding, with blanks for listing the required test ratings and for certification of report.
 - 3. Submit reports on forms similar in content to standard AABC or NEBB test forms.
 - 4. Submit final test and balance report. Include Record Drawings with terminal codes for cross-reference with the Submittal, such that terminals referenced in the Submittal are easily located on the Drawings.
 - 5. Include identification and types of instruments used, and their most recent calibration date.
 - 6. Submit resume data on person who is to directly supervise testing, adjusting and balancing work.
- D. Maintenance Data: Include copies of balancing report and identification of instruments in maintenance manuals.
- E. NEBB or AABC Certificate: At time of submittal of forms, submit NEBB or AABC certification form for review.

1.06 Warranty

- A. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
- B. Warranty shall meet the requirements of the following programs:
 - 1. AABC – National Project Performance Guarantee
 - 2. NEBB – Conformance Certification

PART 2 - PRODUCTS

2.01 PATCHING MATERIALS

- A. Ductwork and Housings: Use plastic plugs with retainers to patch drilled holes.

2.02 INSTRUMENTS

- A. Utilize test instruments and equipment as recommended in the following:
 - 1. NEBB's Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.
 - 2. AABC's Manual MN-1, "AABC National Standards."

PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Perform TAB work with doors, closed windows, and ceilings installed, etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for testing, adjusting and balancing are clean and free from debris, dirt and discarded building materials.
- B. Verify the following:
 - 1. Equipment is operable and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Final filters are clean and in place.
 - 4. Duct systems are clean of debris.
 - 5. Fan rotation is correct.
 - 6. Dampers are in place and open.
 - 7. Access doors are closed.
 - 8. Air outlets are installed and connected.
 - 9. Hydronic Systems have been flushed, filled, and vented.
 - ~~10. Correct pump rotation.~~
 - ~~11.10.~~ Proper strainer baskets are clean and in place.
 - ~~12.11.~~ Service and balance valves are open.
 - ~~13.12.~~ Any conditions affecting system operation, such as open doors, adjacent pressurized areas, and the like, are in final operating conditions prior to testing and balancing.
- C. Report any defects or deficiencies noted during performance of services to Architect and Commissioning Agent. Promptly report abnormal conditions in Mechanical Systems or conditions which prevent system balance.
- D. Automatic Temperature Control Systems:
 - 1. Set and adjust automatically operated devices to achieve required sequence of operations. Coordinate with the automatic temperature control supplier. Do not proceed without his representation.
 - 2. Verify controls for proper calibration and correct as necessary.

3.02 TEST HOLE LOCATIONS

- A. Install test holes at the inlet and outlet of air handling unit fans, exhaust fans, utility fans, and the like, and elsewhere as required to facilitate traverses and to test the air systems. Plug holes when finished. Install test holes in air handlers to obtain test data for each component.

3.03 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, outside, and exhaust air quantities.

- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets. Log shows each successive test.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- G. Adjust fans to deliver within 5 percent of specified flow. Adjust air outlets and inlets to within 10 percent of specified flow. Adjust to obtain balance with minimum fan speed possible.
- H. Adjust fan for variable air volume systems with terminal units at 50 percent cooling airflow, opening terminal units at end of controlling duct run to achieve fan flow specified. Report final duct static pressure setpoint and supply fan and exhaust/return fan VFD speeds and frequencies.
- I. Adjust outside air to fans as scheduled. Measure outside air for variable air volume fans at full flow. Adjust belt driven fan speeds to obtain necessary flow with variable frequency drive at 60 Hertz.
- J. Adjust relief exhaust fans on variable air volume systems to maintain a positive building static pressure of 0.05 inch w.c. Verify and document calibration of building static pressure sensors.

3.04 AIR MOVING EQUIPMENT TESTING

- A. Location.
- B. Manufacturer.
- C. Model.
- D. Supply airflow, specified and actual.
- E. Return airflow, specified and actual.
- F. Outside airflow, specified and actual.
- G. Total external static pressure, specified and actual.
- H. Inlet pressure.
- I. Discharge pressure.
- J. Fan RPM.

3.05 EXHAUST FAN TESTING

- A. Location

- B. Manufacturer.
- C. Model.
- D. Airflow, specified and actual.
- E. Total external static pressure, specified and actual.
- F. Inlet pressure.
- G. Discharge pressure.
- H. Fan RPM.

3.06 RETURN AIR/OUTSIDE AIR TESTING

- A. Identification/location.
- B. Design airflow.
- C. Actual airflow.
- D. Design return airflow.
- E. Actual return airflow.
- F. Design outside airflow.
- G. Actual outside airflow.
- H. Return air temperature.
- I. Outside air temperature.
- J. Required mixed air temperature.
- K. Actual mixed air temperature.
- L. Design outside/return air ratio.
- M. Actual outside/return air ratio.

3.07 ELECTRIC MOTORS TESTING

- A. Manufacturer.
- B. HP/BHP.
- C. Phase, voltage, amperage; nameplate, actual, no load. Record voltage and amperage on all phases of 3 phase motors.
- D. RPM.
- E. Service factor.
- F. Starter size, rating, heater elements.

3.08 V-BELT DRIVES TESTING

- A. Identification/location.
- B. Required driven RPM.
- C. Driven sheave, diameter and RPM.
- D. Belt, size and quantity.
- E. Motor sheave, diameter and RPM.

3.09 DUCT TRAVERSE TESTING

- A. System zone/branch.
- B. Duct size.
- C. Area.
- D. Design velocity.
- E. Design airflow.
- F. Test velocity.
- G. Test airflow.
- H. Duct static pressure.
- I. Air temperature.
- J. Air correction factor.

3.10 AIR DISTRIBUTION TESTING

- A. Air terminal number.
- B. Room number/location.
- C. Terminal type.
- D. Terminal size.
- E. Design velocity.
- F. Design airflow.
- G. Test (final) velocity.
- H. Test (final) airflow.
- I. Percent of design airflow.

3.11 TERMINAL UNIT TESTING

- A. Manufacturer.
- B. Type (i.e., constant, variable, single, dual duct).
- C. Identification/number.
- D. Location.
- E. Model.
- F. Size.
- G. Minimum static pressure.
- H. Minimum design airflow.
- I. Maximum design airflow.
- J. Maximum actual airflow.
- K. Inlet static pressure.
- L. Inlet and outlet temperature with heating valve open.
- M. Coil water pressure drop, inlet and outlet temperatures and flowrate.

~~N. Electric Heater Coil Data: KW, voltage, phase.~~

~~O. Fan airflow for fan-powered terminal units.~~

3.12 DUCT PRESSURE SENSOR (VAV SYSTEM) TESTING

- A. Location.
- B. Static pressure with fan at block load airflow.

3.13 WATER SYSTEM PROCEDURES

- A. Adjust water systems to provide required or design quantities. Use calibrated orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on pressure drop across various heat transfer elements in the system.
- B. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- C. Effect system balance with automatic control valves fully open to heat transfer elements.
- D. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shutoff valves for balancing unless indexed for balance point.

- E. Adjust differential pressure on variable flow systems to minimum value that produces design flows to equipment.

3.14 COOLING COIL TESTING

- A. Identification/number.
- B. Location.
- C. Service.
- D. Manufacturer.
- E. Airflow, design and actual.
- F. Entering air DB temperature, design and actual.
- G. Entering air WB temperature, design and actual.
- H. Leaving air DB temperature, design and actual.
- I. Leaving air WB temperature, design and actual.
- J. Water flow, design and actual.
- K. Water pressure drop, design and actual.
- L. Entering water temperature, design and actual.
- M. Leaving water temperature, design and actual.
- N. Air pressure drop, design and actual.

3.15 HEATING COIL TESTING

- A. Identification/number.
- B. Location.
- C. Service.
- D. Manufacturer.
- E. Airflow, design and actual.
- F. Water flow, design and actual.
- G. Water pressure drop, design and actual.
- H. Entering water temperature, design and actual.
- I. Leaving water temperature, design and actual.
- J. Entering air temperature, design and actual.

- K. Leaving air temperature, design and actual.
- L. Air pressure drop, design and actual.

3.16 ADJUSTING

- A. Recorded data represents actually measured or observed conditions. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops. Adjust air systems to deliver specified volumes with lowest possible fan speed.

3.17 DOMESTIC WATER

- A. Adjust domestic water recirculation system to ensure hot water circulation in mains.

END OF SECTION

SECTION 23 05 53**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials and installation of mechanical systems identification.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
- B. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices, unless otherwise indicated.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2- by 11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.

PART 2 - PRODUCTS**2.01 MECHANICAL IDENTIFICATION MATERIALS**

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Manufacturers: Allen Systems, Inc., W. H. Brady Co., Signmark Division, Industrial Safety Supply Co., Inc., Seton Name Plate Corporation, or approved.

2.02 PLASTIC PIPE MARKERS

- A. Provide one of the following:
1. Snap-on Type: Manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers.
 2. Pressure-Sensitive Type: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive, vinyl pipe markers.
- B. Small Pipes: For external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
1. Snap-on application of pretensioned semi-rigid plastic pipe marker.
 2. Adhesive lap joint in pipe marker overlap.
 3. Laminated or bonded application of pipe marker to pipe (or insulation).

4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.

~~C. Large Pipes: For external diameters of 6 inches and larger (including insulation, if any), provide either full band or strip type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:~~

- ~~1. Laminated or bonded application of pipe marker to pipe (or insulation).~~
- ~~2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.~~
- ~~3. Strapped to pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.~~

~~D.C.~~ Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

~~E.D.~~ Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.03 PLASTIC DUCT MARKERS

- A. General: Manufacturer's standard laminated plastic, color-coded duct markers. Supply separate color codes for supply, exhaust, outside, and return air.
- B. Include the Following Nomenclature:
 1. Direction of air flow.
 2. Duct service (supply, return, exhaust, outdoor air).

2.04 VALVE TAGS

- A. Brass Valve Tags: Polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener. 1-1/2-inch diameter tags, except as otherwise indicated. Valve designations to be coordinated with *existing* valve identifications to ensure no repetitive designations are utilized.
- B. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- C. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include center hole to allow attachment.

2.05 PLASTIC EQUIPMENT MARKERS

- A. General: Manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:
 1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
- B. Nomenclature: Match terminology used on drawing schedules as closely as possible.
- C. Size: Provide approximate 2-1/2- by 4-inch markers for control devices, dampers, and valves; and 4-1/2- by 6-inch markers for equipment.

2.06 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, and intake ductwork with duct markers, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork identification color).
- B. Location: In each space where ductwork is exposed, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.
- D. Dampers: Provide 12-inch, plenum-rated marker ribbon to end of balancing damper handles.

3.03 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on each system and include arrows to show normal direction of flow.
- B. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels and plenums), and exterior nonconcealed locations, in locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.
 - 4. At access doors and similar access points which permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 20 feet along each piping run, except reduce spacing to 10 feet in congested areas of piping and equipment, i.e., mechanical rooms.

3.04 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.
- B. Install mounted valve schedule in each mechanical room.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices: Pumps, compressors, chillers, cooling towers and similar motor driven units, electric duct heaters, terminal units, coils, fans, chillers, boilers, blowers, unitary HVAC equipment, tanks and pressure vessels, filters, water treatment systems and similar equipment.

3.06 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked.
- B. Cleaning: Clean face of identification devices and glass frames of valve charts.

END OF SECTION

SECTION 23 05 48**VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials and installation of seismic restraint devices and related items. Provide complete vibration isolation systems in proper working order.

1.02 CERTIFICATION DATA

- A. Bidders on the air handling devices and fans, and terminal units, ~~and sound attenuators~~ must supply the appropriate inlet, outlet, radiated, discharge, and loss or regenerated octave band sound power level data, measure in accordance with the applicable ASHRAE or ANSI Specifications at a certified laboratory. The units selected should meet the Specification criteria of the tables in this Section and Equipment Schedules on Drawings. Do not consider units in excess of the listed values as appropriate for use on this project.

1.03 SEISMIC CONTROL AND RESTRAINT

- A. Mechanical Equipment:
1. Brace or anchor mechanical equipment to resist a horizontal force acting in any direction using CBC, latest edition.
 2. Vibration Isolated Equipment: Provide factory fabricated seismic restrained vibration isolating components. Earthquake resistant designs for equipment, i.e., air handling units, blowers, motors, ductwork, and mechanical piping, to conform to the regulations of the CBC, latest edition. Where standard factory fabricated components are not available, provide properly designed custom components which meet the requirements herein.
 3. Provide any restraints noted on Drawings for Division 23 work.
- B. Anchorage:
1. Where anchorage details are not shown on Drawings, the field installation subject to approval of the project structural engineer.
 2. In other cases, retain a professional structural engineer licensed in the state in which the work will be done to provide shop drawings of seismic bracing for ductwork/equipment/~~water heaters~~. Professional engineer to design and provide wet stamped (sealed) shop drawings for equipment, ductwork, ~~water heaters~~, and piping seismic bracing. Submit shop drawings and calculations along with equipment submittals.
 3. The restraints which are used to prevent disruption of the function of the piece of equipment because of the application of the horizontal force to be such that the forces are carried to the frame of the structure in such a way that the frame will not be deflected when the apparatus is attached to a mounting base and equipment pad, or to the structure in the normal way, utilizing the attachments provided. Secure equipment to withstand a force in any direction.
- C. Specify the seismic bracing and anchorage of piping in Section "Hangers and Supports for HVAC Piping and Equipment."
- D. Provide earthquake bumpers to prevent excessive motion during starting and stopping of equipment and for earthquake bracing. Install bumpers after equipment is in operation to allow proper placement and alignment and ensure that bumpers are not engaged during

normal system operation.

1.04 RUSTPROOFING

- A. General: Design vibration isolation hardware or treat for corrosion resistance.
- B. Isolators exposed to weather to have steel parts zinc electroplated, PVC coated, plus coating of neoprene or bitumastic paint. Etch aluminum components for outdoor installation and paint with industrial grade enamel.
- C. Nuts, bolts and washers zinc electroplated.
- ~~D. _____ Structural steel bases thoroughly cleaned of welding slag, primed with zinc chromate and finished with two coats of industrial enamel.~~

1.05 ELECTRICAL CONNECTIONS

- A. Make electrical connections to mechanical equipment motors through a flexible conduit designed to reduce motor vibration transfer into the rigid conduit which is directly attached to the building structure.
- B. Flexible Conduit: Sufficiently long to provide a 360 degree loop in the flex between the motor and the rigid conduit. Route conduit through side of equipment roof curb and attaching flexible conduit. Caulk around curb penetration water tight.
- C. Provide a soft neoprene bushing at the connection point between the flex and the rigid conduit to break the metal-to-metal contact.
- D. Ground wires from vibrating equipment to be flexible with sufficient slack to prevent vibration transfer. Ground wires must not directly contact structural membranes (floors, walls or ceilings) of the building.

1.06 QUALITY ASSURANCE

- A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with building systems. Coordinate plan dimensions of final selections and mechanical equipment with size of housekeeping pads.
- B. Supply and install any incidental materials needed to meet the requirements stated herein.

1.07 SUBMITTALS

- A. Provide a complete description of products to be supplied including product data, dimensions and specifications. Provide installation instructions for each product.
- B. Provide a complete tabulation showing for each piece of vibration isolator supporting equipment the following:
 - 1. The equipment identification mark.
 - 2. The isolator type with rated load.
 - 3. The actual load per isolator.
- C. Provide fabrication/shop drawings of steel rails, inertia bases, steel base frames, reinforcing, vibration isolator mounting attachment method, unitary straps and location of equipment attachment bolts.

- D. Provide structural calculations for isolator seismic restraint ~~for equipment including, but not limited to boilers, chillers, cooling towers, heat exchangers, roof curbs, fuel storage tanks, pumps, condensing units, AC units, exhaust fans, storage tanks,~~ sealed by a professional structural engineer, registered in the state of California.

PART 2 - PRODUCTS

2.01 METAL PARTS INSTALLED OUT-OF-DOORS

- A. Cold dip galvanized, cadmium plated or neoprene coated after fabrication.

2.02 SEISMIC RESTRAINTS FOR PIPING AND DUCTWORK

- A. Use the document "Seismic Restraints Manual Guidelines for Mechanical Systems." Secure piping, ductwork, and the like to withstand a force in any direction.
- B. Sway bracing is not required for pipes that are installed on very short hangers (12 inches or less).
- C. Secure piping bracing at every fourth hanger transversely and every eighth hanger longitudinally.
- D. As approved by code authority, use a bracing system manufactured by Superstrut, Mason, or Pipe Shields Inc., or approved.
- E. Design restraints to meet CBC Seismic Restraint requirements. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

2.03 EQUIPMENT

- A. Provide a means to prohibit excessive motion of mechanical equipment during an earthquake.
- B. Provide equipment, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to 0.5 of equipment operating weight.
- C. Design restraints to meet CBC Seismic Restraint requirements. Provide structural engineering calculations sealed by a professional engineer registered in state of California.

2.04 NEOPRENE PAD (NP)

- A. One layer of 5/16-inch thick ribbed or waffled neoprene, 40 to 50 durometer. Size pads for loading between 40 and 50 PSI.
- B. NP Isolators: Amber/Booth type NR.
- C. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., IAC, Koppers, Vibrex.

2.05 FLEXIBLE DUCT CONNECTIONS (FDC)

- A. Neoprene loaded vinyl material or neoprene loaded canvas with vapor barrier. Flame spread rating of 25 or less, and a smoke spread rating of 50 or less, per ASTM E84. Not affected by temperatures as low as minus 10F, or as high as 200F.
- B. Flexible Connections: Ventglas manufactured by Ventfabrics, Amatex, or approved.

2.06 FLEXIBLE PIPE CONNECTIONS (FPC)

- A. Straight, double sphere shape fabricated of multiple plies of nylon cord, fabric and neoprene, vulcanized so as to become inseparable and homogenous. Able to accept compressive, elongative, transverse and angular movements.
- B. Select and fit to suit the system temperature, pressure and fluid type. Do not use rods or cables to control extension of the connector.
- C. Pipe Sizes 2 Inches or Smaller: Threaded female union couplings on each end. Larger sizes: Metallic flange couplings.
- D. FPC: Mason MFTNC.
- E. Manufacturers: Supply vibration isolation mounts by a single manufacturer. Acceptable suppliers are as follows: Amber/Booth Co. - A.B., Korfund Dynamics - K.D., Mason Industries, Inc. - M.I., Peabody Noise Control Inc. - P.N.C., Vibration Mountings & Controls, Inc. - V.M.&C., Metraflex, Vibrex.
- F. Connections to match piping system.

2.07 GROMMETS

- A. Combine a neoprene washer and sleeve.
- B. Isogrommets manufactured by MBPS, Inc.
- C. Series W by Barry Controls, or approved.
- D. Neoprene Durometer: Between 40 and 50. Grommets: Specially formed to prevent fastening bolts from directly contacting the isolator base plate.

2.08 RESILIENT NONHARDENING SEALANT

- A. Sealants for Acoustical Purposes: DAP acoustical sealant.
- B. Manufacturers: Pecra, Tremco, USG, or approved.

2.09 FOAM RUBBER

- A. Foam Rubber Sheets: Armstrong Armaflex, or approved.

2.10 ACOUSTICAL WRAP

- A. Sound barrier material, designed specifically for sound control, apply for duct/pipe lag material, for indoor or outdoor use. 2.54 mm (0.10 inch) thick barium sulfate loaded limp vinyl sheet bonded to a thin layer of reinforced aluminum foil, on one or both sides:
1. Nominal Density: 1.0 lb./ft²
 2. Thermal Conductivity K: 0.29 BTU-in/hr-ft²-0F
 3. Rated service Temperature range: -40F to 220F
 4. Flamespread: 10 (ASTM E84)
 5. Smoke Developed: 40 (ASTM E84)
 6. Minimum STC: 27
 7. Corrosion Resistance: most oil, grease, acids and mid alkalis
- B. Sound Transmission Loss (STC):
- | Frequency | 125 | 250 | 500 | 1000 | 2000 | 4000 | STC |
|----------------------|-----|-----|-----|------|------|------|-----|
| Transmission Loss dB | 15 | 19 | 21 | 28 | 33 | 37 | 2 |
- C. Manufacturers: Kinetic Noise Control, Inc. (KNM-100AL), Thermafiber Industrial Felt, or approved.

2.11 ACCESS PANELS

- ~~A. Provide flush mounting access panels as required for service of fire dampers, cleanouts, valves, and the like, and other items requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum 24x24 (or required and approved size). Wall access panels to be minimum 12x12 (or required and approved size).~~
- ~~B. Manufacturers: Milcor, Karp, Elmdor, In-Ryko, Acudor, or approved. Provide two keys for each set of locks provided.~~

PART 3 - EXECUTION**3.01 APPLICATION**

- A. General:
1. Set floor-mounted equipment ~~with steel base rails~~ on 4-inch-high housekeeping type concrete pads as detailed. Extend pad 6 inches beyond footprint of equipment in each direction.
 2. Install flexible duct connections at fan unit intakes, fan unit discharges, and wherever else shown on Drawings.
 3. Install flexible pipe connections (FPC) at pipe connections to vibration isolated equipment. Included, but not be limited to, air handling units, pumps, chillers, and cooling towers.
 4. Isolate miscellaneous pieces of mechanical equipment, i.e., storage tanks, and expansion tanks from the building structure by NP or HN isolators.
 5. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of the isolated equipment.
 6. Under no circumstances destroy isolation efficiency by bolting the isolators to the roof or floor or equipment. If bolting is necessary, provide rubber grommets and washers to isolate the bolt from the base plate.

7. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from the structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.
 8. Pipe and Duct Hangers in Equipment Rooms: Support water, ~~gas~~ piping and ducts connected to rotating equipment within the equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment to have a minimum of 1/2 the static deflection of that of the equipment isolators. Other isolators should have a minimum of 1/4 the static deflection of that of the equipment.
- B. Drain Service Piping Connected to Vibration Isolated Equipment: Do not contact the building structure or other nonisolated system unless it is resiliently mounted as described above.

3.02 VIBRATION ISOLATION EQUIPMENT INSTALLATION

- A. General: Install vibration isolation equipment in accordance with the manufacturer's written instructions.
- B. Flexible Duct Connections: Squarely align sheet metal ducts or plenum openings with the fan discharge, fan intake or adjacent duct section prior to installation of the flexible connection, so that the clear length is approximately equal the way around the perimeter. Install connections such that the fan unit or adjacent duct section is able to move 1 inch in any direction without causing metal-to-metal contact or stretching taught the flexible connection. Install the connections so that the clear space between ducts is a minimum of 4 inches, and the connection has a minimum of 1-1/2 inches of slack material. Install flexible connections per SMACNA.
- C. Flexible Pipe Connections: Install flexible pipe connections to minimize initial misalignment.
- D. Foam Rubber: Provide foam rubber sheets between fan bases and roof mounted equipment curbs and between rooftop mounted HVAC equipment and their curbs.
- E. Anchorage: Adequately anchor or brace mechanical equipment, piping and ductwork to resist displacement due to seismic action, include snubbers on equipment mounted on spring isolators, chiller, pump, cooling tower, and the like.

3.03 ADJUSTING AND CLEANING

- A. Clean each vibration isolator. Verify that each is working freely, and that there is no debris in the immediate vicinity of the unit that could short circuit unit isolation.

- B. Schedule:

Equipment:	Type:
Duct Connections to AHU	FDC
Air Handler Casings	NP
Pipe Connections to AHU's	FPC

3.04 ACCESS PANELS

- A. Install wall and ceiling access panels to provide access to concealed valves, fans, motors, shock arrestors, fire dampers, terminal units, coils and other mechanical items needing service. Provide access panels at locations required or specified herein. Coordinate locations/sizes of access panels with Architect prior to work.

END OF SECTION

SECTION 23 05 29**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Material and installation of supports, anchors and sleeves including: horizontal piping hangers and supports; vertical piping clamps; hanger rod attachments; building attachments; saddles and shields; miscellaneous metals, miscellaneous materials; roof equipment supports; anchors; equipment supports; wall and floor sleeves; and escutcheon plates.

1.02 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of supports and anchors, of types and sizes required.
- B. Regulatory Requirements:
1. Provide pipe hangers and supports whose materials, design and manufacture comply with MSS SP-58, "Pipe Hangers and Supports - Materials, Design and Manufacture," latest edition.
 2. Select and apply pipe hangers and supports complying with MSS SP-69, "Pipe Hangers and Supports - Selection and Application," latest edition.
 3. A copy of the above-referenced standards on the construction site at all times.
- C. Seismic: Provide per Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Manufacturers: B-Line, Elcen Metal Products Co., F&S Control, Globe, Kindorf, Kinline, Michigan, Superstrut, Unistrut, Power-Strut. Note: See individual Sections for roof equipment support.

1.03 SUBMITTALS

- A. Submit the following:
1. Manufacturer's technical product data, including installation instructions, for each type of support, anchor and sleeve. Include UL approval drawing from manufacturer for each different pre-engineered firestop assembly.
 2. Assembly type shop drawings for each type of sleeve, indicating dimensions, weights, required clearances, and methods of assembly of components.
 3. Shop drawings for each individual roof pipe curb assembly, indicating number and location of each pipe or conduit which is to pass through the curb. Indicate pipe insulation requirements.

PART 2 - PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

- A. General:
1. Horizontal Piping Hangers and Supports-Horizontal and Vertical Piping, and Hanger Rod Attachments: Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 2. Building Attachments: Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.
 3. Saddles and Shields: Factory fabricated saddles or shields under piping hangers and supports for insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12 inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
 4. Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller.
 5. Concrete Inserts: Malleable iron body, black finish. Lateral adjustment.
 6. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- B. Pipe Hangers Size 2 Inches and Smaller: Adjustable swivel ring hanger, UL listed. Michigan 100 or 101.
- C. Pipe Hangers Size 2-1/2 Inches and Larger: Adjustable clevis type, UL listed. Michigan 400.
- D. Riser Clamps: Steel, UL listed. Michigan 510 or 511. Copper coated; Michigan 368.
- E. Plumbers Tape: Not permitted as pipe hangers or pipe straps.
- F. Michigan numbers are indicated for type and quality. Comparable products manufactured by Globe, Elcen, B-Line, Kindorf, Kinline, Unistrut, Anvil, Super Strut, Tolco, PHD, Power-Strut, or approved.

2.02 ROOF EQUIPMENT SUPPORTS

- A. General:
1. Coordinate the location and type of each roof equipment support with the roofing system supplier. Coordinate systems to maintain roof warranty.
 2. Minimum 18 gauge galvanized steel with fully mitered and welded corners, internal bulkhead reinforcing, integral base plates, pressure-treated wood nailer, and 18 gauge galvanized steel counterflashing. Provide insulated curbs where surrounding roof is insulated.
 3. Compensate for slope in roof so top of support is level.
 4. Construct curb to withstand seismic forces.
- B. Manufacturers:
1. Equipment Supports: Pate ES, Custom Curb, Vibrex, or Thycurb.
 2. Equipment Curbs: Pate PC, Custom Curb, Vibrex, or Thycurb.

3. Pipe Curb Assemblies: Pate PCC, Custom Curb, Vibrex, or Thycurb.

2.03 WALL AND FLOOR SLEEVES

- A. General:
 1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Provide Type S unless otherwise noted. Thunderline Corporation, or approved.
 2. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
 3. Insulating Caulking: Eagle, Pitcher Super 66 high temperature cement, or approved.
 4. Fabricated Accessories:
 - a. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 - b. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
 - 1) Sleeve Size 4 Inches in Diameter and Smaller: 18 gauge.
 - 2) Sleeve Sizes 5 to 6 Inches: 16 gauge.
 - 3) Sleeve Sizes 7 Inches and Larger: 14 gauge.
 - c. Fire-Rated Safing Material:
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985F and K value of 0.24 at 75F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100F to 1200F service with K value of 0.40 at 150F.]

2.04 ANCHORS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer.
- B. Manufacturers: Anchor-It, Hilti Hit System, Epcon System, or Power Fast System.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine the Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- B. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.

3.02 INSTALLATION

- A. Building Attachments: Install within concrete or on structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- B. Hangers and Supports:
1. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not support piping from other piping.
 2. Support fire protection piping independently of other piping.
 3. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
 4. Allow controlled movement of piping systems to permit freedom of movement between pipe anchors and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
 5. Piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
 6. Insulated Piping: Provide protection saddles where insulation without vapor barrier is indicated. Provide protection shields on insulated piping where insulation with a vapor barrier is indicated.
 7. Hanger Spacing:
 - a. Steel Pipe 1 Inch and Smaller: 6 feet.
 - b. Steel Pipe 1-1/4 Inches and Larger: 10 feet.
 - c. Copper Tubing 1-1/2 Inches and Smaller: 6 feet.
 - d. Copper Tubing 2 Inches and Larger: 10 feet.
 - e. 90 Degree Offsets: Within 2 feet, both sides of offset.
- C. Anchors: Install at ends of principal pipe runs where indicated on Drawings. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.
- D. Roof Equipment Supports, Equipment Curbs, and Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to mechanical equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
 2. Equipment Supports: Provide for roof mounted equipment which does not require a structural roof deck penetration (i.e., condensing units).
 3. Equipment Curbs: Provide for equipment which requires a structural roof deck penetration other than piping or conduit (i.e., fans, ducts).
 4. Pipe Curb Assemblies: Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., refrigerant piping, electrical power and control wiring).
 5. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise.
- E. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

- F. "Link-Seal" Pipe Sleeves: Install at exterior wall piping penetrations. For penetrations below grade provide Schedule 40 steel sleeve with 1-inch, continuously welded, "weep ring" centered on length of sleeve.
- G. Fabricated Pipe Sleeves:
 - 1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeves not to be more than 1 pipe size larger than piping or piping plus insulation size.
 - 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1/4 inch above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 3/4 inch above floor finish.
 - 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 - 4. Seal each end airtight with a resilient nonhardening sealer.
- H. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - 1. Install fabricated pipe sleeve.
 - 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve I.D. with specified material.
- I. Piping penetrations through fire-rated (1 to 3 hour) assemblies: Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.

3.03 ADJUSTING AND PAINTING

- A. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
- B. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.04 FIRESTOPPING PENETRATIONS IN FIRE-RATED WALL/FLOOR ASSEMBLIES

- A. Refer to Section 07 84 ~~00 43~~.
- B. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.
- C. Manufacturers: Hilti, Proset, or approved.

END OF SECTION

SECTION 23 05 23**GENERAL-DUTY VALVES FOR HVAC PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials, installation and testing of valves, including the following:
 - 1. Globe valves.
 - 2. Drain valves.
 - 3. Ball valves.
 - 4. Balancing valves.
 - 5. Butterfly valves.
- B. Refer to Specification sections for each system medium (i.e., ~~plumbing~~, hydronics, ~~gas~~, and the like), for valve application.

1.02 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of valves of types and sizes required.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of valve.
- B. Maintenance Data: Submit maintenance data and parts list for each type valve. Include this data, product data, and certifications in maintenance manual.

PART 2 - PRODUCTS**2.01 VALVES - GENERAL**

- A. General:
 - 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 - 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6 inches and smaller, and 4 inches and smaller for plug valves. Provide gear operators for quarter-turn valves 8 inches and larger. Provide chain-operated sheaves and chains for overhead valves.
 - 3. End Connections: Mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is installer's option.
- B. Service:
 - 1. Water Shutoff and Isolation Valves:
 - a. Pipe Sizes 2-1/2 Inches and Smaller: Ball valve.
 - b. Pipe Sizes 3 Inches and Larger: Butterfly valve.
 - 2. Drain Service; All Pipe Sizes: Drain valves.

- C. Manufacturers: Crane, Fairbanks, Anvil, Jenkins, Kennedy, Walworth, Red/White (commercial grade), Mueller, Legend, Conbraco, Nibco, DeZurik, Hays, Powell, Stockham, Hammond, Watts, Milwaukee, Victaulic, or approved. Note: See individual sections for specialty valves (balancing valves, pressure regulators, relief valves, earthquake valves, gas valves).

2.02 GLOBE VALVES

- A. 2 Inches and Smaller: Class 125, bronze body, screw-in bonnet, integral seat, renewable disc, straight body, Nibco 211. Angle body, Nibco 311.
- B. 2-1/2 Inches and Larger: Class 125, iron body, bolted bonnet, flanged ends, renewable seat and disc, bronze mounted. Straight Body: Nibco F-718-B. Angle Body: Nibco F-818-B.

2.03 DRAIN VALVES

- A. Class 125, bronze body, screw-in bonnet, rising stem, composition disc, 3/4-inch hose outlet. Threaded: Nibco 73. Solder: Nibco 72.

2.04 BALANCING VALVES

- A. Bronze with a machined orifice flow restriction, multi-turn globe type valve, internal O-rings, rated working pressure of at least 240 PSIG (175 PSI iron construction, 2-1/2 inches and larger), flow setting indicating pointer and calibrated nameplate, memory stops, and pressure readout port with integral check valve on each side of the orifice. Bell & Gossett, Armstrong, Nibco, Wheatley, Tour & Anderson, or Illinois.
- B. Combination check valve/balancing valve not allowed, 1/4 turn plug type allowed on 8 inches and larger pipe only.

2.05 BALL VALVES

- A. 2-1/2 Inches and Smaller: 150 PSI, bronze body, full port, bronze trim, three-piece construction, TFE seats and seals. Threaded: Nibco T-595-Y. Soldered: Nibco S-595-Y.
- B. 3 Inches and Larger: 150 PSI, cast iron body, full port, two-piece body, TFE seats with stainless steel ball. FDA rated for potable water. Flanged Connection: Watts G4000.
- C. Victaulic Series 721 Standard Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.06 BUTTERFLY VALVES

- A. Select lug type valves.
- B. 6 Inches and Smaller: 200 PSI, ductile iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, manual lever and lock. Nibco LD2000, or Victaulic 300 for mechanical coupling fittings.

2.07 ACCESS PANELS

- A. Provide flush mounting access panels as required for service of fire dampers, cleanouts, valves, and the like, and other items requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum 24x24 (or required and approved size). Wall access panels to be minimum 12x12 (or required and approved size).
- B. Manufacturers: Milcor, Karp, Elmdor, In-Ryko, Acudor, or approved. Provide two keys for each set of locks provided.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- B. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter for each valve that must be installed with stem below horizontal plane.
- C. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.
- D. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5 feet above floor and hook to clips to clear aisle passage.
- E. Stem Selection: Outside screw and yoke stems, except provide inside screw, nonrising stem where space prevents full opening of OS&Y valves.
- F. Seats: Renewable seats, except where otherwise indicated.
- G. Balancing Valves: Install with minimum 4 pipe diameters, straight inlet and outlet pipe or per manufacturer's recommendations.

3.02 VALVE ADJUSTING AND CLEANING

- A. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
- B. Valve Identification. Tag valves per "Identification for HVAC Piping and Equipment."

3.03 ACCESS PANELS

- A. Install wall and ceiling access panels to provide access to concealed valves, fans, motors, shock arrestors, fire dampers, terminal units, coils and other mechanical items needing service. Provide access panels at locations required or specified herein. Coordinate locations/sizes of access panels with Architect prior to work.

~~B. Where access panels are for service of fire, fire/smoke, or smoke dampers, stencil the words "Fire Damper," "Fire/Smoke Damper," or "Smoke Damper" in 1/2-inch high capital letters on the outside of the panels.~~

END OF SECTION

SECTION 23 05 10**HYDRONIC PIPING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included:
1. Materials, installation and testing of pipe, tubing and fittings.
 2. Refer to Specification Sections for each system medium (i.e., plumbing, hydronics, gas, and the like), for pipe application.

1.02 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping products of types and sizes required.
 2. Welding Qualification: Qualify welding procedures, welders and operators in accordance with ANSI B31.9 for shop and project site welding of piping work.
- B. Manufacturer's Inspection: Inspect flanges, fittings and field applied welds in accordance with manufacturer's standard written quality control procedure in accordance with the following techniques:
1. Visual Method: Comply with MSS SP-55 except as otherwise indicated.
 2. Radiographic (X-Ray) Method: Employ wherever recommended or required for pressurized piping systems.

1.03 SUBMITTALS

- A. Piping Materials List: Provide a typewritten list which schedules the piping materials to be used for each system as a function of applicable nominal pipe size ranges. Arrange schedule in outline form for each specific piping system, e.g., "Chilled Water System," "Heating Water System," and the like. Include ASTM, ANSI or other numbers and other data as necessary to demonstrate compliance with requirements.
- B. Test Procedure: Submit a typewritten checklist type of testing procedure indicating testing medium (i.e., water, air, nitrogen, and the like), pipe service, pipe and fitting type and classification, test pressure, pass/fail criteria and any other pertinent data.

PART 2 - PRODUCTS**2.01 PIPING - GENERAL**

- A. Provide pipe, tube and fittings of the type, fitting requirements, grade, class, size and weight indicated or required for each service, as indicated in other Division 23 Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

2.02 STEEL PIPE

- A. ASTM A53, Hot Dipped, Zinc Coated Welded or Seamless, Grade B: Black, unless otherwise indicated, schedule as specified.

- B. ASTM A135, Electric Resistance Welded, Grade B: Black, unless otherwise indicated, schedule as specified.

2.03 COPPER TUBE

- A. Temper: Annealed (hard drawn).
- B. Water Service: ASTM B88, Type as indicated for each service.
- C. Drain, Waste, and Vent (DWV): ASTM B306.

2.04 FITTINGS FOR STEEL PIPE

- A. General: Flanges, fittings, unions and other products, mark in accordance with MSS SP-25.
- B. Welding Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
- C. Branch Connections: From mains or headers 2-1/2 inches or larger, welded tees or forged welding outlets.
- D. Welding Outlets: "Weldolets" or "Threadolets" equivalent to Bonney Forge. Use forged welding outlets wherever branch line is at least 1 nominal pipe size smaller than local main or header.
- E. Threaded Fittings: ANSI B2.1, ASTM A47, 150 PSI rating, except where otherwise specified, prevailing codes or requirements or Specifications dictate use of 300 PSI rating. Fabricate from standard malleable iron with dimensions conforming to ANSI B16.3.
 - 1. Fitting requirements for galvanized steel piping systems to be the same as for black steel pipe except each to have galvanized coating.
 - 2. Fittings for waste, vent and drainage piping to be drainage pattern type.
- F. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in the USA. Flanges which have been machined, remade, painted, or are nondomestic origin are not acceptable. Provide raised or full face ends wherever indicated or required.
- G. Unions: ANSI B16.39, ASTM A47, and be fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads: ANSI B2.1.
- H. Fasteners: Semi-finished carbon steel bolts and hex nuts conforming to ASTM A307. Threads and Dimensions: ANSI B1.1 and B18.2.
- I. Threaded Pipe Plugs: ANSI B16.14.
- J. Thread Lubricant: RectorSeal No. 5 or Slic-tite Teflon Paste.
- K. Mechanical Couplings (For Chilled Water Systems Only Not on Heating Hot Water Systems):
 - 1. Manufacturers: Victaulic, Gruvlok, or approved.
 - 2. Coupling Housings: Malleable iron ASTM A47 or ductile iron ASTM A536.
 - 3. Coupling Housing Description: Grooved or rolled mechanical type, which engages grooved or rolled shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secured together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's published literature.

4. Gaskets: Mechanical grooved or rolled coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D2000. Water Services: EDPM Grade E, with green color code identification.
 5. Bolts and Nuts: Heat treated carbon steel, ASTM A183, minimum tensile 110,000 PSI.
 6. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
 7. Fittings: Grooved or rolled shouldered end design to accept grooved or rolled mechanical couplings.
 - a. Malleable Iron: ASTM A47.
 - b. Ductile Iron: ASTM A536.
 - c. Fabricated Steel: ASTM A53, Type F for 3/4 to 1-1/2 inches; Type E or S, Grade B for 2 to 20 inches.
 - d. Steel: ASTM A234.
 8. Flanges: Class 125 cast iron and Class 150 steel bolt hole alignment.
 - a. Malleable Iron: ASTM A47.
 - b. Ductile Iron: ASTM A536.
 9. Pipe/Grooved: Carbon steel, A-53B/A-106B/A135 Schedule 40. Roll or cut grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends to be grooved or rolled in accordance with current listed standards conforming to ANSI/AWWA C-606.
- L. Pressfit System:
1. Manufacturers: Victaulic or approved.
 2. Carbon steel Pressfit system for 2 inches and under Schedule 5, 0.065 wall pipe conforming to ASTM A235, A795 or A53, having a maximum yield strength of 45,000 PSI and a maximum hardness of Rb70. Water, air, chemical, oil and vacuum systems with working pressures to 300 PSI. UL/FM approved to 175 PSI.

2.05 FITTINGS FOR COPPER TUBE

- A. Wrought copper/bronze solder joint fittings complying with ANSI B16.22.
- B. DWV Service:
 1. Cast Copper Solder Joint Drainage Fittings: ANSI B16.23.
 2. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29.
- C. Wrought or cast copper/bronze rolled joint fittings complying with ANSI B16.22.

2.06 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Insulating (Dielectric) Unions: ~~Standard units recommended by manufacturer for use in the service indicated, which isolate ferrous from nonferrous piping, and prevent galvanic corrosion action. Minimum rated "flashover" voltage: 600 volts. Watts 3000 Series. Provide insulated flanges for flanged piping system connection to dissimilar metals.~~ **Under no circumstances shall dielectric unions or dielectric pipe nipples be used on heating hot water, domestic and chilled water on piping applications, exterior and interior. To isolate ferrous from nonferrous piping, and prevent galvanic corrosion action, high-grade brass nipples and brass unions at transition points.**
- B. Welding Materials: Comply with Section 2-C of ASME Boiler Code, as applicable.
- C. Tin-Antimony Soldering Materials: ASTM B13.

- D. Gaskets for Flanged Joints: ANSI B16.12; full faced for cast iron flanges; raised face for steel flanges, unless otherwise indicated or recommended by manufacturer. Gaskets: Minimum 1/8-inch thick fabricated from nonasbestos bases.
- E. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-O" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations conform to accepted published procedures, i.e., UPC Installation Standard 3-75 and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited.

2.07 PREINSULATED PIPING SYSTEM

- A. Manufacturers: Rovanco, Thermacore, PERMA-PIPE or approved.
- B. Factory preinsulated piping system, consisting of an inner media carrier pipe, insulation around the carrier pipe, and a water/vapor seal jacket over the insulation.
- C. Carrier Pipe Material: Schedule 40 black steel pipe with 150 PSI malleable screwed fittings. Type "K" copper with brazed fittings approved.
- D. Insulation: Rigid closed cell polyurethane, average density of at least 2 lb./ft.³, conforming to ASTM C552, Type II, Class 1, K factor of not more than 0.14 (BTU/in)/(hr/sq.ft./deg. F) at 50F.
- E. Outer Casing:
 - 1. PVC pipe of minimum 60 mils thickness.
 - 2. Each factory prefabricated section provides complete sealing of the insulation at each end of the conduit section by one of the methods listed below. Provide a permanent water and vapor seal.
 - 3. Carry over the outer casing and extend it to the carrier pipe.
 - 4. Use prefabricated caps specifically designed for end seal of prefabricated insulation systems. Fabricate caps of the same material as the outer casing.

2.08 UNIONS

- A. Steel Pipe Union: 150 PSI malleable iron, brass to iron seat, ground joint, black or galvanized to match pipe.
- B. Copper Pipe Union: 200 PSI working pressure. Bronze body, solder or grooved ends. Pipes 2 inches and under use ground joint, pipes 2-1/2 inches and larger use flanged face or grooved ends.
- C. Insulating Unions: 250 PSI working pressure. Pipe ends and material to match piping. Electric current below 1 percent of galvanic current. Gasket material as recommended by manufacturer. Epcor approved.

2.09 ESCUTCHEONS

- A. Brass material, chrome plated finish. Size sufficient to cover pipe openings through wall, floor or ceiling. Set screw or spring to secure to pipe. Coordinate opening sizes.

2.10 ACCESS PANELS

- A. Manufacturers: Milcor, Karp, Elmdor, In-Ryko, Acudor, or approved. Provide two keys for each set of locks provided.

- B. Provide flush mounting access panels as required for service of fire dampers, cleanouts, valves, and the like, and other items requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum 24x24 (or required and approved size). Wall access panels to be minimum 12x12 (or required and approved size).

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms, and other electrical or electronic equipment spaces and enclosures. Within equipment rooms, provide minimum 3 feet lateral clearance from sides of electric switchgear panels. Do not route piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such items.
- B. Installation/Coordination:
1. General: Comply with basic requirements of Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each route with a minimum of joints and couplings, but with adequate and accessible unions or flanges for disassembly, maintenance, and replacement of valves and equipment. Reduce sizes by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance. Comply with ANSI B31.9 Code for Pressure Piping.
 2. Installed piping not to interfere with maintenance of equipment, opening of doors or other moving parts nor be directly above or near any portion of electrical equipment.
 3. Support piping such that connected equipment and flanges do not bear weight of piping.
 4. Adequately support vertical lines at their bases or by a suitable hanger placed in horizontal line near the riser or, preferably, by a base fitting set on a pedestal.
 - ~~5. Piping not to be suspended or supported by pumps. Apply no force to pumps by connecting pipes. After final pipe adjustments and initial operational verification of the pumps, recheck alignment of pumps and realign as required.~~
 - ~~6.5.~~ Piping systems are to be installed to drain. Provide properly sized drain valves at low points.
 - ~~7.6.~~ Ream pipes after cutting to full bore. Remove foreign matter from inside of pipe before installing. Keep installed piping free from dirt and scale and protect open ends from foreign matter. Use temporary plugs or other approved methods for opening and closure.
 - ~~8.7.~~ Remake or replace defective, leaking or otherwise unsatisfactory joints or material. Peening, caulking, or doping of piping is not permitted.
 - ~~9.8.~~ Install piping to prevent stresses and strains to piping and hangers and supports due to expansion or contraction and building settlement. Provide proper loops, guides, offsets, anchor points, or expansion joints. Verify with anticipated settlement or shrinkage of building. Verify construction phasing of project, type of building construction products and type for coordinating installation of piping systems. Include provisions for servicing and removal of equipment without dismantling piping.

40.9. Piping Systems Routing Within Unconditioned Spaces, Plenums, Chases, or Cavities:

- a. Unless absolutely unavoidable, route fluid filled and (or) pressurized piping systems on the "warm" side of local building wall, roof, or ceiling thermal insulation batts, boards, or blankets as near to heated space as practical.
- b. Whenever such routing as described above is entirely impractical or impossible, provide heat tracing systems to piping, wherever necessary. Inform Architect before proceeding.

44.10. Corrosion Control:

- a. Underground Steel Piping Corrosion Protection: Factory wrap uninsulated underground steel piping systems with protective coating composed of a coal-tar saturated wrapping tape over a 20 mil thick coal-tar epoxy coating, equivalent to "Republic X-Tru-Coat." Wrap joints spirally with a minimum overlap of 1/2 tape width. Extend wrap not less than 3 inches above grade. . Provide tinker test to check for holidays. Provide cathodic protection to meet requirements of NACE Standard RP0169-2002.

~~b. Install hot water heating vessels with a stainless steel fitting at tank and a dielectric fitting on both supply and discharge sides of hot water tanks.~~

42.11. Pipe Sleeves:

- a. Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
- b. Floor Sleeves and Exterior Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1 inch above finished floor. Caulk pipes passing through floor with nonshrinking grout or approved caulking compound. Provide "Link-Seal" Type S sleeve sealing system for slab on grade and exterior walls. Caulk/seal piping and ductwork passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
- c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking caulking compound. Caulk/seal piping and ducts passing through fire-rated building assemblies with UL approved fire-rated assemblies. Provide fire-rated assemblies per local AHJ requirements.

~~d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.~~

43.12. Conform with applicable codes and industry standards.

44.13. Install uninsulated piping so that unrestrained direct contact with the structure or other system installations is avoided. Where contact with or passage through building or structural features cannot be avoided; firmly anchor piping to, or isolated from, the structure to prevent noise transmission and occurrence of physical damage. Install piping to be insulated with adequate clearance around piping to allow for placement of full thickness insulating material.

- C. Pressure Piping Routing:
1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
 2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 3. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 1/2 inch wherever furring is indicated for concealment of piping. Allow for insulation thickness, if any. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
 4. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
- D. Preparation:
1. Unions:
 - a. Insulating (Dielectric) Unions: Comply with manufacturer's instructions for installing unions wherever piping of dissimilar metals are adjoined. Install unions in manner which will prevent galvanic action and inhibit corrosion.
 - b. Standard Unions: Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
 2. Copper Tubing:
 - a. Remove burrs from and clean outer surface of tube ends and inner surface of fittings.
 - b. Copper-Soldered: Make soldered joints for copper tubing and fittings with code approved solder alloys meeting ASTM and ANSI standards and listings. Solder-paste-flux combination fillers are not approved. Installations to conform to accepted published procedures, i.e., UPC IS 375, IS 21-80 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Apply flux as recommended by manufacturer. Allstate Silver Bearing Solder 430 or other approved solder alloys which do not contain lead or cadmium.
 - c. Copper-Brazed: Make brazed joints for copper tubing and fittings with code approved brazing filler alloys meeting ASTM and AWS standards and listings. Filler alloys of BCuP2 classification (e.g., "Phos-0" or "Fos-Copper") may not be used to make joints between copper tubing and cast brass or bronze fittings. Filler alloys containing cadmium are not approved for use in potable water piping. Installations to conform to accepted published procedures, i.e., UPC IS 3-75 standards and CDA Publications. Use of steel wool for cleaning tube and fittings is prohibited. Remove bonnets and nonmetallic seats on valves and cool body with damp cloth while soldering or brazing. Remove excess flux from completed joints in accordance with manufacturer's instructions and code standards.

- d. Copper-Rolled Joints: Pipe ends clean and free from indentations, projections and roll marks in the area from pipe end to rolled area for proper sealing of gasket. Apply a thin uniform coat of nonpetroleum-based lubricant to the gasket, coupling or housing by brush or hand. Place the gasket over one pipe end, the pipe ends aligned and brought together, and the gasket positioned between rolled area and pipe ends. Assemble the coupling housing over the gasket with housing keys engaging both rolled areas. Insert the bolts and nuts started, uniformly tighten until the housing bolt pads are firmly together, metal to metal.
- e. Pressurized Service:
 - 1) Unless otherwise indicated, wrought copper/bronze solder joint fittings complying with ANSI B16.22.1995.
 - 2) Copper Tube Unions: Standard products as recommended by manufacturer for use in the service. Rated at 150 percent design operating pressure.
 - 3) Mechanically Formed Tee Connections:
 - a) Form mechanically extracted collars in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Fully adjustable collaring device to ensure proper tolerance and complete uniformity of the joint.
 - b) Notch the branch to conform with the inner curve of the run tube and dimpled to ensure penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube.
 - c) Braze joints in accordance with the Copper Development Association Copper Tube Handbook using B-cup series filler metal. Note: Soft soldered joints will not be permitted.

3.02 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
 - 2. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect. Remove cracked or dented units and replace with new units.

3.03 ADJUSTING AND CLEANING

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of painting, insulation, or coatings, if any. Comply with the preparation requirements of Section 23 05 53, Identification for HVAC Piping and Equipment, and Section 23 07 00, HVAC Insulation, as applicable. Flush out water filled or drainage piping systems with clean water, and flush other piping systems with dry air or nitrogen after completing required tests. Inspect each segment of each system for completion of joints, supports, and accessory items.
- B. Inspection: Inspect pressurized piping in accordance with the procedures of ANSI B31.9.

3.04 PROTECTION

- A. Protect piping from damage. Replace damaged items with new.

3.05 ESCUTCHEONS

- A. Install on exposed pipes passing through walls or floors, ~~and on fixture stops and waste connections to wall.~~

3.06 PIPE TEST

- A. General:
1. Make tests in presence of Architect or authorized representative.
 2. Make test before pipes are concealed.
 3. Fill system and remove air from system at least 24 hours before test begins.
 4. Correct leaks in screwed fittings by remaking the joint. Cut out leaks in welded joints and reweld; caulking is not permitted.
- B. Water piping: Apply test pressure of 125 PSI and maintain for 1 hour with no visible leaks and no appreciable drop after the test pump has been disconnected.

3.07 ACCESS PANELS

- A. Install wall and ceiling access panels to provide access to concealed valves, fans, motors, shock arrestors, fire dampers, terminal units, coils and other mechanical items needing service. Provide access panels at locations required or specified herein. Coordinate locations/sizes of access panels with Architect prior to work.
- ~~B. _____ Where access panels are for service of fire, fire/smoke, or smoke dampers, stencil the words "Fire Damper," "Fire/Smoke Damper," or "Smoke Damper" in 1/2-inch high capital letters on the outside of the panels.~~

END OF SECTION

SECTION 23 00 40**ACCEPTANCE TESTING AND DOCUMENTATION****PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. This section describes the Acceptance Testing and documentation of the mechanical system(s) and outlines the duties and responsibilities of the contracting team for Acceptance Testing.
- B. Apply the Acceptance requirements to products, equipment and systems provided under this Division, where indicated on plans, and where required by California Title 24 requirements.
- C. Engage the services of a firm specializing in commissioning of mechanical systems or shall submit contractor qualifications for review by architect where testing and documentation is to be performed by contractor. Where duct pressure testing validation is required, submit name and qualification for HERS Certified testing agency.

1.02 THE COMMISSIONING TEAM

- A. Form the Commissioning Team of:
 - 1. Mechanical contractor's representative
 - 2. DDC Controls contractor's representative
 - 3. HERS Certified Testing Agency where required
 - 4. Inspector of record
 - 5. Owner's staff representative

PART 2 - PRODUCTS**2.01 DUTIES OF THE TEAM**

- A. The duties of the Team are as outlined in the Title 24 Requirements and summarized below:
 - 1. Plan, organize and implement the Acceptance Testing process and within 1 month of the award of the contract, submit the names and addresses of the Testing team member(s).
 - 2. The Acceptance testing team shall submit a complete description of the testing procedures and systems to be tested to the architect for review.
 - 3. The Acceptance testing team shall coordinate tests of systems and equipment and assemble documentation related to tests. Submit documentation relative to tests and proposed procedures to design engineer for review prior to submitting documentation to Authority having Jurisdiction (AHJ.) Team responsible for performing data analysis, calculation of performance indices and crosschecking of results with the requirements of Title 24 and the Contract documents. The installing contractor or agent responsible for testing and documentation shall record their State of California Contractor's license number or their State of California Professional Registration License number on each Certificate of Acceptance for submittal.

4. Responsible for submitting Certificate of Acceptance including paper and electronic copies of measurements and monitoring results and supporting documentation to the AHJ. Where AHJ questions results or requires additional testing, complete additional testing and provide required documentation at no additional cost to the Owner.

2.02 TIME SCHEDULE

- A. Determine the time period of the commissioning of the systems by the general contractor and Acceptance testing team. It is important to note that AHJ will not release a final Certificate of Occupancy until a Certificate of Acceptance is submitted that demonstrates that the specified systems and equipment have been shown to be performing in accordance with the Title 24 standards.

2.03 ACCEPTANCE TESTING – PHASE I - DOCUMENTATION

- A. Team shall assemble documentation showing thermostat and sensor locations, control device locations, control sequences and notes.
- B. Per Title 24 requirements, team shall provide record drawings to building owner within 90 days of receiving a final occupancy permit (refer to other specification sections for requirements on record drawings.)
- C. Per Title 24 requirements, team shall provide operating and maintenance manuals to the building owner (refer to other specification sections for requirements on operation and maintenance manuals.)

2.04 ACCEPTANCE TESTING – PHASE II – INSPECTION AND TESTING

- A. Team shall review the installation, perform acceptance testing and document results for the following systems:
 1. Variable Air Volume Systems
 2. Constant Volume Systems
 3. Package Systems
 4. Air Distribution Systems
 5. Economizers
 - ~~6. Demand Control Ventilation Systems~~
 - ~~7.6. Ventilation Systems~~
 - ~~8.7. Variable Frequency Drive Fan Systems~~
 - ~~9.8. Hydronic Control Systems~~
 - ~~10. Hydronic Pump Isolation Controls and Devices~~
 - ~~10. Supply Water Reset Controls~~
 - ~~11. Water Loop Heat Pump Control~~
 - ~~12. Variable Frequency Drive Pump Systems~~
 - ~~14.9. System Programming~~
 - ~~14. Time Clocks~~
- B. Review of installation shall confirm mechanical equipment and devices are properly located, identified, calibrated, and set points and schedules programmed per contract document requirements.

2.05 ACCEPTANCE TESTING - PHASE III - CERTIFICATION

- A. Team shall document operating and maintenance information, complete installation certificate, and indicate test results on the Certificate of Acceptance, and submit the Certificate to the AHJ prior to receiving final occupancy permit. Team shall submit forms MECH-1-A through MECH-9-A as required by Title 24 requirements.

PART 3 - EXECUTION

3.01 ACCEPTANCE TESTS AND DOCUMENTATION

- A. Refer to California Title 24, Non-residential manual for specific testing procedures and documentation requirements. The detailed requirements can be found at http://www.energy.ca.gov/title_24/2005standards/index.html. Contractor is responsible for reviewing and complying with these standards

END OF SECTION

SECTION 23 75 00**AIR HANDLING UNITS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Work Included: Materials, installation and testing of central station air handling unit.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. ANSI/NFPA 90A, Installation of Air Conditioning and Ventilation Systems.
 2. AMCA Compliance: Test and rate per AMCA 210 and 500.
 3. ARI Compliance: Test and rate per ARI 430-99, Central Station Air Handling Units.
 4. ARI Compliance: Test and rate coils per ARI 410-2001, Forced-Circulation Air-Cooling and Air-Heating Coils.
 5. UL: Provide units and components which are labeled and listed by UL.

1.03 SUBMITTALS

- A. Submit For: Air handlers.
- B. Coil Selection: Submit manufacturer's computer-generated output data.

PART 2 - PRODUCTS**2.01 FILTER GAUGES**

- A. Provide Dwyer 2000 Magnehelic gauges.
- B. Magnehelic gauge to be accurate to plus or minus 2 percent of full range. Weatherproof glass.
- C. Provide sensing probes and shutoff valves for each gauge.
- D. Provide gauge for each filter bank.

2.02 MODULAR AIR HANDLING UNITS

- A. Unit Casing:
1. Unit shall be constructed of a complete frame with easily removable panels. Removal of any panel shall not affect the structural integrity of the unit. Single height coil sections shall have removable frame sections to facilitate vertical coil extraction.

2. All units shall be supplied with 16-gage, G-90 galvanized steel base rails. Bolt-on legs are NOT acceptable. Perimeter 10-gage lifting lugs for overhead lifting shall be provided on each section. Slings units in place of lifting lugs shall not be acceptable.
3. Unit shall be thermally broken to minimize the conduction path from the inside of the casing to the outside.
4. Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, and shall have one of the following exterior finishes as specified:
 - a. Pre-painted with a baked enamel finish passing 500-hour salt spray test (ASTM B-117) for pre-painted steel and 125-hour marine level 1 prohesion test (ASTM G-85.A5) for pre-painted steel.

~~b. _____ Unpainted G-90 galvanized steel.~~

~~5. Casing panels (top, sides, and bottom) shall be constructed of galvanized steel, and shall have one of the following interior finishes as specified:~~

~~a. Pre-coated with a silver zeolite antimicrobial material registered by the US EPA for use in HVAC applications.~~

~~b. Unpainted G-90 galvanized steel.~~

~~6.5.~~ Casing panels (top, sides, and bottom) shall have no exterior exposed raw edges that could lead to rust formation. All casing corners shall be radiused or chamfered.

~~7.6.~~ Casing panels (top, sides, and bottom) shall be one piece, double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

~~8.7.~~ Casing deflection shall not exceed a 1:200 ratio when subject to an internal pressure of \pm 5-in. wg.

~~9.8.~~ Side panels shall be easily removable for access to unit and shall seal against a full perimeter automotive style gasket to ensure a tight seal.

~~10.9.~~ The panel retention system shall comply with UL 1995 which states all moving parts (for example, fan blades, blower wheels, pulleys, and belts) that, if accidentally contacted, could cause bodily injury, shall be guarded against accidental contact by an enclosure requiring tools for removal.

~~11.10.~~ Accessibility ~~options~~ shall be as follows:

~~a. _____ Hinged double-wall access door on either side with removable access panel(s) on the other side.~~

~~b.a. _____ Hinged double-wall access doors on both sides. Provide removable double-wall access panels where there is not adequate room for an access door to fully open.~~

~~b.b. _____ Removable double-wall access panels on both sides.~~

~~12.11. Provide: Depending on the options selected and the remaining available space inside each section, the following options may be available:~~

- a. Thermal pane reinforced glass viewports shall be factory-installed on the access panel(s) or door(s) of the section.
- b. Marine lights shall be factory installed with ~~or without~~ convenience outlets.

~~13.12. Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used. Painted welds on unit exterior steel or galvanized steel are not acceptable.~~

~~14.13. All coil sections shall be doublewall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13. Single height coil sections shall have removable frame sections to facilitate vertical coil extraction.~~

~~15. Blow thru sections shall have a diffuser plate as an integral part of the fan section.~~

B. Access Doors:

1. Access doors shall be one piece, double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

C. Drain Pans:

1. Drain pans shall be insulated double-wall ~~galvanized~~ or stainless steel construction. The pan shall be sloped in 4 directions toward the drain fitting. Drain pan shall have a recessed bottom drain design with ~~1-1/2-in~~ ~~1 1/2-in.~~ MPT connection exiting through the hand side or opposite side of the casing (see plans for locations) ~~as specified~~. Drain connection shall be insulated from the drain pan to the point at which it exits the casing. One drain outlet shall be supplied for each cooling coil section. Drain pan shall allow no standing water and comply with ASHRAE Standard 62. Where 2 or more coils are stacked in a coil bank, intermediate drain pans shall be provided and the condensate shall be piped to the bottom drain pan. The bottom coil shall not serve as a drain path for the upper coil.

D. Casing ~~Options:~~

1. Doublewall constructed unit to prevent fiberglass erosion into the airstream and to allow cleaning of the unit interior. 2-inch-thick interior wall of either 20 gauge solid ~~or 18-gauge perforated plate~~ galvanized steel. Foil faced insulation is not acceptable.
2. Ship fully assembled unit (within freight limitations) on a minimum 10 gauge galvanized steel base rail/housekeeping pad.
3. Seal all positive pressure section panels with closed-cell foam gasketing.

- E. Insulation: Factory insulate unit with 2-inch, 1-1/2 lb. density, mat-faced insulation. Insulate connecting channels to prevent seating. ~~4-inch, use 1-1/2 lb. density insulation where noted on drawings.~~

- F. Outside Air/Return Air/Economizer Dampers: Provide outside air/return air dampers on filter mixing box to modulate the volume of outside and return air to perform economizer function. Airfoil design dampers and either parallel or opposed blade type with metal compressible jamb seals and extruded vinyl blade jamb seals on all blades. Rotate blades on stainless steel sleeve bearings. Maximum damper blade length to be 60 inches. Leakage rate not to exceed 5 CFM/sq.ft. at 2-inch w.g., 9 CFM/sq.ft. at 4-inch w.g.
- G. Base Construction:
1. Construct base frame from structural steel galvanized channel around the perimeter of the unit, with intermediate channel and angle iron supports. Size members to freespan the unit.
 2. All drain connections on air handling units to terminate at the side of the unit.
- H. Filters: ~~Throwaway type.~~ 2 4-inch-thick Merv-13 (see drawings) fiberglass media contained in a rigid frame. Filters to have a rigid supporting maze across both the entering and leaving faces of the media. Size filters so as not to exceed scheduled face velocities. Provide manometer, mounted on exterior of unit, across filter section.
- I. Fans:
1. Forward curve (FC) as required for proper operation, (reference Drawings).
 2. Certify housed fan performance as complying with ARI 430-99. Dynamically balanced centrifugal fans at the factory as a complete fan assembly (fan wheel, motor, drive and belts). Fan shafts not to exceed 75 percent of their first critical speed at any cataloged RPM.
 3. Equip fans with self-aligning anti-friction pillow block bearings with a minimum life of 200,000 hours. Equip bearings with grease lines allowing for lubrication from one side of the fan.
 4. Internally isolate fan and motor assembly unit casing with spring isolators (2-inch deflection with seismic snubbers), furnished and installed by unit manufacturer. Isolate fan scroll from the unit by a flexible canvas duct.
- J. Motors: Mount motors integral to an isolated fan assembly furnished by unit manufacturer. Mount motors inside the unit casing. Mount motors side base to permit adjustment of drive belt tension. Motors to be inverter rated and listed for use with variable frequency drives.
- K. Coils:
1. All water coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with ARI Standard 410. All water ~~and direct expansion~~ coils shall be tested at 450 psig air pressure.
 2. General Fabrication:
 - a. ~~All water and refrigerant coils shall have minimum 1/2 in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches. Optional tube wall thickness of 0.025 in. shall be supplied, if specified.~~

~~b.a. Optionally, w~~ Water coils shall have minimum 5/8-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.020 inches. ~~Optional tube wall thickness of 0.035 in. shall be supplied, if specified.~~

~~e.b.~~ Aluminum plate fin type with belled collars. ~~Optional copper plate fins shall be supplied, if specified.~~

~~d.c.~~ Aluminum-finned coils shall be supplied with dieformed casing and tube sheets of mill galvanized steel or stainless steel as specified. ~~Copper-finned coils shall be supplied with stainless steel casing and tube sheets.~~

~~e.d.~~ Fins to have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. Use no soldering or tinning in the bonding process. Mount coils in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Certify capacities, pressure drops and selection procedure in accordance with ARI 410-2001.

3. Hydronic Heating and Cooling Coils:

- a. Headers shall be constructed of ~~non-ferrous material (red brass or copper) steel~~ with ~~steel~~ MPT connections. Headers shall have drain and vent connections accessible from the exterior of the unit. ~~Provide Optional non-ferrous headers and nipples shall be supplied if specified.~~
- b. Configuration: Coils shall be drainable, with non-trapping circuits. Coils will be ~~tested and~~ suitable for a design working pressure of 300 psig at 200 F.

~~L. Water Heating Coils:~~

- ~~1. Enclose all coils in a coil section. Coils headers and U-bends not to be exposed.~~
- ~~2. Coils to have a supply header to ensure distribution of hot water to each tube of coil.~~
- ~~3. Proof test coils to 300 PSIG and leak test to 200 PSIG, air pressure underwater.~~

~~M. Water Cooling Coils:~~

- ~~1. Enclose all coils in a coil section. Coil headers and U-bends not to be exposed.~~
- ~~2. Counter to airflow water flow.~~
- ~~3. Proof test coils to 300 PSIG and leak test to 200 PSIG air pressure underwater.~~
- ~~4. Headers to be copper. Steel pipe headers are not acceptable.~~

~~N.L.~~ Electrical: Single point electrical connection for each fan. Unit main control panel has factory mounted unit, fused disconnect switch, full voltage, non reducing, ~~variable frequency drive AC motor starter~~, control power disconnect switch, 115V convenience outlet, and marine light, all accessible through integral front panel. Fans to be factory wired complete to load side of disconnect switch. Provide 24V control power transformer. Provide auxiliary relay to shut down unit on signal from ionization detector.

~~O.M.~~ Manufacturers: Carrier, Trane, McQuay, ~~Temtrol Temptrol~~ or approved.

PART 3 - EXECUTION**3.01 INSPECTION**

- A. Examine areas and conditions under units to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 UNIT INSTALLATION

- A. General: Install units in accordance with manufacturer's installation instructions, plumb and level, and firmly anchor in locations indicated. Maintain manufacturer's recommended clearances.
- B. Ductwork: Connect supply and return to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
- C. Drain Piping: Provide trap at condensate drain; construct at least 1 inch deeper than fan pressure in inches of water.
- D. Start-Up: Start up in accordance with manufacturer's instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- E. Air Handling Units:

1. Install units on ~~neoprene pad spring isolators~~ and secure as detailed (see structural drawings).
2. Rig and set units in place. Ensure that spreader bars are used and the units are protected from the lifting cables.
3. Entire air handling unit is to be leveled. Remove all internal hold down bolts and shipping fasteners, and install parts shipped loose. ~~Level spring isolators~~.
4. Check and realign all access doors and dampers to ensure smooth operation through the entire range of travel.
5. Upon start-up each fan motor is to be checked for fan rotations, and amp draw for each phase. Amp readings are to be marked on the fan scroll.
6. All belt drives are to be readjusted for tension and alignment.
7. Provide a drain valve on each coil drain fitting, and a vent valve on each coil vent.
8. All pipe and conduit penetrations to the casing are to be thoroughly sealed and caulked to prevent air leakage.
9. Test installed unit for vibration and noise.

3.03 SPARE PARTS

- A. Furnish to Owner, with receipt, for each unit:
1. One set matched fan belts for each belt-driven fan.

2. One complete set filters for each unit, not including new filters to be installed after testing and balancing.

3.04 INSULATION

- A. Insulate piping, condensate drains, drip pans, and all other associated appurtenances per Section 23 07 00, HVAC Insulation.

END OF SECTION

SECTION 25 55 00**BUILDING MANAGEMENT AND CONTROL SYSTEM (BMS)****PART 1 – GENERAL****1.01 SUMMARY**

- A. Description: Furnish all labor, materials, equipment, and service necessary to design, program, install and commission a complete and operating facility management and control system. The system shall be fully compatible throughout the Campus and shall utilize Direct Digital Controls, pneumatic/electronic interfaces and actuation devices, as described within the bid package and as additionally described herein. The BMS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally or over a secure Intranet within the building or by remote access utilizing a standard Web Browser (MS Explorer 6.0) over the Internet. This shall include the ability to perform HVAC control, electrical, gas and water metering, energy management, alarm monitoring, security and personnel access control, fire and life safety systems and all trending, reporting and maintenance management functions related to normal building operations.
- B. The Drawings, Diagrams, Points Lists and Schematics are diagrammatic only and are intended to describe the overall concept and magnitude of the project. All labor, material, equipment and software not specifically referred to herein or on the Drawings, Diagrams, Points Lists and Schematics, that are required to meet the functional intent, shall be provided without additional cost to the Owner. The Contractor shall provide for all power required for control devices as well as structural support and attachments with any calculations and drawings required for permitting
- C. All labor, material, equipment and software not specifically referred to herein that are required to meet the functional intent of this specification, shall be provided without additional cost to the owner.

1.02 SYSTEM DESCRIPTION, GENERAL

- A. The entire BMS shall be comprised of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the intranet to a host computer in a remote location.
- B. The BMS shall be able to communicate to third party systems such as chillers, boilers, air handling systems, energy metering systems and other energy management systems, access control systems, fire-life safety systems and other building management related devices with open interoperable communication capabilities.
- C. The BMS devices for this project shall be able to be part and fully interoperate with the existing Yamas YNET Building Control Wide Area Network existing throughout the District, without having to use additional programming and configuration software

Pursuant to Section 3400 of the Public Contract: Yamas YNET Building Control Wide Area Network and Web Interface Systems is now in use on the particular public improvement described as San Mateo County Community College District. At each instance in these specifications that "Yamas YNET Building Control Wide Area Network and Web Interface Systems" is designated by brand name, said manufacturer's system is required and is designated to coordinate with existing systems that are in place at Skyline College, College of San Mateo, Cañada College and the District Administration Building. The Contractor will furnish and install only "Yamas YNET Building Control Wide Area Network and Web Interface Systems" systems and devices as required, and no substitutions shall be deemed to be "or equal" or allowed.

1.03 SUBMITTALS

- A. A detailed work plan, phasing plan and proposed implementation schedule shall be submitted within 90 days of contract award.

Six copies of shop drawings of proposed system architecture and proposed products and equipment utilized in control system shall be submitted. The shop drawings shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system will properly function as intended. At the time each modernization project is contracted and in coordination with the efforts of the respective contractors on the modernization work, shop drawings shall be prepared and forwarded to the General Contractor for the work related to that contract. The shop drawings shall respect the timing and sequencing of the General Contractor's schedule for submittals, and shall be complete in all respects for the scope of work under which the specific General Contractor would be responsible. Additionally, the shop drawings shall address how the control systems depicted would interface with and integrate with the overall system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation as well as a hard copy graphical depiction of the application control programs shall also be included with each submittal package.

- C. Submittals shall also include a trunk cable schematic diagram depicting the Graphical User Interface (GUI) computer, control panel locations and a description of the communication type, media and protocol.
- D. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ files.

1.04 RELATED WORK SPECIFIED UNDER SEPARATE SECTIONS

- A. Division 22, Plumbing, and Division 23, Heating, Ventilating & Air Conditioning:
- Providing taps and installation of wells in piping for control system sensors and flow measurement devices.
 - Installation of any control system dampers.
- B. Division 25, Integrated Automation, and Division 26, Electrical:
- Providing motor starters and disconnect switches (unless otherwise noted).
 - Provision, installation and wiring of smoke detectors (unless otherwise noted).
 - Provide power to all DDC control panels

1.05 AGENCY AND CODE APPROVALS

- A. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
- UL-916; Energy Management Systems
 - ULC; UL - Canadian Standards Association
 - FCC, Part 15, Subpart J, Class A Computing Devices

1.06 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.08 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.09 QUALITY ASSURANCE

- A. The Manufacturer of the Temperature Control System shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the temperature control system manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.10 QUALIFICATIONS OF BIDDER

- A. All bidders must be temperature control contractors in the business of installing direct digital temperature controls for five (5) years.
- B. All bidders must have installed and completed at least five (5) direct digital temperature control jobs of similar design equipment as specified.
- C. All bidders must be able to provide 24 hour service with 2 hour response time. This scope is provided under a separate contract.
- D. All bidders must be an authorized distributor of the pre-qualified manufacturers specified

and listed below.

- E. All bidders must have capabilities of doing component level repairs on electronic systems.
- F. Complete turnkey in-house staff for: Installation, Engineering, Programming, Test, Training, and Check-out.
- G. The following bidder and product is pre-qualified:
 - 1. YNET Web Interface System - Installed by Yamas Controls

Yamas Controls
 Janey Kaster
 1 South Linden Avenue Suite 1
 South San Francisco, CA 94080
 (650) 616-7420
 jkaster@yamas.com

PART 2 - MATERIALS

2.01 GENERAL

- A. The BUILDING MANAGEMENT AND CONTROL SYSTEM (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, host computer system(s) with GUI software, portable operator's terminals, modems, printers and other devices as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.
- C. Specification Nomenclature:

BMS	BUILDING MANAGEMENT AND CONTROL SYSTEM
NAC	Network Area Controller
SDC	Standalone Digital Controller
IDC	Interoperable Digital Controller
IA	IA Series, Interoperable LONMARK Controller
LIDC	Lighting Interface Digital Controller
WBI	Web Browser Interface
POT	Portable Operator's Terminal
POI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
GP	Graphical Programmer
HMI	Human Machine Interface
PAC	Personnel Access Controller
YNET	Yamas Graphical User Interface

2.02 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate LonWorks Technologies using

Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK Interoperability Association's v3.1 Physical and logical Layer guidelines in all unitary, terminal unit and other devices or both communication protocols in one interoperable system.

- B. The supplied computer software system shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using Java enabled 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 shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. 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.
 - 2. 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.

2.03 NETWORKS

- A. The Local Area Network (LAN) shall be residing on the existing SMCCCD Ethernet network supporting Java, XML, HTTP and COBRA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local host computer system.
- B. Access to the system from a remote location shall be via the utilizing an adequate PC with standard web browser and from a local computer system (by owner) via direct connection to the Ethernet LAN or thru VPN.
- C. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3
 - 2. Cable; 10 base-T, UTP-8 wire, category 5
 - 3. Minimum throughput; 10Mbps with ability to increase to 100 Mbps

2.04 NETWORK AREA CONTROLLER (NAC)

- A. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
1. Calendar functions
 2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of LonWorks controller data
 7. Network management functions for all LonWorks devices
- B. The NAC shall provide multiple user access to the system and support for ODBC or SQL. An embedded database resident on the NAC must be an ODBC-compliant database or must provide an ODBC data access or must provide an ODBC data access mechanism to read and write data stored within it.
- C. The NAC must provide the following hardware features as a minimum:
1. One Ethernet port –10 / 100 Mbps
 2. Two RS-232 ports
 3. One LonWorks port – 78KB FTT-10A
 4. Battery backup
 5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1-gigabyte storage capacity)
 6. The NAC must be capable of operation over a temperature range of 0-55°C
 7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
 8. The NAC must be capable of operation over a humidity range of 5-95% non-condensing
- D. The NAC must provide all tools for Java enabled Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users in its minimum configuration.
- 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 local network or remote via dial-up, telephone connection, or wide-area network.
 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a) To alarm
 - b) Return to normal
 - c) To fault
 4. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

5. Provide timed (schedule) routing of alarms by class, object 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.
7. Control equipment and network failures shall be treated as alarms and annunciated.
8. The systems shall be capable to annunciate alarms in the following manners:
 - a) Screen message text
 - b) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on day of the week, time of day and recipient.
 - c) Pagers via paging services that initiate a page on receipt of email message.
 - d) Graphic with flashing alarm object(s)
 - e) Printed message, routed directly to a dedicated alarm printer
 - f) Audio messages
9. The following shall be recorded by the NAC for each alarm (at a minimum):
 - a) Time and date
 - b) Location (building, floor, zone, etc.
 - c) Equipment (air handler, etc.)
 - d) Acknowledge time, date and user who issued acknowledgement
 - e) Number of occurrences since last acknowledgement
10. Alarm actions may be initiated by user defined programmable objects created for that purpose.
11. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
12. A log of 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.
13. Provide a "query" feature to allow review of specific alarms by user defined parameters.
14. A separate log for system alerts (controller failures, network failures, etc.) shall provided and available for review by the user.
15. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

F. Data Collection and Storage

1. The NAC shall be provided with the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by a log object that shall have, at a minimum, the following configurable properties:
 - a) Designating the log as interval or deviation.

- b) For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
- c) For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

- d) For all logs, provide the ability to set the maximum number of data stores and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - e) Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
3. All log data shall be stored in a relational data base in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
4. All log data shall be available to the user in the following formats:
 - a) HTML
 - b) XML
 - c) Plain text
 - d) Comma or tab separated values
5. The NAC shall have the ability to archive it's log data via a server on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a) Archive on time of day
 - b) Archive on user-defined number of data stores in the log (buffer size)
 - c) Archive when log has reached it's user-defined capacity of data stores
 - d) Provide ability to clear logs once archived
6. The NAC shall 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 it's 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:
 - a) Time and date
 - b) User ID
 - c) Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
7. Data Base back up and storage:
 - a) The NAC shall have the ability to automatically backup its database. The database shall be backed up monthly.
 - b) Copies of the current database and, at the most recently saved database shall be stored in the NAC.
 - c) The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.05 STANDALONE DIGITAL CONTROLLERS (INVENSYS IA-SERIES)

General

- A. The SDC controllers shall permit the simultaneous operation of all control, communication facilities management and operator interface software, as programmed by the Contractor or User. Modification of the on-board SDC controller database shall be performed on-line using the built-in interface. Systems that require the SDC to be removed from service while DDC control sequences are modified shall not be acceptable.
- B. SDC controllers shall utilize true floating-point arithmetic capabilities. To accommodate totalization of large totalized values, SDCs with reporting capability shall support the calculation, accumulation and display of values within the range of +/-10 to the 10th power. The SDC shall employ a multi-tasking, multi-user operating system.
- C. All programming defining the functions to be performed by the SDC, including but not limited to application programs and point database within each SDC shall be protected from loss due to power failure for a minimum of six months. Systems not providing non-volatile memory shall provide a system rechargeable battery backup system sufficient to provide protection for the specified 6 month period.
- D. SDC controllers shall be equipped with a minimum of two operator service ports for the connection of serial devices such as the GP, HMI, modems, printers, etc. Connection of a service device, to a service port, shall not cause the SDC controller to lose communications with its peers or other networked device controllers. The SDC shall be able to route alarms, trends, and reports to any serial device connected to the network. This shall also include the auto dialing to remote locations. The SDC shall be capable of dialing out to a minimum of ten remote locations for the annunciation of alarms. Alarms shall include the time, date, and alarm condition, in addition to a user-defined detailed message detailing the condition.
- E. The SDC shall provide Alarming, point trending and Energy report generation capabilities. Alarming points shall be uniquely definable, with multiple alarms assignable to a single point. Such alarms shall be provided with a unique 80-character message. Systems utilizing an alarm messages library, shall describe the size of the library and verify how all alarming within the SDC will be guaranteed unique 80 character messages.
- F. The quantities of trended point values shall be limited only by total controller memory space. If necessary, a SDC may be dedicated fully to a trending task, allowing all controller memory to be available for the trend storage. Each unique trend report shall contain a minimum of 4 different points and a minimum of 128 samples per point. Trending frequency for each report shall be operator definable from a sample once a second to a sample once every 24 hours. Trend reports shall be internally formatted by the SDC and shall be reportable directly to a serial printer, a VT-100 display terminal, a CCS, CHS or any other device capable of receiving a formatted ASCII data file.
- G. The energy reports shall not be limited in quantities only by available memory within the GDC. Each Energy report shall be fully formatted and reportable to a serial printer, a VT-100 display terminal, a CCS, a CHS or any other device capable of receiving a formatted ASCII data file. As a minimum, each Energy report shall provide a daily report and a monthly report with summary information such as outside air temperature, outside air humidity, total energy consumed and degree-day calculations.

- H. The SDC controller shall provide a built-in operator interface, which consists of an alphanumeric LCD display of 4 lines x 20 characters, and a multi-function keyboard. Devices without such built-in displays shall provide a permanently connected HMI as described elsewhere in this specification, one per SDC.
- I. The SDC shall provide for logical grouping of network variables and allow for viewing and editing of system parameters. Logical grouping menus shall allow for detailed descriptions of system variables of a minimum of 20 characters.
- J. The SDC shall communicate via the BMS Network Interfaces to the enterprise LAN, whether dedicated or common. The SDC shall provide communications connectivity to the LonWorks bus and shall support any LONMARK/LonWorks compliant devices.
- K. The SDC shall provide connectivity to the currently marketed BMS solutions offered by the manufacturer. The SDC shall be interoperable these BMS offerings for scheduling, global data sharing, Energy Demand Limiting, alarming, optimized start/stop, and systems integrations for all other data within the entire BMS. In addition, the SDC shall provide connectivity to existing DDC controllers currently marketed by the manufacturer.
- L. The SDC shall be compliant with the current and previously marketed HMIs of the manufacturer, and shall be capable of full bi-directional communications through the LAN, with previously manufactured SDC controllers sold for the last ten years by the manufacturer.

2.6 INTEROPERABLE LONMARK CONTROLLERS (INVENSYS IA-SERIES)

General

- A. Controls shall be microprocessor based Interoperable Invensys IA Series Controllers (IA), bearing the applicable LONMARK interoperability logo on each product delivered. IAs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, VAV Terminal Boxes and other applications as shown on the drawings. IAs shall be based on the Echelon Neuron 3150 microprocessor working from software program memory which is physically located in the IA. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
- B. To simplify controls and mechanical service troubleshooting, the IA shall be mounted directly in the control compartment of the unitary system. The IA shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment.
- C. The IAs shall communicate with the SDC at a baud rate of not less than 78.8K baud. The IA shall provide LED indication of communication and controller performance to the technician, without cover removal.
- D. The IAs shall be fully supported and communicate with any and all GUI(s) on the bus.

E. S-Bus Sensor

The S-Bus Sensor shall connect directly to the IA controller and shall not utilize any of the I/O points of the controller. The S-Bus Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The S-Bus Sensor shall provide a communications jack for connection to the LON communication trunk to which the IA controller is connected. The S-Bus Sensor, the connected controller, and all other devices on the LON bus shall be accessible by the Graphical Programming tool.

The S-Bus Sensor shall be available in the following variations;

Tamper-resistant (no display)

Tamper-resistant with tenant override

Basic user functions (LCD display and setpoint adjustment and tenant override)

Full user functions (LCD display and network-variable access and tenant override)

ASHRAE 95 compliance (LCD display and sub-base functionality)

The S-Bus Sensor shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of the electronics or esthetic covering. The IA Sensor shall allow for the customization of the color on the esthetic covering as a standard offering. User interface with the IA Sensor shall be provided as a configurable function by the BMS, and shall offer password protection for access to network variable editing. Multiple network variables shall be accessible and editable by the IA Sensor. Icons shall be utilized to represent sensor and controller function status, affording independence from a single language for use interface.

F. IA Controller Functionality

The IA CONTROLLER shall provide a -40 to 140 degree Fahrenheit ambient operating temperature range. The IA CONTROLLER shall be provided in a modular configuration that allows for the rough in of all wiring without the presence of any of the IA Controller electronics. IA Controller devices that require the electronics to be present at the time of wiring, will require an additional controller to be provided for every 10 devices on the drawings, to allow for the preconfiguration and storing for service purposes.

- G. All input/output signals shall be directly hardwired to the IA Controller. For all non-VAV terminal applications, a minimum of two input points of the IA Controller shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If universal points are not available, a minimum of two input points (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the IA Controller shall be of the relay and universal analog form. All digital outputs shall be relay type. IA Controller devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool (GP) or a volt-ohm meter (VOM). All I/O points shall be utilized by the local IA Controller or shall be available as I/O points for other controllers throughout the network.

- H. All IA Contollers shall be fully application programmable and shall at all times maintain their LONMARK certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IA Controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

- I. The IA Controller shall be provided with the ability to interface with the Graphical Programming tool. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the GP to have full functionality as described in GP section of this specification. Through the connected controller all IA Controller devices on the LON bus shall be accessible by the Graphical Programming tool.
- J. Mechanical equipment manufacturers desiring to provide IA Controller type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.
- K. VAV Controller Functionality (INVENSYS IA-SERIES)
 1. Controls shall be microprocessor based Pressure Independent Variable Air Volume Digital Controllers, as shown in the drawings. The VAV IA controller shall be a single integrated package consisting of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. An alternate model shall be offered that allows for direct connectivity to an external actuator for those applications that employ a non-butterfly style damper configuration. All input/output signals shall be directly hardwired to the VAV IA controller. The internal actuator shall employ a manual override that allows for powered or non-powered adjustment of the damper position. In all cases, the controller shall automatically resume proper operation following the return of power to, or control by the IA. Programming, configuring and/or troubleshooting of input/output signals shall be easily executed through the IA sensor or GP tool connected at the wall sensor location.
 2. The VAV IA control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10-year life from all components. The VAV IA controller shall provide internal differential pressure transducer for pressure independent applications with an accuracy of $\pm 5\%$. Flows through transducers requiring filter maintenance are not acceptable. The VAV IA shall provide zone control accuracy equal to or better than ± 1 degree Fahrenheit. Systems providing control accuracy's greater than ± 1 degrees Fahrenheit are not acceptable. With the submittal package, contractor shall provide performance data that verifies control accuracy of the VAV IA controller.
 3. All input/output signals shall be directly hardwired to the VAV IA controller. A minimum of one input point of the VAV IA controller shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If a universal point is not available, a minimum of one input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the IA controller shall be of the relay and universal analog form. All digital outputs shall be relay type. IA devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool or a volt-ohm meter (VOM). All I/O points shall be utilized by the local IA controller or shall be available as I/O points for other controllers throughout the network.

4. The BMS contractor shall provide VAV IA controller to the VAV box manufacturer, for factory mounting. The VAV terminal unit supplier shall include in its price all costs for mounting of VAV IA controller, connection of actuator to damper shaft, wiring of device power, wiring of VAV IA controller to fan (fan powered terminal) and wiring to electric reheat coils or reheat valve actuator as specified on drawing.
5. The VAV terminal manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV box. The VAV terminal unit manufacturer shall supply a line to low voltage transformer, of sufficient capacity, to power the VAV IA controller plus all reheat valves and/or contactors and fan circuits associated with the VAV terminal and actuator assemblies. The BMS contractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The BMS contractor shall provide and install all wiring between the valve and VAV IA controller and between the room sensor and the VAV IA controller.

L. IA VAV - Air Balancing

Through the portable tool, the VAV IA controller shall support a fully prompted Air Balance sequence. The GP tool shall, when connected through the wall sensor, access the connected VAV IA unit. The air balance sequence shall step the balancing contractor through the checkout and calibration of the VAV IA controller. Upon completion of the balancing sequence, the flow values presented by the VAV IA shall match those observed by the balancing contractor's measurement equipment. Additionally, upon completion of the air balance, the SDC shall automatically archive the balance settings for future use if the controller were to require replacement. The BMS contractor will provide the software tool and cable to the balancer at no cost with a one time one hour instruction. The balancing contractor is required to return the tool in working order as soon as he completes his work.

2.07 SYSTEM PROGRAMMING

- A. The system supplied by the installer must be programmed using "Java" objects. A library of control, application, and graphical objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and "wiring" them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User screens are created in the same fashion. Data for the user screens is obtained by graphically linking the user screen 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 screen. Systems requiring separate software tools or processes to create applications and user interface screens shall not be acceptable.
- B. Programming Methods
 1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical soft-wiring 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 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; i.e., internal, external, hardware, etc.

2. Configuration of each object will 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 will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode will provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line, the monitor mode will 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. Uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.08 GRAPHICAL USER INTERFACE SOFTWARE (Add to existing YNET System)

- A. Operating System: The GUI shall run on Microsoft Windows 2000 or later.
- 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-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and 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. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, 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 set points shall be accomplished in a graphical manner.
 5. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 6. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

7. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 8. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
 2. Add/delete objects to the system.
 3. Tune control loops through the adjustment of control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select points to be alarmable and define the alarm state.
 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. 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 through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- H. Alarm Console
1. The system will be provided with 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 acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 2. When the Alarm Console is enabled, a separate alarm notification window will supercede 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 shall not be acceptable.

2.09 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™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BMS, shall not be acceptable.
- C. 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 Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 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. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
 6. User's 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 set points in a graphical manner.
 - b) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - c) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - d) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - e) View logs and charts
 - f) View and acknowledge alarms

7. The system shall provide the capability 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 their 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.

2.10 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 Graphical User Interface programming software, to support the integration of these devices into the BMS. 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

2.11 LonWorks NETWORK MANAGEMENT

- A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system shall not be accepted.

2.12 GRAPHICAL USER INTERFACE COMPUTER (provided by owner if required)

- A. The desktop computer shall be an Intel Pentium based computer (minimum processing speed of 400 Mhz with 256 MB RAM and a 10-gigabyte minimum hard drive). It shall include a 32X CD-ROM drive, 3.5" floppy drive, a 100 MB Zip drive, 2-parallel ports, 2-

asynchronous serial ports and 2-USB ports. A minimum 17", 28-dot pitch SVGA color monitor with a minimum 80 Hz refresh rate shall also be included.

- B. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 8-ppm print speed minimum.

2.13 OTHER CONTROL SYSTEM HARDWARE

- A. Control Damper Actuators (where furnished by the Temperature Control sub-contractor): Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Provide one actuator per damper minimum. Pneumatic actuators shall be sized to provide a minimum of 5 in-lb torque per square foot of damper area and shall include positive positioning pneumatic relays when sequenced with other actuators or when control action is to be proportional.
- B. Control Valves: Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Electrically controlled valves shall include spring return type actuators sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed). Pneumatically actuators for valves, when utilized, shall be sized for tight shut-off against system pressures. Three-way butterfly valves, when utilized, shall include a separate actuator for each butterfly segment.
- C. Wall Mount Room Thermostats: Each room thermostat shall provide temperature indication to the digital controller, provide the capability for a software-limited set point adjustment and operation override capability. An integral LCD shall annunciate **current room temperature and** set point as well as override status indication. In addition, the thermostat shall include a port for connection of the portable operator's terminal described elsewhere in this specification.
- D. Duct Mount, Pipe Mount and Outside Air Temperature Sensors: 10,000-ohm thermistor temperature sensors with an accuracy of $\pm 0.2^{\circ}\text{C}$. Outside air sensors shall include an integral sun shield.
- E. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- H. Power Monitoring Interface: The Power Measurement Interface (PMI) device shall include the appropriate current and potential (voltage) transformers. The PMI shall be certified under UL-3111. The PMI shall perform continuous true RMS measurement based on 32 samples-per-cycle sampling on all voltage and current signals. The PMI shall provide outputs to the BMS based on the measurement and calculation of the following parameters: (a) current for each phase and average of all three phases, (b) kW for each phase and total of all three phases, (c) power factor for each phase and all three phases, (d) percent voltage unbalance and (e) percent current unbalance. These output values shall be hard-wired inputs to the BMS or shall be communicated to the BMS over the open-protocol LAN.

- I. Water Flow Meters (when required): Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown. Accuracy shall be $\pm 2\%$ of actual reading from 0.4 to 20 feet per second flow velocities.
- J. Water Differential Pressure Switch: Switch shall measure the pressure difference between two sources and activate a SPDT switch upon an adjustable change in pressure differential. Pressure differential set point shall be adjustable between 8-70 psi. Switches shall be selected to withstand expected system pressures. Switch electrical rating shall be 20 amp at 120 VAC.
- K. Ambient Light Sensor: Ambient light sensor designed to provide an analog output signal proportional to the ambient light present. Sensor shall contain a precision photo-diode type cell for light measurement. Sensor shall be designed for outdoor application and be directed towards the north sky, away from lighted signs, outdoor lights or similar light producing equipment. Maximum range shall be adjustable from 5 to 750 foot-candles at the sensor face. Accuracy shall be $\pm 1\%$ at 70 degrees F.
- L. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. All electrical devices within a control panel shall be factory wired. All external wiring shall be connected to terminal strips mounted within the panel. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- M. Variable Frequency Drives: Furnished and installed by BMS installer. See specification Section 23 09 13.**
- N. Air Flow Measuring Stations (AFMD): Furnished and installed by BMS installer. See control diagrams for use in measuring outside airflow.**
- 1. Ebtron GTX 116 Thermal Dispersion type or equal. Must be able to accurately measure airflow and temperature to be considered.**
 - 2. Each sensor shall have (2) bead-in-glass thermistors**
 - 3. Operating range 0 to 5,000 FPM**
 - 4. Airflow accuracy shall be $\pm 2\%$ of reading over entire operating airflow range.**
 - 5. Temperature accuracy shall be $\pm 0.15^\circ\text{F}$ over the entire operating temperature range of -20F to 160F .**
 - 6. Probes shall be constructed of extruded, gold anodized 6063 aluminum tube. All wires within the tube shall be kynar coated.**
 - 7. Probe mounting brackets shall be 304 stainless steel.**
 - 8. Transmitter shall have LCD display capable of simultaneously displaying air flow and temperature.**
 - 9. Transmitter shall have a power switch and operate on 24 VAC power (supplied by BMS installer, not isolated).**
 - 10. Linear analog output signals for air flow and temperature: field selectable, fuse protected and isolated, 0-10VDC or 0-24mA (4 wire).**
 - 11. AFMS shall be UL listed and CE labeled as an entire assembly.**
- O. Differential Pressure Sensor (Dry Media): As manufactured by Veris, Setra, BAPI, or Modus.**

1. **Sensor shall have multiple ranges available.**
 2. **Sensor shall have provision for zeroing by pushbutton or digital input.**
 3. **Sensor shall have field selectable outputs of 0-5v, 0-10v, and 4-20ma.**
 4. **Sensor shall be available with unidirectional or bi-directional mode.**
 5. **Sensor shall have brass-barb fittings.**
 6. **Sensor shall operate from 24vdc or 24vac. (AC power applies to operation in voltage mode only)**
 7. **Sensor housing dimensions shall be 4.5" x 4.5" x 2"**
 8. **Sensor shall have LCD display.**
 9. **Sensor accuracy shall be +/-1% FS selected range.**
 10. **Sensor overpressure rating shall be 3 PSID proof, and 5 PSID burst.**
- P. Raceways and wiring shall comply with Division 26 00 00 unless otherwise specified herein:**
1. **Wire insulation shall be 600 volt, Type THW or THHN.**
 2. **Line voltage shall be #12 or larger.**
 3. **Low Voltage shall be #16 or larger**
 4. **Sensor and signal wiring shall be #18 AWG unless otherwise specifically required by the connected equipment.**
- Q. BTU Measurement System**
1. **The entire BTU Measurement System shall be manufactured by a single manufacturer, ONICON Incorporated, and shall consist of a turbine flow meter, two solid state temperature sensors, a BTU meter, thermowells, all required mechanical installation hardware, and color-coded interconnecting cable.**
 2. **The entire system shall be serialized and include a factory calibration of the complete system. All equipment shall be covered by manufacturer's transferable two-year "No Fault" warranty.**
- R. UtilityVision Panel - Contractor shall purchase from distributor Chevron Monitoring Services. The UtilityVision Panel will contain the following:**
1. **One AcquiSuite A8812 metering platform**
 2. **One Isobar Ultra4 plug-in strip**
 3. **One AcquiSuite A8812 110V ac to 24V DC power transformer**
 4. **One 2x4 junction box with dual 110V AC outlets installed. Ready for field connection to 110V AC circuit.**
- Note: Additional electronic monitoring devices and their associated wiring terminal strips may also be required based on possible custom UtilityVison panel requirements that can arise. Contact Chevron Energy Solutions, Stan Gray (913-748-8667) for additional information as required.**
5. **Contractor shall terminate all wiring to the appropriate terminal strips.**

PART 3 - EXECUTION

3.01 INSTALLATION

- A.** All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the

employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

- B. Install system and materials in accordance with manufacturer's instructions.
- C. Line voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by Div. 16
- D. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Temperature Control sub-contractor.
- E. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.02 CONTROL SYSTEM WIRING

- A. All electrical control wiring and low voltage power wiring to the control panels shall be the responsibility of the BMS contractor. All 120 V power for control panels by Div.16
- B. All wiring shall be in accordance with Division 16, the National Electrical Code and any applicable local codes. All BMS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where BMS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.
- C. All exposed wiring shall be routed within surface metal raceway painted to match adjacent surfaces and routed in a neat, unobtrusive manner, parallel to surfaces. The routing may often take a non-direct route to minimize its appearance and as such Contractor shall assume extra material and labor to allow for approach.

3.03 BTU MEASUREMENT SYSTEM, THERMOWELLS AND UTILITY VISION PANELS

- A. Furnish and install all labor, materials, equipment, and service necessary to install and commission a complete and operable UtilityVision Monitoring System.**
- B. Mount UtilityVision Panel in an accessible location in specified utility equipment room, and provide 120Volt Power to the panel. The power source shall be a separate line with its own circuit breaker or circuit protection device, though it can share the same power supply as the BTU meter. Use a three wire service in which one wire is protective earth ground.**
- C. Install a ½ " EMT with a CAT 6 cable and RJ45 connectors each end from the UtilityVision Panel to the District's IT network switch. Final connections to the IT switch to be made by the District's Information Technology Department.**
- D. Furnish and install the Onicon System-10 BTU Meters per manufacturer's Installation and Operation Guide, which is summarized below. Contractor shall complete System-10 Lon Order Form prior to ordering BTU meter.**
 - 1. BTU Meter**
 - a. Furnish an ONICON System-10-MOD BTU Meter. The BTU meter electronics shall be housed in a steel 8"x10"x4" NEMA-13 enclosure**

and shall include a front panel mounted two-line alphanumeric LCD display for local indication of Energy Total, Energy Rate, Flow Rate, Flow Total, Supply Temperature and Return Temperature. A single 24VAC connection to the BTU shall provide power to the BTU meter electronics and to the ONICON turbine flow meter (120 VAC input is optional). Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable by the user using the front panel keypad (no special interface device or computer required). A certificate of calibration shall be provided with each BTU meter.

- b. The contractor shall locate the BTU meter on a vibration free surface that can be easily read by the plant operators, mount the unit, and provide 120VAC power source. The power source should be a separate line with its own circuit breaker or circuit protection device, though it can share the same power supply as the UtilityVision Panel. Use a three wire service in which one wire is protective earth ground.
- c. Terminate the wire connections from the temperature sensors to the BTU Meter T3 terminal strip, per installation instructions.
- d. Terminate the wire connections from the flow sensors to the BTU Meter T4 terminal strip, per installation instructions.
- e. The BTU meter shall provide communication conforming to Modbus RTU / 9600 baud communication protocol, and shall provide the following information via Modbus: Energy Total, Energy Rate, Flow Rate, Flow Total, Supply Temperature and Return Temperature. Install and connect ½ " EMT with Modbus network utilizing 18 gauge twisted pair (Belden 1120A 2-wire, or equivalent) connecting the two (2) System 10 Lon BTU Meters to the UtilityVision Panel. Multiple meters should be daisy chained per manufacturer's instructions.

2. Flow Meter Installation

- a. The turbine flow meter shall sense the turbine rotation by means of electronic impedance sensing (magnetic sensing not acceptable). Each flow meter shall be individually wet calibrated against a volumetric standard accurate to within 0.1% and traceable to the U.S. National Institute of Standards and Technology (NIST). A certificate of calibration shall be provided with each flow meter. Flow meter accuracy shall be within $\pm 0.5\%$ at calibrated typical flow rate, within $\pm 1\%$ of reading over a 10:1 turndown (3.0 to 30 ft/s) and shall be within $\pm 2\%$ of reading over a 50:1 turndown from 0.4 ft/s through 20.0 ft/s velocity. Flow meter shall be rated for line pressure up to 400 PSI. The turbine flow meter shall be manufactured by ONICON Incorporated and shall be a Model F-1200 Dual Turbine Insertion Flow Meter, Frequency Output.
- b. The contractor shall locate the flow meter in the supply or return pipe on the respective hot water or chilled water system, whichever pipe offers the best arrangement. The meter should have obstacle clearances of 10 pipe diameters upstream and 5 meters downstream. The flow meter itself can be mounted in a horizontal pipe from 0 to 180

degrees, however do not install the meter on the highest horizontal pipe as it may contain air pockets. The meter can also be installed in vertical pipe though the meter shall not be installed in vertical piping where the water is traveling downward as it may contain air pockets.

- c. The thermowells may be installed as a hot tap using a wet tap drilling machine and the hot tap installation kit, per the installation instructions. The installation kit consists of a 1-1/4" weld-a-let, 1-1/4" close nipple, 1-1/4" full port ball valve, and a 1" reducer. See the attached F1100 Hot Tap detail for additional information.
- d. Contractor shall install the 22 gauge twisted shielded 7-conductor cable, typically provided through the meter order, from the temperature sensor to the BTU meter.

3. Thermowell and Temperature Sensor Installation

- a. Temperature sensors shall be bath calibrated against a NIST traceable standard and matched for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm 0.150F$ (including the error from individual temperature sensors, sensor matching, input offsets, and calculations). Temperature data shall be transmitted to the BTU meter via a current loop.
 - b. The contractor shall locate the temperature sensors as close as possible to the beginning and end of the loop in which the transfer of thermal energy will be measured.
 - c. The thermowells may be installed as a hot tap using a wet tap drilling machine, per the installation instructions.
 - d. The temperature sensors are factory matched and tagged by serial number to each specific BTU meter, and are also labeled as Supply and Return. Install temperature sensors into thermowells per installation instructions.
 - e. Contractor shall install the 22 gauge twisted shielded cable, typically provided through the meter order, from the temperature sensor to the BTU meter.
- E. All work shall be in conformance with Division 26 00 00.
- F. Tag and label. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding per Division 26 00 00, where applicable.
- G. Test-meter installation for proper operation, accuracy, and usability of output data.
- H. Coordinate with the Chevron Metering Division to verify that they are able to "view" all installed components from a remote location. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.04 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Temperature Control sub-contractor at no expense to the Owner

3.05 WARRANTY ACCESS

- A. The Owner shall grant to the Temperature Control sub-contractor, reasonable access to the BMS during the warranty period. The owner shall provide VPN access at no cost to the contractor, for remote communication to the BMS during this period.

3.06 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Temperature Control sub-contractor shall load all system software and start-up the system. The Temperature Control sub-contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. Graphical User Interface software documentation shall be provided in HTML document format with context-sensitive hyperlinks is an integral part of the graphical user interface and does not require separate hard-copy manuals.
- C. The Temperature Control sub-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 DDC system operation.
- D. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in 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 the Temperature Control sub-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.

3.06 OPERATOR INSTRUCTION, TRAINING

- A. During system check-out and testing and at such time acceptable performance of the BMS hardware and software has been established the Temperature Control sub-contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Temperature Control sub-contractor shall provide 16 hours of instruction to the owner's designated personnel on the operation of the BMS system and describe its intended use with respect to the programmed functions specified. Operator orientation of the BMS system shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.
- C. The training shall be in two sessions as follows:
 - 1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
 - 2. First Follow-Up Training: One days (8 hours) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

END OF SECTION

SECTION 26 20 00**LOW VOLTAGE ELECTRICAL DISTRIBUTION****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
1. Grounding.
 2. Dry-type transformers.
 3. Power distribution panelboards.
 4. Lighting and appliance branch panelboards.
 5. Overcurrent protection devices.
 6. ~~_____ Contactors.~~
 7. ~~_____ Time switches.~~

1.02 SYSTEM DESCRIPTION

- A. Basis of Design: Switchboards, dry-type transformers, and power distribution panelboards, on Drawings are designed based on Square D product line. Approved manufacturers listed below are allowed on condition of meeting the specified conditions including the available space for the equipment (including Code required working clearances). Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

1.03 SUBMITTALS

- A. Provide Shop Drawings and Product Data for the Following Equipment:
1. Grounding.
 2. Dry-type transformers.
 3. Power distribution panelboards.
 4. Lighting and appliance branch panelboards.
 5. Overcurrent protection devices.
 6. ~~_____ Contactors.~~
 7. ~~_____ Time switches.~~
- B. Provide operating and maintenance instructions from the manufacturer for project closeout, see Project Closeout Requirements in Division 01.
1. Dry-type transformers.
 2. Power distribution panelboards.
 3. Lighting and appliance branch panelboards.
 4. Overcurrent protection devices.
 5. ~~_____ Contactors.~~
 6. ~~_____ Time switches.~~

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.
- C. Conform to SMCCD requirements and standards. ~~Conform to the requirement of the serving electric utility.~~

PART 2 - PRODUCTS**2.01 GROUNDING MATERIALS**

~~A. Ground Rods: Copperclad steel, 3/4 inch diameter, 10 feet long, tapered point, chamfered top. Manufacturers: Weaver, Thomas & Betts, Talley, or approved.~~

~~B.A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors. Mechanical type of connectors are not acceptable. Manufacturers: Burndy Hyground Compression System, Erico/Cadweld, Amp Ampact Grounding System, or approved.~~

~~C. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe. Burndy GAR Series, O-Z Gedney, Thomas & Betts, or approved.~~

~~D.B. Grounding Electrode Conductor: Bare copper stranded conductor.~~

2.02 DRY-TYPE TRANSFORMERS

A. Manufacturers: Eaton Electrical, Federal Pacific, General Electric, Jefferson Electric, Siemens, Square D, Controlled Power Co., or approved.

B. Voltage: Unless otherwise indicated on Drawings, operate transformers at 3 phase, nominal 480VAC delta primary to 3 phase 120/208VAC wye secondary. Provide standard NEMA, ANSI 3 phase primary taps; that is, 10 percent range of tap voltage adjustment for transformers smaller than 30KVA and 15 percent range tap voltage adjustment for 30KVA and larger.

C. Maximum temperature rise at full load: 150 degrees above 40C ambient temperature. NEMA TP-1 compliant.

D. Provide transformer coils of the continuous wire wound construction and impregnate with non-hygroscopic, thermosetting varnish prior to baking.

E. Visibly ground the core of the transformer to enclosure by means of a flexible ground strap.

F. Mount transformers, core and coil, on vibration mounting pads designed to suppress transmission of 120-cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight.

G. Transformer Supports: Provide vibration isolation hangers and pads, brackets and supports for a complete installation.

H. Provide weather resistant enclosure and factory rating for exterior locations.

I. Lugs: Provide mechanical type lugs for conductor terminations.

2.03 LIGHTING AND APPLIANCE BRANCH PANELBOARDS

A. Manufacturers: Eaton Electrical, General Electric, Siemens, Square D, or approved..

B. Enclosures:

1. Flush Panelboards Rated 400 Amp or Less: Maximum enclosure depth, 5-3/4 inches.
2. Wiring Gutter Size: 5 inches at sides, 6 inches top and bottom.
3. Finish: Galvanized steel constructed in accordance with UL 50 requirements.

- Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
4. Hinged door with door-in-door construction, flush lift latch and lock, two keys per panel. Key panelboards alike.
- C. Interior:
1. Copper ground bar with suitable electroplating (tin) for corrosion control at connection.
 2. Provide copper ground bar to accommodate specified terminal lugs.
 3. Predrill bus for bolt-on type circuit breakers.
 4. Provide double lugs or landing pads for feed through feeders.
 5. Provide feed through feeder lugs for field connection of multi-section flush panel sections, where applicable.
 6. When distribution panel is feeding isolated ground circuits, provide isolated ground bar, insulated from panelboard enclosure, to accommodate specified terminal lugs.
 7. Provide fully rated ~~(unless otherwise noted on drawings)~~ integrated equipment rating greater than the available fault current. See drawings for available fault current. ~~If drawings do not have the available fault currents, then coordinate with serving electric utility.~~ Minimum rating is 10,000 amps rms symmetrical for 208 volt panelboards; 14,000 amps rms symmetrical for 480 volt panelboards.
 8. Lugs: Mechanical type rated for both aluminum and copper conductors.
 9. Provide interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating on the interior or in a booklet format inserted in a sleeve inside the panel cover.
- D. Main Circuit Breaker, Where Applicable: UL listed to accept solid or stranded, ~~aluminum or~~ copper conductors. Lugs suitable for 90C rated wire sized according to the 75C temperature rating per CEC.
- E. Branch Circuit Breakers:
1. Bolt-on type bus connectors.
 2. UL listed to accept solid or stranded, ~~aluminum or~~ copper conductors. Lugs suitable for 90C rated wire sized according to the 75C temperature rating per CEC.
 3. UL listed for use with the following factory installed accessories: Shunt trip, auxiliary switch and alarm switch.
 4. UL listed with the following ratings:
 - a. 15 to 125 amp breakers: Heating, Air Conditioning, and Refrigeration (HACR).
 - b. 15 to 30 amp breakers: High Intensity Discharge (HID) lighting.
 - c. 15 to 20 amp breakers: Switch Duty (SWD).
- F. When indicated on Drawings, provide an isolated ground bus in addition to the equipment ground bus.

2.04 Power Distribution Panelboards

- A. Manufacturers: Eaton Electrical, General Electric, Siemens, Square D, or approved.
- B. Enclosures:
1. Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
 2. Finish: Galvanized steel constructed in accordance with UL 50 requirements. Front shall have ANSI 49 gray enamel electrodeposited over cleaned

- phosphatized steel.
3. Hinged door with door-in-door construction, flush lift latch and lock, two keys per panel. Key panelboards alike.
- C. Interior:
1. Copper bar with suitable electroplating (tin) for corrosion control at connection.
 2. Provide copper ground bar to accommodate specified terminal lugs.
 3. Panelboard Interior: Three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. Molded polyester insulators shall support and provide phase isolation to entire length of bus.
 4. Predrill bus for bolt-on type circuit breakers.
 5. Provide double lugs or landing pads for feed through feeders.
 6. Provide feed through feeder lugs for field connection of multi-section flush panel sections.
 7. When distribution panel is feeding isolated ground circuits, provide isolated ground bar, insulated from panelboard enclosure, to accommodate specified terminal lugs.
 8. Fully equip unused spaces for future devices, including manufacturer required connectors and mounting hardware.
 9. Provide fully rated ~~(unless otherwise noted on drawings)~~ integrated equipment rating greater than the available fault current. See drawings for available fault current. If drawings do not have the available fault currents, then coordinate with serving electric utility. Minimum rating is ~~40,000-~~ 25,000 amps rms symmetrical for 480 volt panelboards.
 10. Lugs: Mechanical type rated for both aluminum and copper conductors.
 11. Provide interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating on the interior or in a booklet format inserted in a sleeve inside the panel cover.
- D. When indicated on Drawings, provide an isolated ground bus in addition to the equipment ground bus.

2.05 OVERCURRENT PROTECTION DEVICES

~~A. Fuses: Dual element, time delay, current limiting, nonrenewable type, rejection feature. UL Class RK1 1/10 to 600 amp, UL Class L, above 600 amps. Provide fuse pullers for complete range of fuses. Manufacturers: Bussmann, Ferraz-Shawmut, Littelfuse, or approved.~~

~~B.A.~~ Molded Case Circuit Breakers:

1. 1-, 2-, or 3-pole bolt-on, single-handle common trip, 600VAC or 250VAC as indicated on Drawings.
2. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
3. Calibrate for operation in 40C ambient temperature.
4. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
5. 151 to 400 Amp Breakers: Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
6. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions. Provide ground fault function for breakers greater than 400 amps.
- ~~7. Provide circuit breakers series rated when series combination ratings are applied, identify equipment enclosures.~~
- ~~8.7.~~ Manufacturers: Eaton Electrical, General Electric, Siemens, Square D, or approved.

2.06 LIGHTING CONTACTORS

~~A.Manufacturers: Asco, Eaton Electrical, General Electric, Siemens, Square D, or approved.~~

~~B.Approved per UL 508. Design in accordance with NEMA ICS2-211B, rated for application to 600-volt maximum.~~

~~C.Electrically Held Contactor Coil: Continuously rated and encapsulated.~~

~~D.Mechanically Held Contactor: Encapsulated latch and unlatch coils, coil clearing contacts.~~

~~E.Enclosures: Provide NEMA enclosure suitable for location and use, flush or surface-mount as indicated on Drawings.~~

~~F.Lighting Contactors:~~

~~1.Continuously rated 20 amp per pole for types of ballast and tungsten lighting and resistance loads, do not derate for use on high-inrush loads.~~

~~2.Contacts: Double break, silver-cadmium-oxide. Auxiliary arcing contacts not acceptable. Convertible Contacts, N.O. or N.C. Contact status, N.O. or N.C., clearly visible.~~

2.07 ELECTRONIC TIME SWITCHES

~~A.Double pole, single throw; one N.O. contact, one N.C. contact. 24-hour digital. Battery power source to provide minimum of 3 years of memory backup. Eight event setpoints. Provide enclosure with separate hinged door, recessed or surface as indicated on Drawings.~~

~~B.Manufacturers: Intermatic, Paragon, Tork, Sangamo, or approved.~~

PART 3 - EXECUTION**3.01 INSTALLATION**

~~A. Verify campus utility requirements prior to bidding and provide associated work required by campus utility including, but not limited to: Service underground primary including conduit, pull cord, excavation and backfill, underground pull vaults, pole risers, transformer pads, vaults, and the like, secondary service lateral including conduit, and conductors, grounding of transformers.~~

~~B.A. Raceway Grounding:~~

- ~~1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger grounding conductor is included with circuit, use grounding bushing with lay-in lug.~~
- ~~2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to the enclosure, by grounding bushings and ground wire to the grounding bus.~~
- ~~3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.~~
- ~~4. Install equipment grounding conductor, code size minimum unless noted on Drawings, in nonmetallic raceway systems.~~

~~C.B. Feeders and Branch Circuits Grounding:~~

- ~~1. Provide separate, equipment grounding insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Install continuous insulated equipment copper ground conductors~~

~~within the following circuits; feeders, circuits for computer systems and other circuits as indicated on Drawings.~~

2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment ground conductors for feeders and branch circuits sized in accordance with Table 250.122.

D.C. Boxes, Cabinets, Enclosures and Panelboards Grounding: Bond grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.

E.D. Motors, Equipment and Appliance Grounding: Install code size equipment grounding conductor from outlet box to (motor) equipment frame or manufacturer's designated ground terminal.

F.E. Receptacle Grounding: Connect ground terminal of receptacle to equipment ground system by No. ~~12~~ 14 conductor bolted to outlet box except isolated grounds where noted. Self grounding nature of receptacle devices does not eliminate conductor bolted to outlet box.

G.F. Telecommunications Grounding System: Mount telecommunications main grounding busbar (TMGB) in each IDF. Mount a telecommunications grounding busbar (TGB) in each IDF. Install main telecommunications bonding backbone (TBB) conductor continuous from the MDF to every IDF. Bond the TMGB to the main building electrical grounding system and the nearest acceptable structural ground with a 3/0 AWG copper equipment grounding conductor.

H.G. Separately Derived Systems: Ground each separately derived system.

I.H. Panelboards (Power Distribution Panelboards and Lighting and Appliance Branch Panelboards):

1. Install panelboards as directed by manufacturer's installation instructions.
2. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
3. Install panelboards surface or flush mounted in accessible locations as indicated on drawings. Maintain or exceed minimum clearances required by code.
4. Where flush panels are installed, verify available recessing depth and coordinate wall framing with other divisions.
5. Feeder conductors to enter directly in line with lug terminals wherever practicable. Feeder conductors, except ground and neutral, not to exceed 45 degree deflection from raceway entry to feeder phase lugs.
6. Where panels are installed flush, provide two 2-inch spare conduits from panel to accessible space above.
7. Where panels are installed flush in fire rated walls maintain fire rating of wall.
8. Surface panels to have metal trim covers with no sharp edges or corners. Surface panel enclosure finish to match trim cover.
9. Where two or more panels are installed side-by-side, provide covers of same height with each trim independently removable without disturbing the other sections.
10. Provision for Future: Where provision for "future" or "space" is noted on Drawings, equip the space with bus connections to the future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and physical clearance. Provide buses for the ampere rating as shown for the future device.

J. Overcurrent Protection Devices:

- ~~1. Fuses: For each class and ampere rating of fuse installed, provide the following~~

~~quantities of spares for quantity of fuses installed:~~

~~a. 1 to 24: Provide 6 spare.~~

~~b. 25 to 48: Provide 9 spare.~~

~~c. 49 and Above: Provide 12 spare.~~

~~2. Provide testing of ground fault interrupting breakers.~~

~~K. Contactors:~~

~~1. Provide vibration isolation mounting pads for electrically held contactors installed within or on walls which are common to occupied spaces. Isolate terminals and operating mechanisms from enclosure.~~

~~2. Install contactors and relays to reduce noise such that it will not create a disturbance or distraction in the areas in which such equipment is located.~~

L.I. Control Devices:

1. Install time switches and other automatic control devices in accessible locations near the source of power or grouped at a common location in mechanical rooms or similar spaces.
2. Install photoelectric control devices at such locations as necessary to be most effective. Avoid locating photoelectric devices in or at locations where they can be influenced by other than natural light or under eaves. Verify location of equipment with Architect.

M.J. Dry-Type Transformers:

1. Comply with other applicable Sections of this Specification. Transformers up to 45KVA may be floor-mounted, wall-mounted or suspended where so indicated on Drawings. Floor-mount transformers above 45KVA rating.
2. Provide transformers with concrete working or housekeeping pad minimum 8 inches larger than transformer and minimum 3 inches above finish grade. Install plumb and level.
3. Do not mount transformers closer to combustible materials than allowed by CEC. Provide adequate ventilation, mount transformers away from adjacent surfaces as recommended by manufacturer.
4. Mount transformers on vibration isolating pads suitable for isolating the transformer housing from building structure.
5. Use flexible conduit, 18 inch minimum length, for connections to transformer case. Make connections to side panel or bottom of enclosure. Include ground conductor in flex.
6. Provide seismic restraints per local requirements.
7. Mount wall-mounted transformers with a minimum of 6 feet 6 inches of headroom below unit.
8. Field Quality Control:
 - a. Check for damage and tight connections prior to energizing transformers.
 - b. Measure primary and secondary voltages and make appropriate tap adjustments.
 - c. Revise the installation of noisy units to achieve an acceptable noise level or replace with a new unit with an acceptable sound level.

3.02 CLEANING

- A. Thoroughly clean the exterior and the interior of each ~~switchboard and~~ distribution panelboard in accordance with manufacturer's installation instructions.
- B. Vacuum construction dust, dirt and debris out of each switchboard and distribution panelboard.
- C. Where enclosure finish is damaged, touch up finish with matching paint in accordance with manufacturer's specifications and installation instructions.

3.03 TESTING

- A. Test to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings and specifications.
 - 1. Daylight sensing automatic lighting controls.
 - 2. Occupant sensing automatic lighting controls.
 - 3. Automatic time switches for lighting control.
- B. Functionally test sequences of operation to ensure operation in accordance with approved drawings and specifications.
- C. Prepare and complete report of test procedures and results and file with the Owner.

END OF SECTION

SECTION 26 09 15**LIGHTING RELAY CONTROL PANEL****PART 1 - GENERAL****1.01 INTRODUCTION**

- A. The work covered in this Section is subject to requirements in the General Conditions of the Specifications.
- B. Coordinate the work in this Section with the trades covered in the other Sections of the Specification to provide a complete and operative system.

1.02 DESCRIPTION OF WORK

- A. Extent of lighting control system work is indicated by drawings, and by the requirements of this section. It is defined to include lighting relay control panels, switch inputs, intertie to other building systems (fire alarm, security and energy management system for HVAC) and wiring.
- B. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring.
- C. Basis of Design: Lighting relay panels on Drawings are designed based on PCI Lighting Litekeeper product line. Approved manufacturers listed below are allowed on condition of meeting the specified conditions including the available space for the equipment (including Code required working clearances). Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

1.03 QUALITY ASSURANCE

- A. Approvals:
 - 1. Test the control panels and list under the UL 916 Energy Management Equipment standards.
 - 2. CEC Compliance: Comply with applicable CEC regarding electrical wiring standards.
 - 3. NEMA Compliance: Comply with applicable portions of the NEMA standards regarding the types of electrical equipment enclosures.
 - 4. Component Pretesting: Control equipment shall undergo strict inspection standards. Previously test the equipment and burn-in at the factory prior to installation.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's data on lighting control system and components, including recommended spare parts list.
- B. Shop Drawings: Submit drawings of lighting control panel and accessories including, but not necessarily limited to the riser diagram / system diagram, low voltage relay panels, power and communications wiring and termination, input/output schedules and sequence of operation for each control zone.

1.05 APPROVED MANUFACTURERS

- A. Approved Manufacturers: PCI LiteKeeper 8, Leviton Lighting Controls, Douglas Lighting Controls, Intelligent Lighting Controls, Lighting Control & Design.

PART 2 - PRODUCTS**2.01 MATERIALS AND COMPONENTS**

- A. System Description:
1. The lighting control system consists of low voltage relay control panels with 64 programmable switch inputs and up to 8 relays.
 2. Each low voltage lighting control panel is microprocessor controlled. Accomplish programming through either the RS-232 port or through the network connection employing the Keeper Enterprise software or with an integral 2 x 16 – 32 character self-prompting LCD display and programming keypad.
 3. Programmable intelligence includes time-of-day control, 32 holiday dates, a Warn Off to warn occupants of an impending OFF, timed inputs, preset control, auto daylight savings, astronomical clock w/offsets, and local control, digital switches and network overrides.
 4. When control panel provides a Warn Off (flash the lights) to inform the occupants of an impending OFF command. The Warn Off command will allow 10 extra minutes for the occupants to override their lights or exit the premises.
 5. Control panels permits lighting to be overridden ON for after-hours use or cleaning. Provide these overrides with hard-wired inputs or voice-guided touch-tone telephone control.
 6. Control panel enclosures offer a maximum space of 8 relays.

2.02 HARDWARE FEATURES

- A. Diagnostic Aids:
1. Each control panel shall incorporate diagnostic aids for confirmation of proper operation, or in case of failure these aids shall guide the individual in rapid troubleshooting of the system.
 2. The control panels shall employ both a backlit LCD and LED's to indicate:
 - a. POWER (LED)
 - b. SYSTEM OK (LED)
 - c. ON/OFF STATUS of EACH RELAY (LED & LCD)
 - d. SYSTEM CLOCK AND DATE (LCD)
 - e. PROGRAMMING CONFIRMATION (LCD)
 3. Control systems that do not provide visual self-help diagnostics shall not be acceptable.
- B. Status Indication of Relays: The system shall provide visible status indication of all relays through the window of each control panel. The visual indication shall disclose On/Off status and relay number. Systems that do not provide relay status while the enclosure door is closed shall not be acceptable.

- C. Operator Interface: The control panel programming interface resides in firmware in the control panel. The programming interface shall consist of a circuit board mounted keypad and 2 line x 16 character LCD display. The integral keypad shall provide access to the main programming features. The keypad shall permit the user to manually command any or all relays individually. It shall also allow the user to link switch inputs and time schedules to relay outputs. Each panel shall control its own loads from internal memory. A control system that relies on a central control computer/processor or external time clocks shall not be permitted. Systems that utilize blocking diode technology for relay assignments shall not be acceptable.
- D. Low voltage switches (Overrides): The controller shall provide timers for each low voltage switch (override). Each low voltage switch (override) timer shall be capable of 0-999 minutes. Software shall enable or disable low voltage switches (overrides) based on Priorities, Masks or Time of Day scheduling.
- E. Digital Switch: The lighting controller shall support digitally addressable LED annunciated switches. The maximum total number of digital switches that may exist on the lighting control network is 16,320. Each Subnet shall support 64 buttons. The digital switch network requires CAT 5 cable between switches. The digital switches shall control any relay group combination on the PCI-Net lighting control network. Data communications status feedback for system checkout and troubleshooting (transmit and receive LED'S) shall be visible on the interface. The digital switch configuration system shall permit custom labeling for multiple button switch locations. The digital switch configuration shall be Decora® form and function.
- ~~E.F.~~ Dry Contact Inputs: The control system shall permit 8 dry contacts inputs for override purposes. Support momentary 3 wire or 2 wire (toggle) inputs. Support maintained contacts as 2 wire (SPST) inputs. Inputs shall be dry contacts (24VDC at 12 ma. internally supplied to the inputs). The 24VDC power supply is provided with an auto-resettable fuse. Should an inappropriate electrical connection be made the design shall protect the board and switches until the fault is removed. Software link switch input to any number of relays for override control. The control panel shall have dry contact inputs on the logic board. Control systems that utilize separate accessories to allow for dry contact switches shall not be acceptable. Control systems that do not supply both digital switches and analog switches from the same controller shall not be permitted.
- ~~E.G.~~ Photocell Control: The controller shall accept dry contact ambient light sensors. The controller shall provide power for the sensor thereby eliminating any external power supply. Sensors shall provide for outdoor and indoor applications and issue a command to the controller once the threshold is reached. The sensor shall provide user adjustable dead band control.
- ~~E.H.~~ Remote Overrides: The controller shall accept remote commands issued from other inputs. The controller shall provide this feature without the need to add extra equipment to the controller. Remote overrides can be issued from the Telephone Interface Module (TIM), Photocells, Motion Sensors, Digital or Dry Contact Switches. Lighting systems that need to add extra equipment to receive remote overrides are not acceptable.
- ~~E.I.~~ Service Override & Priority Override: The control panel shall provide a three position master-service override for the control unit. The service override shall not be accessible from the exterior. Systems that provide a service override on the exterior of the controller shall not be acceptable.
- ~~E.J.~~ Modular Design:
1. The control system shall employ all modular connectors to avoid repeat wiring in case of component failure. Mount the system CPU board on quick-release

spring pins that shall permit an entire change out of the processor and input board.

2. Connections for the switch inputs shall incorporate modular connectors. Provide modular relay board designed for rapid field replacement or upgrading. Systems that do not employ modular connectors shall not be acceptable.

J.K. Battery Back-up: The system shall utilize a memory back-up device that is system integrated and non-serviceable. Protect the data in RAM against power interruptions lasting as long as 10 years. Provide maintenance free power interrupt protection circuit.

K.L. Multi-tapped Transformer: The control panel incorporates the use of a multi-tapped transformer. The panel shall not require specification of voltage for each control location. The voltages of 120 and 277VAC available with each standard control panel.

L.M. Status Indication of Relays: The system shall provide visible status indication of all relays through the window of each control panel. The visual indication shall disclose ON/OFF status and relay number.

M.N. Service Override: The control panel shall provide a 3 position service override for the entire panel. The service override shall not be accessible from the exterior.

N.O. Lockable Enclosure: Enclose each control panel in a lockable NEMA Class 1 enclosure and shall provide pre-punched knockouts.

O.P. Relays: Electrically held 20amp 120/277VAC relays. Relays must be specified Normally Open or Normally Closed. Rate the relays for 10 million mechanical operations.

1. Standard Relay Module (SRM-NC): The system shall utilize normally closed control relays, which are rated to 20 amps at 120/277VAC. Magnetically hold the relays and provide on a card of eight relays per card. The wire terminations shall be able to accept 10 AWG. Rate the relays for 10 million mechanical operations. Provide a limited 10-year warranty on the individual relay cards. Systems that do not offer a limited 10-year warranty on all installations are not acceptable.
2. Latching Relay Card (LRC): The controller shall provide an option to provide latching relays that are rated to 20 amps at 347VAC. The relay shall provide an integral switch for both manual hand operation and visual indication of relay status. Rate the relays for 10 million mechanical operations. The wire terminations shall be able to accept 6 AWG wire. Provide a limited 10-year warranty on the individual relays. Systems that do not offer a limited 10-year warranty on all installations are not acceptable.
3. Latching Relay Card (LRC-RR7): The controller shall provide an option for remote placement of the control relays. A modular card shall connect into the relay compartment. Twisted (3) conductor cable shall power and control the remote mounted relays. Maximum distance is 500 feet employing 18 AWG conductor.
4. The following features shall be standard in the PC based software:
 - a. Standard Software Features:
 - 1) Real Time Relay Status Monitoring
 - 2) Alpha-Numeric Descriptors
 - 3) Communications: Direct, TCP/IP and Modem
 - 4) Status Indication
 - 5) Global Software Modifications
 - 6) Manual Relay Commands
 - 7) Relay Pattern Commands
 - 8) Preset Options
 - 9) User Management – Password protection and privilege modification for multi-user security.
 - 10) Logging of Controller Actions (switch inputs, TIM commands, &

- relay actuations)
- b. File Maintenance
 - 1) Archive Programs
 - 2) Data Base Restoration
 - 3) Uploading and Downloading of Programs
 - 4) Snap Shots — indication of changes and flawless panel restoration.
- c. Software package shall permit the PC to be utilized for other functions (i.e. word processing, database, & etc.) besides lighting control. Systems that require an “on-line” dedicated computer for control system operation shall not be acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION AND DOCUMENTATION

- A. Installation: Install the control system and fully wire as shown on the drawings by the installing contractor. Complete all electrical connections to all control circuits, and override wiring.
- B. Documentation: Provide accurate “as-built” drawings to the owner for correct programming and proper maintenance of the control system. The “as-builts” shall indicate the load controlled by each relay and the relay panel number.
- C. Operation and Service Manuals: The factory shall supply all operation and service manuals.

3.02 PRODUCT SUPPORT AND SERVICE

- A. Factory Support: Factory telephone support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.

3.03 SYSTEM ACCEPTANCE

- A. Test to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings and specifications.
- B. Functionally test sequences of operation to ensure operation in accordance with approved drawings and specifications.
- C. Prepare and complete report of test procedures and results and file with the Owner.
- D. An operational user program shall exist in the control system. The program shall execute and perform all functions required to effectively operate the site according to the requirements.
- E. Demonstration of program integrity during normal operation and pursuant to a power outage.
- F. Provide a minimum of 4 hours training on the operation and use of the control system.

- G. Lighting System Control Testing and Commissioning:
1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
 2. Testing shall include:
 - ~~a.~~ ~~Daylight automatic controls.~~
 - ~~b.~~a. Occupant sensing automatic controls.
 - ~~e.~~b. Automatic time and override controls for interior lighting.
 - ~~d.~~c. Automatic time and photo controls for exterior lighting.

3.04 WARRANTY

- A. Warranty: Manufacturer shall supply a 3-year warranty on all hardware and software. Systems that provided special warranties based on installation shall not be acceptable.

END OF SECTION

SECTION 26 08 05**ELECTRICAL ACCEPTANCE TESTING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
1. Testing, evaluation and calibration of equipment provided, installed and connected in Division 26.
 2. Evaluation of connection and normal operation of utilization equipment, provided in other Divisions, for installation and connection in Division 26.

1.02 REFERENCES

- A. Acceptance Testing Criteria: Latest edition of Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, published by IETA.
- B. Applicable Codes, Standards and References:
1. California Electrical Code (CEC).
 2. National Electrical Manufacturer's Association (NEMA).
 3. American Society for Testing and Materials (ASTM).
 4. Institute of Electrical and Electronic Engineers (IEEE).
 5. International Electrical Testing Association (IETA).
 6. American National Standards Institute (ANSI).
 7. State and local codes and ordinances.
 8. Insulated Power Cable Engineers Association (IPCEA).
 9. Association of Edison Illuminating Companies (AEIC).
 10. OSHA Part 1910; Subpart S, 1910.308.
 11. National Fire Protection Association (NFPA).

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
1. Retain the services of a recognized independent testing firm for the purpose of performing inspections and tests as specified herein.
 2. Independent test firm providing report direct to Architect.
 3. Material, equipment, labor and technical supervision to perform tests and inspections provided by testing firm.
 4. It is the intent of these tests to assure that electrical equipment, Contractor or Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design Specifications.
 5. Tests and inspections determine suitability for energization.
 6. Supply to the independent testing organization complete sets of approved shop drawings, coordination study (provided by Contractor's equipment supplier under Contractor's direction, setting of adjustable devices and other information requested by testing agency).
- B. Scope of Testing, Evaluation and Calibration:
- ~~1. Power transformers.~~
 - ~~1. Distribution transformers.~~
 - ~~2. Low voltage circuit breakers (greater than 100 amp).~~
 - ~~4. Medium voltage circuit breakers.~~
 - ~~5. Switchboards.~~
 - ~~6. Ground fault protective signaling.~~

- ~~7. _____ Protective relays and associated instrument transformers.~~
- ~~8. _____ Medium voltage cables.~~
- ~~9.3. _____ Grounding systems.~~
- ~~10.4. _____ Motor control centers.~~

1.04 SUBMITTALS

- A. Test Reports:
 - 1. Maintain written record of tests.
 - 2. At completion of project, assemble and certify a final test report. Submit report to Architect prior to final acceptance to include:
 - a. Summary of project.
 - b. Description of equipment tested.
 - c. Visual inspection report.
 - d. Description of tests.
 - e. Test results.
 - f. Conclusions and recommendations.

1.05 QUALITY ASSURANCE

- A. Qualifications of Testing Firm:
 - 1. Corporately independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers and installers of equipment or systems evaluated by testing firms.
 - 2. Independent organization as defined by OSHA Title 29, Part 1936 and IETA.
 - 3. Regularly engaged in the testing of electrical materials, devices, appliances, electrical installations and systems for the purpose of preventing injury to persons or damage to property and other equipment.
 - 4. Engaged in testing practices for minimum of 2 years.
 - 5. Use only full-time technicians, regularly employed by firm for testing services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians and line workers may assist, but may not perform testing or inspection services.
 - 6. Submit proof of above qualifications with Bid Documents.
- B. Certifications:
 - 1. Comply with OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910 and 1936. Full membership in the IETA constitutes proof of such criteria.
 - 2. Lead, on site, technical person currently certified by IETA in Electrical Power Distribution System Testing.
 - 3. Instruments used by testing firm to evaluate electrical performance meet IETA Specifications for Test Instruments.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Tests:
 - 1. Contractor's Responsibilities:
 - a. Perform routine insulation resistance, continuity and rotation tests for distribution and utilization equipment prior to and in addition to tests performed by testing firm.

- b. Notify the testing firm when equipment becomes available for acceptance tests. Coordinate work to expedite project scheduling.
- 2. Testing Firm's Responsibilities:
 - a. Notify Architect prior to commencement of any testing.
 - b. Report directly to Architect any systems, material or installation found defective on the basis of acceptance tests.
 - c. Provide auxiliary portable power supply necessary for conducting tests.

3.02 ADJUSTING

- A. Final Settings: Testing firm responsible for implementing final settings and adjustments on protective devices and tap changes in accordance with Architect's specified values.

END OF SECTION

SECTION 26 01 00**BASIC MATERIALS AND METHODS****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
1. Raceways.
 2. Wires, cables and connectors.
 3. Outlet boxes.
 4. Devices and plates.
 5. Identification.
 6. Safety disconnect switches.

1.02 SYSTEM DESCRIPTION

- A. Provide raceways, wires, cables, connector, boxes, devices, finish plates and the like for a complete and operational electrical system.
- B. Electrical Connections: Connect equipment, whether furnished by Owner or other Divisions of the Contract, electrically complete.
- C. Supporting Devices: Safety factor of 4 required for every fastening device or support for electrical equipment installed. Support to withstand four times weight of equipment it supports. Bracing to comply with Seismic Zone 4 requirements.

1.03 SUBMITTALS

- A. Provide shop drawings and product data for the following:
1. Raceways.
 2. Wires, cables and connectors.
 3. Identification equipment.
 4. Safety disconnect switches.
- B. Provide the following operating and maintenance instructions from the manufacturer for project closeout, see project closeout requirements in Division 01:
1. Devices and plates.
 2. Safety disconnect switches.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- B. Furnish products listed by UL or other testing firm acceptable to AHJ.

PART 2 - PRODUCTS**2.01 RACEWAYS**

- A. Conduits:
1. Galvanized Rigid Steel Conduit (GRC): Hot-dip galvanized after thread cutting. Manufacture in conformance with Federal Specification WWC-581 and ANSI

C80.1.

~~2. Intermediate Metal Conduit (IMC): Hot dip galvanized after thread cutting. Manufacture in conformance with Federal Specification WWC-581.~~

~~3.2. Electrical Metallic Tubing (EMT): Hot-dip galvanized and chromate coated. Manufacture in conformance with Federal Specification WWC-563 and ANSI C80.3.~~

~~4.3. Flexible Conduit: Reduced wall flexible steel conduit. Hot-dip galvanized. Manufacture in conformance with Federal Specification A-A-55810.~~

~~5.4. Flexible Conduit, PVC Coated: Hot-dip galvanized steel. PVC chemical resistant jacket extruded to core, up to 1-inch trade size. PVC chemical resistant jacket, tubed over core, up to 4-inch trade size.~~

~~6. PVC: Class 40 heavy wall rigid PVC. Rated for use with 90C conductors. Manufacture in conformance with Federal Specification WC1094A and NEMA TC-2.~~

B. Conduit Fittings:

1. Bushings: Malleable iron with plastic insulator lining, 150C rated.

2. Ground Bushings: Malleable iron with plastic insulating liner and aluminum grounding lug rated for copper or aluminum conductor, 150C rated.

3. EMT Connectors and Couplings:

~~a. Set Screw Type: Zinc plated steel, insulated throat connectors.~~

~~b.a. Compression Type: Zinc plated steel, insulated throat connectors, raintight up to 2 inches.~~

4. Rigid Steel Conduit Ells: PVC coated or painted with No. 51 bitumastic material, long radius ells, minimum radius of 36 inches.

5. Expansion/Deflection Fittings:

a. EMT: Use O-Z Gedney Type TX.

b. GRC: Use O-Z Gedney Type AX, DX and AXDX.

2.02 WIRES AND CABLES

A. Copper, 600 volt rated throughout. Conductors 14AWG to 10AWG, solid ~~or stranded~~. Conductors 8AWG and larger, stranded. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back. Conductors 3AWG and larger, minimum insulation rating of 75C. Insulation types THWN, THHN or XHHW. Minimum insulation rating of 90C for branch circuits. Color code conductors as follows:

PHASE	208 VOLT WYE	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B	Red	Orange (High Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	N/A	N/A

B. Service Entrance Cable: Copper conductor, 600 volt insulation, XHHW, Type SE.

2.03 CONNECTORS

A. Copper Pads: Drilled and tapped for multiple conductor terminals.

B. Lugs: Indent/compression type for use with stranded branch circuit or control conductors. Manufacturers: Anderson, IlSCO, Panduit, Thomas & Betts, 3M, or approved.

C. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 18 through 8AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable. Manufacturers: 3M, Ideal, or approved.

2.04 BOXES

- A. Accessories: Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- B. Weatherproof Outlet Boxes: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket, blank plugs and corrosionproof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish. Bell, Carlon, Red Dot, or approved.
- C. Junction and Pull Boxes: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of the type shape and size, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers. Circle AW, Hoffman, or approved.
- D. Box Extension Adapter: Die-cast aluminum construction. Install over flush wall outlet boxes to permit flexible raceway extension to equipment. Bell 940 Series, Carlon, Red Dot IHE4 Series, or approved.
- E. Conduit Fittings: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and plastic conduit bushings of the type and size to suit each respective use and installation. O-Z Gedney, Thomas & Betts, or approved.

2.05 WIRING DEVICES

- A. Wall Switches:
 - 1. Toggle Type Characteristics: Quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage. Cooper 1221, Leviton 1221, Hubbell 1221, Pass & Seymour 20ACI.
- B. Receptacles:
 - 1. Finish: Same exposed finish as switches. ~~Receptacles connected to emergency circuits, red finish.~~
Duplex Receptacle Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding. Industrial Grade: Back and side wired. Single piece, rivetless. Brass grounding system and mounting strap. 20 amp. Cooper 5362, Hubbell 5362, Leviton 5362A, Pass & Seymour 5362A.
 - ~~2. Isolated Ground Receptacle: Isolated ground "delta" on receptacle face, same finish as standard duplex receptacles, 20 amp. Hubbell IG-5362, Cooper IG-5362, Leviton, Pass & Seymour.~~
 - ~~3.2.~~ Ground Fault Circuit Interrupter (GFCI) Receptacle: Meets or exceeds UL943 (Class A GFCI), UL498. Feed through type, back-and-side wired, 20 amp, 125VAC, Cooper XGF20, Hubbell GF5362, Leviton 8898, Pass & Seymour 2094.
 - ~~4.3.~~ UL Wet-Listed Covers While-In-Use: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit. UV stabilized polycarbonate cover with closed cell neoprene foam gasket. Pass & Seymour WIUC10, Leviton 5977, Hubbell WP826MP, Cooper 4966.
 - ~~5.4.~~ Special Purpose Receptacles: Refer to drawings for NEMA Standard Specification.

- C. Finish Plates: Match building-district standard.
- D. Surface Covers:
 - 1. Material: Galvanized or cadmium plated steel, 1/2-inch raised industrial type with openings appropriate for devices installed in surface outlets.
 - 2. Cast Box and Extension Adaptors: Aluminum, with gasket, blank. One gang, Bell 240-ALF, Carlon; two gang, Bell 236-ALF, Carlon, or approved.

2.06 SAFETY DISCONNECTS

- A. Toggle Type Disconnect Switches: 120 volt, 1 pole, 20 amp, 1 HP maximum. NEMA 1 enclosure for indoors, NEMA 3R enclosure for outdoors.
- B. Manual Motor Starters: Quick-make, quick-break. Thermal overload protection. Device labeled with maximum voltage, current and horsepower. Eaton Electrical, General Electric, Siemens, Square D Class 2510, or approved. Provide NEMA 1 enclosure for indoors, NEMA 3R enclosure for outdoors.
- C. Safety Switches: Heavy duty, fused type, dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted. Provide NEMA 1 enclosure for indoors, NEMA 3R enclosure for outdoors. Switches clearly marked for maximum voltage, current and horsepower. Equip enclosure with defeatable cover interlock. Switches rated for maximum available fault current. Manufacturers: Eaton Electrical, General Electric, Siemens, Square D, or approved.

2.07 ELECTRICAL IDENTIFICATION

- A. Engraved Labels: Melamine plastic laminate, white with black core, 1/16 inch thick, manufactured by Lamicoid. Engravers standard letter style, minimum 3/16-inch high letters, capitals. Drill or punch labels for mechanical fastening except where adhesive mounting is necessary because of substrate. Use self-tapping stainless steel screws.
- B. Conductor Numbers: Manufacturers standard vinyl-cloth self-adhesive cable and conductor markers of the wraparound type. Preprinted black numbers on yellow field. Brady, Panduit, or approved.
- ~~C. Underground Utilities Markers: Inert polyethylene plastic ribbon, 6 inches wide by 4 mil thick. Safety Red for electric power distribution. Safety Alert Orange for telephone, signal, data and cable TV. Imprint over entire length of ribbon in permanent black letters, the system description, selected from manufacturer's standard legend which most accurately identifies the subgrade system. Manufacturers: Allen Systems, Inc., Panduit Corp., or approved.~~
- ~~D.C.~~ Circuit Breaker Identification: Provide permanent identification number in or on panelboard or motol control center dead-front adjacent to each circuit breaker pole position.

PART 3 - EXECUTION

3.01 ELECTRICAL CHARACTERISTICS

- A. Verify electrical characteristics of equipment prior to installation of conduits and wiring for equipment. Coordinate HVAC voltage requirements with drawings and equipment submittals prior to rough in.

3.02 MOTOR BRANCH CIRCUIT WIRING

- A. Do not install electrical equipment or wiring on mechanical equipment without approval of Architect.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor branch circuits complete from panel to motor as required by code and manner herein described.
- D. Motor starter, control devices and control wiring provided by other Divisions unless noted on drawings.

3.03 APPLIANCE/UTILIZATION EQUIPMENT

- A. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering devices and coverplates.

3.04 INSTALLATION

- A. Conduit:
 - 1. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal PVC conduit joints with solvent cement and metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal).
 - 2. Conduit Placement:
 - a. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
 - b. Conceal conduits. Exposed conduits are permitted only in the following areas:
 - 1) Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished materials.
 - 2) Existing walls that are concrete or block construction.
 - 3) Where specifically noted on the drawings.
 - c. Where exposed conduits are permitted install parallel or at right angles to building lines, tight to finished surfaces and neatly offset into boxes.
 - d. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.
 - e. Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors.
 - f. Route raceway at least 6 inches from hot surfaces above 120F, including noninsulated steam lines, heat ducts, and the like.
 - ~~3. Below Grade Conduit and Cables: Place a minimum 3-inch cover of sand or clean earth fill around the cable or conduit on a leveled trench bottom. Lay conduit on a smooth level trench bottom, so that contact is made for its entire length. Remove water from trench before electrical conduit is installed.~~
 - ~~4.3. Maximum Bends: Install code sized pull boxes to limit sum of bends in a run of conduit to 270 degrees.~~
 - ~~5.4. Flexible Conduit: Install 12-inch minimum slack loop on flexible metallic conduit and PVC coated flexible metallic conduit.~~

- ~~6.5.~~ Conduit Size: Size as indicated on drawings. Where size is not indicated, provide conduit in minimum code permitted size for THW conductors of quantity required for complete operation. Minimum trade size 1/2 inch.
- ~~7.6.~~ Provide pull cord in empty conduits that exceed 10 feet in length or the total sum of bends exceed 90 degree radius.
- ~~8.7.~~ Conduit Use Locations:
- Underground: PVC.
 - Wet Locations, and areas subject to Mechanical Damage: GRC, ~~IMC~~.
 - Damp Locations and Locations Exposed to Rain: GRC, ~~IMC~~, and EMT up to 2 inches in diameter.
 - Dry, Protected: GRC, ~~IMC~~, EMT.
 - Sharp Bends and Elbows: GRC, EMT use factory elbows.
 - Install pull wire or nylon cord in empty raceways provided for other systems. Secure wire or cord at each end.
 - Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
 - Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
 - Motors and equipment connections subject to movement or vibration and subjected to any of the following conditions; exterior location, moist or humid atmosphere, water spray, oil or grease use PVC coated liquid tight flexible metallic conduit.
- ~~9.8.~~ Branch Circuits: Do not change the intent of the branch circuits or controls without approval. Homeruns for 20 amp branch circuits may be combined to a maximum of six current carrying conductors in a homerun. Apply derating factors as required by CEC. Increase conductor size as needed.
- ~~10.9.~~ Feeders: Do not combine or change feeder runs.
- ~~11.10.~~ Unless otherwise indicated, provide raceway systems for lighting, power and Class 1 remote-control and signaling circuits and Class 2 and 3 remote-control signaling and communication circuits.

B. Conduit Fittings:

- ~~1.~~ ~~Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from over current protection device to outlet.~~
- ~~2.1.~~ Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2 inches in diameter.
- ~~3.2.~~ Use threaded type fittings in wet locations, and damp or rain-exposed locations where conduit size is greater than 2 inches.
- ~~4.~~ ~~Use PVC coated rigid steel conduit ells for underground power and telephone service entrance conduits. Use 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.~~
- ~~5.3.~~ Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes and the like that have feeders 60 amperes and greater.
- ~~6.4.~~ Provide bushing or EMT connector for conduits that do not terminate in box, enclosure, or the like.
- ~~7.5.~~ Provide conduit expansion fittings at building expansion joints and at locations where conduit is exposed to thermal expansion and contraction.
- ~~8.6.~~ Condulets and Conduit Bodies: Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger.

- C. Sleeves and Chases: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceiling or walls. Maintain integrity of fire-rated assemblies at penetrations of walls, ceilings or floors.

- D. Conductors, Wires and Cables:
1. Conductor Installation: Install conductors in raceways having adequate, code size cross-sectional area for wires indicated. Install conductors with care to avoid damage to insulation. Do not apply greater tension on conductors than recommended by manufacturer during installation. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
 2. Conductor Size and Quantity: Install no conductors smaller than 12AWG unless otherwise shown. Provide required conductors for a fully operable system.
 3. Provide dedicated neutrals (one neutral conductor for each phase conductor) in the following single phase circuits:
 - a. Isolated ground circuits.
 - b. Ground fault protected circuits where a GFCI breaker is used in a panelboard.
 - c. Other electronic equipment that produces a high level of harmonic distortion including, but not limited to, computers, printers, plotters, copy machines, and fax machines.
- E. Connectors: Retighten lugs and connectors for conductors to equipment prior to Substantial Completion.
- F. Boxes:
1. Location: Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
 2. Round Boxes: Avoid using round boxes where conduit must enter through side of box, which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.
 3. Anchoring: Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
 4. Special Application: Provide weatherproof outlets for locations exposed to weather or moisture.
 5. Knockout Closures: Provide knockout closures to cap unused knockout holes where blanks have been removed.
 6. Outlet System: Provide electrical boxes and fittings as required for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts, and other necessary components.
 7. Code Compliance: Comply with CEC as applicable to construction and installation of electrical boxes and fittings and size boxes according to CEC, except as noted otherwise.
 8. Flush Outlets in Finished Spaces: Maintain integrity of insulation and vapor barrier. Surface outlets are only acceptable in areas with surface conduit.
 9. Mount center of outlet boxes as required by ADA, or noted on drawings, the following distance above the floor:
 - a. Control Switches: 48 inches.
 - b. Receptacles: 18 inches.
 - c. Telecom Outlets: 18 inches.
 - d. Other Outlets: As indicated in other Sections of Specifications or as detailed on drawings.
 10. Coordinate electrical device locations (switches, receptacles, and the like) with drawings to prevent mounting devices in mirrors, back splashes, behind cabinets, and the like.
- G. Wiring Devices:
1. Wall-Mounted Receptacles: Install with long dimension oriented vertically at centerline height shown on drawings or specified herein.

2. Vertical Alignment: When more than one outlet is shown on drawings in close proximity to each other, but at different elevations, align the outlets on a common vertical center line for best appearance. Verify with Architect.
 3. GFCI Outlets: One GFCI receptacle may be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit provided the following conditions are met:
 - a. The downstream receptacles are in the same room as the upstream GFCI duplex receptacles, and
 - b. The downstream duplex receptacles are labeled as being protected by an upstream GFCI receptacle in the same room.
- H. Provide CEC-required disconnect switches whether specifically shown on drawings or not. Provide disconnect switch in sight of each motor location unless otherwise noted. Provide disconnect switch in site of each motor controller. Motor controller disconnect equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.
- I. Supporting Devices:
1. Verify mounting height of luminaires or items prior to installation when heights are not detailed.
 2. Install vertical support members for equipment and luminaires, straight and parallel to building walls. Provide independent supports to structural member for electrical luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over furred or suspended ceilings.
 3. Do not use other trade's fastening devices as supporting means for electrical equipment, materials or luminaires. Do not use supports or fastening devices to support other than one particular item.
 4. Support conduits within 18 inches of outlets, boxes, panels, cabinets and deflections. Maximum distance between supports not to exceed 8 foot spacing.
 5. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from the floor above or roof structure to prevent sagging and swaying.
 6. Provide seismic bracing per CBC requirements for this building location.
- J. Electrical Identification:
1. Graphics: Coordinate names, abbreviations and designations used on drawings with equipment labels.
 - ~~2. Underground Utilities Markers: Install continuous tape, 6 to 8 inches below finish grade, for each exterior underground raceway.~~
 - ~~3.2. Conductor Identification: Apply markers on each conductor for power, control, signaling and communications circuits.~~
 - ~~4.3. Install an engraved label on each major unit of electrical equipment indicating both equipment name and circuit serving equipment (e.g. "EF-1, CKT. 2P1-1,3,5), including but not limited to the following items: Disconnect switches, relays, contactors, time switches, override switches, service disconnects, distribution switches, branch circuit panelboards, and central or master unit of each electrical system including communication/signal systems.~~
 - ~~5.4. Install engraved labels on the inside of flush panels, visible when door is opened. Install label on outside of surface panel.~~
 - ~~6.5. Install signs at locations detailed or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment.~~

3.05 FIELD QUALITY CONTROL

- A. Wiring Device Tests: Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.
- B. Feeder Tests:
 - 1. Test conductor insulation on feeders of 100 amp and greater for conformity with +1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
 - 2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit report with operating and maintenance manual.

END OF SECTION

SECTION 26 00 00**BASIC ELECTRICAL REQUIREMENTS****PART 1 - GENERAL****1.01 SUMMARY**

A. Section Includes:

1. Electrical systems required for this work includes labor, materials, equipment, and services necessary to complete installation of electrical work shown on Drawings, specified herein or required for a complete operable facility and not specifically described in other Sections of these Specifications. Among the items required are:
 - a. Distribution equipment.
 - b. Feeders to distribution panels, HVAC equipment, Owner provided equipment and other equipment.
 - c. Branch circuit wiring from distribution panels for lighting, receptacles, motors, signal systems, and other detailed wiring.
 - d. Luminaires, control switches, receptacles, relays, supports, and other accessory items.
 - e. Wiring and power connections for motors installed for heating, cooling, and ventilation.
 - ~~e.f.~~ Fire alarm system.
 - ~~d.g.~~ Low voltage systems.

1.02 DEFINITIONS

A. Following is a list of abbreviations generally used in Division 26:

1. ADA Americans With Disabilities Act
2. AHJ Authority Having Jurisdiction
3. ANSI American National Standards Institute
4. APWA American Public Works Association
5. ASTM American Society for Testing and Materials
6. CBC California Building Code
7. CEC California Electrical Code
8. CFC California Fire Code
9. FCC Federal Communications Commission
10. HVAC Heating, Ventilating and Air Conditioning
11. IEC International Electrotechnical Commission
12. IEEE Institute of Electrical and Electronics Engineers.
13. IETA International Electrical Testing Association
14. FM FM Global
15. NEMA National Electrical Manufacturers Association
16. NFPA National Fire Protection Association
17. OSHA Occupational Safety and Health Administration
18. UL Underwriters Laboratories Inc.

B. Provide: To furnish and install, complete and ready for the intended use.

C. Furnish: Supply and deliver to the project site, ready for unpacking, assembly and installation.

D. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site to complete items of work furnished by others.

1.03 ADDITIONAL REQUIREMENTS TO DIVISION 01

- A. Operation and Maintenance Documentation: Provide copies of certificates of code authority acceptance, test data, product data, guarantees, warranties, and the like.
- B. Shop Drawings: When requested by individual Sections provide shop drawings which include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and the like. Refer to individual Specification Sections for additional requirements for the shop drawings.
- C. Closeout Documentation: Submit electrical code authority certification of inspection. Include documentation of on-site electrical testing that was performed.
- D. Record Drawings:
 - 1. Show changes and deviations from the Drawings. Include written Addendum and change order items.
 - 2. Show exact routes of feeders 100 amp and larger; and service entrance conduits.
 - 3. Show exact location of switchboards, distribution panelboards, safety disconnects, motor controllers, and the like.
 - 4. Make changes to drawings in electronic format. Obtain electronic copy from Architect, use the same version of AutoCAD to prepare record drawings as was used by the Architect. Provide electronic copy and hard copy to Architect for review.
 - 5. Provide a full size Record Drawing of the one-line power diagram sealed in a plastic coating. Mount on the wall of the electric room.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- B. Conform to latest adopted version of the CBC with amendments by local AHJs.
- C. Obtain and pay for electrical permits and inspections from local AHJs.
- D. Furnish products listed by UL or other testing firm acceptable to AHJ.
- ~~E. Conform to requirements of the serving electric utility.~~

1.05 SEQUENCING AND SCHEDULING

- A. For the proper execution of the work cooperate with other crafts and contracts as needed.
- B. To avoid installation conflicts, thoroughly examine the complete set of Contract Documents. Resolve conflicts with Engineer prior to installation.
- C. Prior to installation of feeders to equipment requiring electrical connections, examine the manufacturer's shop drawings, wiring diagrams, product data, and installation instructions. Verify that the electrical characteristics detailed in the Contract Documents are consistent with the electrical characteristics of the actual equipment being installed. When inconsistencies occur request clarification from Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide like items from one manufacturer, such as luminaire types, switches, receptacles, breakers, panels, and the like.

2.02 MATERIALS

- A. Provide new electrical materials of the type and quality detailed, listed by UL, bearing their label wherever standards have been established. Indicated brand name and catalog numbers are used to establish standards of performance and quality. The description of materials listed herein governs in the event that catalog numbers do not correspond to materials described herein.
- B. Provide material and equipment that is acceptable to AHJ as suitable for the use indicated. For example, provide wet labeled equipment in locations that are wet.
- C. Include special features, finishes, accessories, and other requirements as described in the Contract Documents regardless of the item's listed catalog number.
- D. Provide incidentals not specifically mentioned herein or noted on Drawings, but needed to complete the system, in a safe and satisfactory working condition.

2.03 FIRESTOPPING

- A. Foam Sealant: Foam sealant for use around conduit penetrations to prevent passage of smoke, fire, toxic gas or water. Maintain seal before, during and after fire. In and around conduit for thermal break at penetration of barrier between heated and unheated spaces. Chase Technology Corporation, Fire Foam, Thomas & Betts, or approved.

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Construction Documents:
 - 1. Drawings are diagrammatic with symbols representing electrical equipment, outlets, luminaires, and wiring.
 - 2. Electrical symbols indicating wiring and equipment shown in the Contract Documents are included in the Contract unless specifically noted otherwise.
 - 3. Examine the entire set of Drawings to avoid conflicts with other systems. Determine exact route and installation of electrical wiring and equipment with conditions of construction.
- B. Clarification:
 - 1. The Drawings govern in matters of quantity, the Specification in matters of quality. In event of conflict on Drawings or in the Specifications, the greater quantity and the higher quality apply.
 - 2. Should the Electrical Documents indicate a condition conflicting with the governing codes and regulations, refrain from installing that portion of the work until clarified by Engineer.

3.02 INSTALLATION

- A. Install electrical equipment complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the electrical equipment, examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from

Engineer prior to proceeding with the installation.

- B. Do not install electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.

~~C. Earthwork: Perform excavation and backfill required for the installation of electrical work.~~

~~D.C.~~ Noise Control:

- 1. Do not install outlet boxes back to back. Do not use straight through boxes.
- 2. Do not place contactors, transformers, starters and similar noise producing devices on walls which are common to occupied spaces unless specifically called for on Drawings. Where such devices must be mounted on walls common to occupied spaces, mount or isolate in such a manner as to effectively prevent the transmission of their inherent noise to the occupied space.

~~E.D.~~ Firestopping:

- 1. Coordinate with the Drawings the location of fire rated walls, ceilings, floors and the like. When these assemblies are penetrated by electrical equipment, seal around the equipment with approved firestopping material.
- 2. Install firestopping material complete as directed per the manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

A. Tests:

- 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified in Division 26. Refer to individual Specification Sections for required tests. Document tests and include in Closeout Documents.
- 2. During site evaluations by Engineer, provide an electrician with tools to remove and replace trims, covers, devices, and the like, so that a proper evaluation of the installation can be performed.

3.04 CLEANING

- A. Remove dirt and debris caused by the execution of the electrical work.
- B. Leave the entire electrical system installed under this Contract in clean, dust-free and proper working order.
- C. Vacuum clean interiors of all new and modified electrical signal and communication equipment enclosures.

3.05 DEMOLITION

- A. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. The Owner will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- B. Examination: Determine the exact location of existing utilities and equipment before commencing work, compensate the Owner for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- C. Promptly notify Owner if utilities are found which are not shown on Drawings.
- D. Execution:
 - 1. Remove existing luminaires, switches, receptacles, and other electrical

- equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
2. Maintain electrical continuity of existing systems. Remove or relocate electrical boxes, conduit, wiring, equipment, luminaires, and the like, as encountered in removed or remodeled areas in the existing construction affected by this work.
 3. Remove and restore wiring which serves usable existing outlets clear of the construction or demolition
 4. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass the abandoned outlets.
 5. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of the construction or demolition and maintain service to the existing load.
 6. Extend circuiting and devices in existing walls to be furred out.
 7. Remove abandoned wiring to leave site clean.
 8. If existing electrical equipment contains PCBs (polychlorinated biphenyl), replace with new. Dispose of material containing PCBs as required by federal and local regulations.
 9. Repair adjacent construction and finishes damaged during demolition work.
 10. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.06 CONTINUITY OF SERVICE

- A. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from the Owner. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specific dates and hours and the maximum durations. Obtain written permission from the Owner for any interruption of power, lighting or signal circuits and systems.
- B. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work, due to maintaining continuity of service herein required.
- C. Organize work to minimize duration of power interruption.

END OF SECTION

SECTION 26 50 00**LIGHTING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section Includes:
1. Luminaires and lampholders.
 2. Ballasts.
 3. Lamps.
 4. ~~Emergency lighting equipment.~~

1.02 SUBMITTALS

- A. Submit for:
1. Luminaires: Include electrical ratings, dimensions, mounting, material, required clearances, terminations, wiring and connection diagrams, photometric data, diffusers, and louvers.
 2. Ballasts.
 3. Lamps.
 4. ~~Emergency lighting equipment.~~
- B. Provide the following operating and maintenance instructions from the manufacturer for project closeout, see Project Closeout Requirements in Division 1:
1. Luminaires.
 2. Ballasts.
 3. Lamps.
 4. ~~Emergency lighting equipment.~~

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Provide luminaires acceptable to code authority for application and location as indicated.
 2. Comply with applicable ANSI standards pertaining to lamp materials, lamp ballasts and transformers, and luminaires.
 3. Comply with applicable NEMA standards pertaining to lighting equipment.
 4. Provide luminaires and lampholders which comply with UL standards and have been UL listed and labeled for location and use indicated.
 5. Comply with CEC applicable to installation and construction of luminaires.
 6. Comply with fallout and retention requirements of CBC for diffusers, baffles, louvers, and the like.

1.04 WARRANTY

- A. Ballast Manufacturer's Warranty: Not less than 2 years for magnetic type ballasts and 5 years for electronic type ballasts, based on date of manufacturer embossed on ballast, current with installation date. Warranty includes normal cost of labor for replacement of ballast.
- B. Lamp Warranty: ~~30 days for incandescent,~~ 6 months for compact fluorescent, 12 months for fluorescent and HID lamps.

1.05 MAINTENANCE

- A. Furnish 2 percent extra lens or louvers for each size and type of fluorescent luminaire.
- B. Furnish 10 percent extra lamps for each size and type installed.
- C. Furnish 5 percent extra ballasts for each size and type.

PART 2 - PRODUCTS**2.01 LUMINAIRES**

- A. Luminaires: Refer to description and manufacturers in Luminaire schedule.
- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet locations.
- D. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material.
- E. Finishes:
 - 1. Manufacturer's standard finish (unless otherwise indicated) over a corrosion resistant primer.
 - 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectances.
 - 3. Exterior Finishes: As detailed in luminaire schedule or on Drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- F. Light Transmitting Components:
 - 1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 - 2. Prismatic acrylic, extruded, flat diffusers, 0.125 inch overall thickness, unless otherwise noted.
- G. Fluorescent Luminaires:
 - 1. Provide open lamp fluorescent luminaires without diffusers or guards with turret type, spring loaded sockets.
 - 2. To facilitate multilevel lamp switching, wire lamps within luminaire with outermost lamp at both sides of luminaire on the same ballast, the next inward pair on another ballast and so on to innermost lamp (or pair of lamps).
 - 3. For T5HO lamps, provide twist and lock design sockets, socket body rated to 110C and socket rotor rated to 140C.
 - 4. Provide wire lamp guards on exposed lamp fluorescent luminaires.

2.02 BALLASTS

- A. General:
 - 1. Provide ballasts UL rated for specified lamps.
 - 2. Thermal Protection: Internal UL Class 'P' with automatic reset.
 - 3. Sound Ratings: Class 'A'. Where not available as standard product from any specified manufacturer, provide quietest rating available.

4. Total Harmonic Distortion: Not to exceed 20 percent of the input current unless otherwise indicated.
 5. Input Voltage: Provide universal voltage ballast matching branch circuit supply voltage.
 6. Provide quantity of ballasts to provide switching as indicated on Drawings.
 7. Provide factory printed wiring diagram on ballast housing.
 8. Ballasts used in enclosed and gasketed luminaires shall be of Type 1 construction.
 9. Comply with FCC rules and regulations Part 18, Class A concerning generation of both electromagnetic interference and radio frequency interference.
 10. Provide 3-year warranty against defects in materials and workmanship, including either a USD 10 replacement labor allowance or complete replacement including labor by an agent of the manufacturer.
- B. Ballasts for Linear Fluorescent Lamps:
1. Power Factor: Minimum 97 percent.
 2. Do not provide magnetic fluorescent ballasts.
 3. Nondimming Electronic:
 - a. Tandem wiring between luminaires may be used to minimize the number of ballasts while accomplishing the switching requirements shown on Drawings. Provide label in lamp compartment of luminaire to identify the function of ballast. Label shall not be visible from room.
 - b. Provide ballasts that meet requirements of UL 935, ANSI C82.11 and bear the appropriate UL label.
 - c. Provide ballasts that withstand input power line transients as defined in ANSI C62.41, Category-A and IEEE 587.
 - d. Provide series wired programmed start ballast unless noted on drawings.
 - e. High frequency operation: Not less than 42kHz.
 - f. Lamp Crest Factor: Maximum 1.7 for programmed rapid start ballasts and maximum 1.85 or less for instant start ballasts.
 - g. Average Ballast Factor (BF): Minimum 88 percent or as indicated in the luminaire schedule.
 - h. Provide 0 degree Fahrenheit minimum starting temperature ballasts for luminaires installed where exposed to anticipated ambient temperature less than 55F.
 - i. Manufacturers: Advance, Universal Lighting Technologies, OSRAM/Sylvania, or approved.
- C. Ballasts for Compact Fluorescent Lamps:
1. Power Factor: Minimum 97 percent.
 2. Provide ballasts which meet requirements of UL 935, ANSI C82.11 and bear the appropriate UL label.
 3. With integral end of lamp life detection and shutdown circuit with automatic reset.
 4. Nondimming Electronic:
 - a. Series wired, programmed rapid start circuitry.
 - b. High frequency operation: Not less than 50kHz.
 - c. Lamp Crest Factor: Maximum 1.5.
 - d. Average Ballast Factor (BF): Minimum 98 percent.
 - e. 0 degree Fahrenheit minimum starting temperature.
 - f. Manufacturers: Advance, OSRAM/Sylvania, Universal Lighting Technologies, or approved.
- D. Provide special types as indicated in the luminaire schedule.

2.03 LAMPS

- A. Provide lamps for luminaires.

- B. Provide lamp cataloged for specified luminaire type.
- C. Provide similar lamps by a common manufacturer unless indicated in the luminaire schedule.
- D. Manufacturers: General Electric, Philips, OSRAM/Sylvania (OSI), Venture, Ushio (MR only), EYE (MR only), or approved unless specific manufacturer is indicated in the luminaire schedule.
- E. Incandescent: Not allowed unless noted in luminaire schedule.

~~F. Tungsten Halogen Incandescent:~~

~~1. Line voltage:~~

~~a. PAR lamps: Provide HIR technology, medium screw base, size, wattage and beam spread as indicated in the luminaire schedule.~~

~~b. Tubular: Provide HIR technology, wattage and base configuration as indicated in the luminaire schedule and proper type for luminaire.~~

~~2. Low Voltage: Wattage, voltage, beam spread, base style and type as indicated in the luminaire schedule.~~

G.F. Fluorescent:

- 1. Provide 3500K fluorescent lamps unless noted in luminaire schedule.
- 2. Linear Fluorescent:
 - a. T-8: Provide the following:
 - 1) Bi-pin base, tri-phosphor coated
 - 2) CRI equal to or exceeding 85.
 - 3) 30000 hours rated on 3 hour switching cycle when used with programmed start ballast.
 - 4) Compatible with dimming ballasts.
 - 5) Length and wattage as indicated in the luminaire schedule.
 - b. T-5: Provide the following:
 - 1) bi-pin base, tri-phosphor coated
 - 2) CRI equal to or exceeding 85.
 - 3) Compatible with dimming ballasts.
 - 4) Length and wattage as indicated in the luminaire schedule.
 - c. Do not provide T-12 lamps.
- 3. Compact Fluorescent:
 - a. Single ended, four-pin plug-in base, tri-phosphor coated, CRI exceeding 81, CCT, wattage and configuration as indicated in the luminaire schedule.
 - b. Do not provide self ballasted screw-in type unless indicated in the luminaire schedule.
 - c. Do not provide magnetic starter type luminaires, ballasts or lamps.

H.G. Special types as indicated in the luminaire schedule.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Verification of Conditions: Verify ceiling construction, recessing depth and other construction details prior to release of luminaire for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment.
- B. Provide lighting indicated on Drawings with a luminaire of the type designated and appropriate for location. Where outlet symbols appear on Drawings without a type

designation, provide a luminaire the same as those used in similar or like locations.

- C. Provide fluorescent and HID luminaires with ballast compatible to lighting control system as shown in drawings and specifications.

3.02 INSTALLATION

- A. Install luminaire of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance for equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.
- E. Egress Luminaires: Provide unswitched emergency circuit to exit signs and emergency luminaires.
- F. Interior Luminaire Supports:
 - 1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Maintain luminaire positions after cleaning and relamping.
 - 3. Support luminaires without causing ceiling or partition to deflect.
 - 4. Provide recessed fluorescent luminaires with four supports as required by DSA.
- G. Wiring:
 - 1. Recessed luminaires to be installed using flexible metallic conduit with luminaire conductors to branch circuit conductors in a nearby accessible junction box over ceiling. Junction box fastened to a building structural member within 6 feet of luminaire.
 - 2. Install luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
 - 3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
 - 4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.
 - 5. Unit Battery Equipment in Egress Luminaires: Provide unswitched conductor to each egress luminaire from serving circuit. This is for the transfer electronics to determine when power has actually been lost.
- H. Relamp luminaires which have failed lamps at completion of work.

3.03 ADJUSTING

- A. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
- B. Align luminaires that are not straight and parallel/perpendicular to structure.

3.04 CLEANING

- A. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
- B. Where finish of luminaires and poles has been damaged, touch up finish as directed by manufacturer's instructions.

END OF SECTION

SECTION 27 53 13
CENTRAL CLOCK SYSTEM

PART 1 - GENERAL**1.01 SUMMARY**

- A. General: The district utilizes a Simplex central clock system that provides synchronized timepieces throughout its three colleges and the district administration building. Provide, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to complete a working Central Clock system installation, as described in these specifications.
- B. Section Includes:
- ~~1. Central clock system controller Simplex 6351 Time controller center.~~
 - 2.1. Secondary field clocks (Simplex #6310-9231) capable of connecting to a SIMPLEX 6351 Master Clock System
 - 3.2. Secondary clock cable requirements
- C. Products Specified But Not Installed Under This Section:
- 1. Secondary clock single gang back boxes with $\frac{3}{4}$ " conduit to accessible ceiling space
- D. Related Sections:
- 1. Comply with related section paragraphs of section 27 00 00 Telecommunications Basic Requirements.
 - 2. Comply with related section paragraphs of section 27 13 10 Telecommunications backbone ISP cabling.
 - 3. Comply with related section paragraphs of section 27 13 14 Telecommunications backbone OSP cabling.
 - 4. Comply with related section paragraphs of section 27 15 13 Telecommunications horizontal cabling.
 - 5. Comply with related section paragraphs of section 26 01 00 Basic materials and methods.

1.02 SYSTEM DESCRIPTION

- A. Overview
- 1. Central clock system (Existing) will provide a centrally located clock controller to maintain accurate time and adjustment to secondary clocks (New) located in classrooms, offices and administration areas throughout the campus distribution system.

1.03 SUBMITTALS

- A. Contractor Qualifications: Submit certification letters for District clock manufacturer "Simplex".
- B. Product Data: Submit product information for components specified herein. Refer to Section 280000 for format and requirements.
- C. Shop Drawings: Submit shop drawings in accordance with Division 1. Refer to Section 280000 for format and requirements.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

~~A. Centralized clock system: Use Simplex model 6351 Synchronized Time Controller Center for head-end equipment.~~

- ~~1. Must be Microprocessor based~~
- ~~2. Must have RS-232 interface for synchronization to external time source.~~
- ~~3. Must have automatic Daylight Saving Time correction.~~
- ~~4. Must have 12 or 24 hour, 6-digits liquid crystal time display.~~
- ~~5. Must have 60 day battery standby.~~
- ~~6. Complies with UL Standards 863.~~

B.A. Secondary Clocks: Use Simplex model 6310-9231 for secondary surface mounted clocks or equal.

1. 12" diameter round black frame.
2. Black Arabic numerals.
3. Use a continuous sweeping second hand.
4. Surface mounted on the wall.

PART 3 - EXECUTION**3.01 INSTALLATION**

~~A. Centralized Controller Equipment Installation~~

- ~~1. Coordinate installation of equipment with other trades to avoid unforeseen conflict in Equipment Room.~~
- ~~2. Properly bond system to Main Telecommunication Ground Bussbar.~~
- ~~3. Mount unit above 48" AFF to accommodate service and maintenance.~~

B.A. Secondary Field Clocks

1. Provide single gang back box with $\frac{3}{4}$ " conduit to accessible ceiling space at 96" AFF (provided by electrical contractor).
2. Route connection cable to single gang back box.
3. Install clock making connection to cable in single gang back box.

END OF SECTION

SECTION 28 31 00**FIRE DETECTION AND ALARM SYSTEM****PART 1 - GENERAL****1.1 SCOPE**

- A. This Section describes a Protected Premises Fire Detection system for the following San Mateo County Community College District sites: Cañada College, College of San Mateo and Skyline College. Modifications to the existing fire alarm system shall provide evacuation alarm tone signaling using horns to sound the alarm signals and ADA-compliant strobe notification devices for visual notification. The system shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The system provided shall have a Fire Alarm Control Panel (FACP) and field devices as indicated on the DSA-approved drawings.
- B. The features and capacities described in this specification are a requirement for this project and shall be furnished by the successful contractor. The District has determined that the Siemens MXL system, provided by Siemens Building Technologies, Hayward, CA (contact Kelly Rogers: 510-783-6000), is the District standard, no equal. The system as described in this specification and as shown on the drawings shall be installed, programmed, tested, and delivered to the owner in fully operational condition. The system shall include all required hardware, software, raceways and interconnecting wiring to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein. The system shall consist of, but not be limited to, the following:
1. Fire Alarm Control Panel (FACP)
 2. Fire Alarm Remote Annunciator (FAAP)
 3. Booster Power Supplies
 4. Addressable Manual Fire Alarm Pull Stations
 5. Addressable Analog Smoke Detectors
 6. Addressable Area Heat Detectors
 7. Addressable Analog Duct Smoke Detectors
 8. Addressable Intelligent Interface Modules
 9. Audible and Visual Notification Appliances
- C. Non-addressable alarm initiating, supervisory and status monitored devices shall be integrated into the fire alarm system, as applicable, via an addressable intelligent interface module, as indicated on the drawings:
- D. Sprinkler Water Flow Alarm (alarm initiating)
1. Sprinkler Valve Tamper Switch (supervisory)
 2. PIV, OS&Y
 3. Kitchen Ansul Systems
 4. Security Interface
 5. Magnetic hold-opens
- E. Connections to existing elevator control panels (by others) and providing the necessary modules for elevator recall and shunt trip functionality.
- F. Audible/visual notification appliances and communicating devices to be controlled by the FACP:
1. Horns
 2. Strobe Lights

3. Combination Horn/Strobes
- G. Connect system to the existing campus MXL network system such that all status changes are transmitted to the Main Campus FACP.
- H. DSA and local requirements shall be adhered to with regard to submitting specifications, wiring diagrams, shop drawings and plans. Responsibility for furnishing the quantities of copies in digital format and/or hard copy, as directed by contract requirements, shall be included as part of the work of this section.

1.2 RELATED SECTIONS, RELATED WORK AND EXISTING CONDITIONS

A. RELATED WORK

1. The contractor shall coordinate work described within this section with all related trades and shall relay all necessary coordination information to the System Supplier in a timely manner such that proper coordination shall take place. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:
 - a. Mechanical Coordination: Sprinkler water flow alarm and valve tamper switches to be provided and installed by the fire protection sprinkler contractor, if a part of this project. See Division 21. They shall be wired and connected to the fire alarm system monitor modules by the contractor.
 - b. Mechanical Coordination: Duct Smoke Detectors shall be provided and wired under this Section and installed under the mechanical section as shown on the fire alarm system drawings.
 - c. Security Interface, if required.
 - d. Coordinate with all other trade contractors for the mounting of and/or interfacing with any and all other fire alarm system related devices.

B. EXISTING CONDITIONS

1. This project consists of modifying the existing fire alarm system within the existing building. The contractor shall visit the site to determine and verify all existing conditions. Existing conditions that would, in the contractor's opinion, prohibit or greatly delay construction progress shall be brought to the Architect and Engineer's attention in writing in a timely manner.
2. No additional compensation shall be permitted for variations due to accessible field conditions that would affect the installation of the fire alarm system.

1.3 REFERENCES - APPLICABLE LISTINGS, CODES, STANDARDS, DOCUMENTS

A. STANDARDS AND CODES

1. All equipment shall be installed and comply with the current adopted provisions of the following codes and standards.
2. All equipment shall be Underwriters' Laboratories (UL), Inc. listed for its intended use. At a minimum, the following standards shall apply:
 - a. UL 268 and 268A - Smoke Detectors for Fire Protective Signaling Systems
 - b. UL 346 - Water-Flow Indicators for Fire Protective Signaling Systems.
 - c. UL 464 - Audible Signaling Appliances.
 - d. UL 864 - Control Units for Fire Protective Signaling Systems.
 - e. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
 - f. UL 1971 - Signaling Devices for the Hearing-Impaired.
3. National Fire Protection Association (NFPA) standards:
 - a. NFPA No. 13 - 1999 Edition - Sprinkler Alarm and Supervision.
 - b. NFPA No. 70 National Electrical Code.
 - c. NFPA No. 72 National Fire Alarm Code.

- d. NFPA No. 90A Installation of Air Conditioning & Ventilating Systems.
- e. NFPA No. 101 Life Safety Code.
- 4. All raceways and wiring shall be installed in compliance with NFPA Standard 70 (National Electrical Code - Article 760) with applicable California amendments. Codes shall be implicitly followed, in particular, with regard to material type and quality, circuitry extensions from and connections to outlet and junction boxes, panel boards and similar appurtenances.
- 5. The fire alarm system and its installation shall comply with all applicable requirements of the Americans with Disabilities Act of 1992.
- 6. The fire alarm system and its installation shall comply with DSA and all other local codes and authorities having jurisdiction, including but not limited to, San Mateo County Community College District's engineering design standards and guidelines.

1.4 SYSTEM DESCRIPTION

- A. The system shall operate as an integrated, multiplexed, protected premises fire alarm control system tied into the existing campus network system.
- B. Changes in the status of monitored points shall be detected by the microprocessor based fire alarm control panel and shall report any change in status to the Main Campus Fire Alarm System utilizing master-slave (Cañada College) networking protocol.
- C. Sensor "dirty" and "excessively dirty" trouble conditions shall report automatically.
- D. Devices shall be listed by UL for sensitivity testing by means of the portable programmer/tester or by readout from the control panel. Each addressable device address shall be set electronically, devices requiring dipswitch settings, rotary switch settings, staples or jumper settings are not acceptable.
- E. Smoke detectors shall alarm at their programmed sensitivity settings and shall not revert to a common default setting when their operating system segment is in the fail safe degrade mode.
- F. System shall individually identify each addressable initiating device and other addressable monitor functions using multiplexing interfacing techniques.
- G. System shall be capable of operating alarm notification appliances, and other control functions, using multiplexing techniques.
- H. Life safety alarm function programs shall perform automatically upon system alarm actuation. In addition, control points may be operated manually at any time by the attendant through appropriate keyboard commands. The FACP shall also provide integral programmable function control switches to allow personnel to manually operate specific pre-programmed control output functions, as required.

1.5 QUALITY ASSURANCE

- A. It is the intent of these specifications to provide a complete fire alarm system that complies in all respects with the requirements of all applicable codes and standards. Equipment, materials, software, installation practices, etc. that do not meet these requirements or do not meet the performance standards herein specified shall not be acceptable.
- B. The equipment furnished under this specification shall be that of the specified manufacturer, no equal. All information herein is intended to establish minimum standards of performance, quality and construction, and is based upon the Siemens MXL

addressable analog equipment designed and manufactured by Siemens Building Technologies, Inc. Catalog and model numbers are specified herein and indicate the materials as well as the operating features required. It is not the intent of these specifications to eliminate competitive installation proposals, only to standardize the District's Fire Life Safety Systems.

- C. Before commencing work the fire protection contractor shall submit data showing that contractor has successfully installed fire alarm systems of the same scope, type and design as specified. The contractor shall also include the names and locations of at least three installations where such systems have performed satisfactorily for the preceding 18 months.
1. The contractor shall submit copies of all required Licenses and Bonds as required by the State.
 2. The system supplier shall employ on staff a minimum of one NICET level 4 personnel or a professional engineer, registered in the State of California.
 3. Installing contractors unable to comply with the provisions of 1.06 shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
- D. Provide the services of a representative or technician from Siemens Building Technologies. The representative or technician is to be certified and experienced in the installation and operation of the type of system specified. The representative shall be licensed in the State, if required by law. The fire alarm contractor shall supervise installation (duct detector locations are to be determined by the mechanical contractor). The system supplier shall provide all software programming, software documentation, system adjustments, preliminary testing, final testing and certification of the system. The fire alarm supplier shall also be required to provide a 4 hour operational instruction to the owner's personnel.
- E. All fire alarm system equipment furnished under this specification shall be UL listed, under the appropriate category, as the product of a single manufacturer. All control equipment shall be listed under UL as a single control unit. The manufacturer shall have been engaged in the production of this type of equipment for at least ten (10) years and have a fully equipped service organization capable of responding within 48 hours from the initial contact for warranty or regular service work. Emergency and/or off hours calls shall be responded to within 4 hours of initial contact, seven days a week.
- F. Prior to bid submittal, contractor shall state what, if any, specific points of the proposed system's operation or the equipment's quality differ in any way from this specification by submission of a complete technical proposal to include supporting literature and drawings. Only those departures from these specifications shall be considered by the engineer. Failure to submit all departures from these specifications and to receive approval for such departures, shall be cause for summary rejection of any submittal documents where unapproved departures are discovered.
- G. Should conflicts arise between project drawings and/or these specifications, regarding design, quantities of devices or circuits, the higher standard and/or quantity and/or cost shall be considered correct.
- H. It is the contractor's responsibility to submit acceptable equipment for review by the engineer. The contractor shall bear all liability for damages arising from his failure to submit equipment that meets these specifications, including, but not limited to, any penalties for failure to meet construction deadline.
- I. Final determination of compliance with these specifications shall rest with the Engineer of Record, who, at its discretion, may require proof of performance at the cost of the contractor. Required proof may include, but shall not be limited to, expense paid visits by

representatives of the owner and engineer to sites where identical equipment is installed and providing beneficial use.

1.6 SUBMITTAL REQUIREMENTS

- A. Prior to the start of work, the contractor shall provide a complete and comprehensive submittal for review by the engineer. These are to describe the proposed system and its equipment. Failure to provide a complete submittal shall be grounds for summary rejection of any incomplete submittal documentation. District reserves the right to deduct monies from payments due Contractor to cover District and Architect/Engineer's additional costs of review beyond the second submission. The complete submittal shall include, but not be limited to, all of the following material:
1. Power Calculations
 - a. Battery capacity calculations shall be a minimum of 125% of the calculated requirement.
 - b. Supervisory power requirements for all equipment.
 - c. Alarm power requirements for all equipment.
 - d. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst case condition plus 25% spare capacity.
 - e. Voltage-drop calculations for wiring runs demonstrating worst-case condition.
 2. Complete manufacturers catalog data including supervisory power usage, alarm power usage, physical dimensions, finish and mounting requirements.
 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system. Floor plans in the current AutoCAD version showing the locations of all equipment and raceways, conductor counts with type and size.
 4. A complete proposed system database including a description of all logic strings, control by event programming and point identification labels on a unique CD-ROM and in a formatted printed form, as required for off site editing, shall be submitted for evaluation by the owner.
 - a. The program shall include all required interactive control functions between the local network systems and the methods for implementing these actions.
 5. Provide the address, telephone number, and contact person(s) of the manufacturer's local service facility for normal and off-hour warranty issues.
 6. Provide a fire alarm system function matrix. Matrix shall illustrate alarm output events in association with initiating devices input events. Matrix shall represent a summary of the installed system alarm, supervisory and trouble functions. (See Appendix-A NFPA-72 for minimum matrix requirements - A-7-5.2.2 (9) 1999).
 7. For each system control and/or power panel, provide panel ampere loading during both normal and alarm modes, with time calculations to substantiate compliance with battery back-up power requirements (battery Ampere-Hour capacity), described elsewhere in these specifications.
 8. For each system control panel, provide written schedule of active and spare addresses provided on each addressable circuit to substantiate compliance with circuit usage/spare requirements, described elsewhere in these specifications.
 9. For each system control panel and system transponder notification appliance circuit, provide proof of spare capability in amperes available for future use, if needed.
 10. Provide manufacture's printed product data, catalog pages and descriptions of any special installation requirements and/or procedures. Drawings depicting any special physical installation requirements shall show physical plans, elevations, all dimensions, conduit entry, minimum access clearances and any other details required.
 - a. Provide shop drawings as follows:
 - b. Drawing or catalog page showing actual dimensions of the main FACP.

- c. Drawing(s) or catalog page(s) showing actual dimensions of any additional system control panels and/or battery cabinets.
 - d. Drawing or catalog page showing actual dimensions of the Remote Annunciator.
 - e. Single line riser diagram showing, all equipment, all connections and number and size of all conductors and conduits.
 - f. Provide samples of various items when so requested by the Architect/Engineer.
- B. A maximum of two submittal reviews will be performed by Engineer. Compensate additional time and material to the Engineer based on their published fees for additional reviews.

PART 2 - SYSTEM OPERATION

2.1 BASIC SYSTEM EQUIPMENT, CIRCUITING, ADDRESSING AND OPERATING CAPABILITIES

A. GENERAL

1. The FACP shall communicate via an RS-485 Carrier Sense, Multiple Access, Collision Detect protocol, also known as CSMA/CD or an ETHERNET type topology.
2. The FACP shall provide NFPA 72, Style 4 (Class B) analog signaling line circuits. Each loop card shall communicate with and receive alarms from up to 120 points, consisting of a maximum of sixty intelligent analog alarm initiating and sixty intelligent controllable output devices. Circuits shall be configured with loop isolators and wired in a manner that prevents a catastrophic wiring event on a floor from affecting the performance of other floors.
3. Remote Annunciator (Siemens RCC Series): LCD type with two lines of 40 characters each. The Remote Annunciator shall communicate to the FACP on one #16 TSP and derive power from the FACP over a pair of #14 AWG conductors. It shall be possible to Acknowledge general "ALARM", "TROUBLE", and "SUPERVISORY" conditions from the Remote Annunciator using a key. Each Remote Annunciator must be housed in a lockable box. NEMA rated boxes are required for any locations, interior or exterior, where adverse weather or high humidity conditions occur. Mount Remote Annunciator(s) as indicated on the drawings, at a height where reasonable viewing is possible by the responding fire authority. Obtain approval of the specific location from the Architect and/or Engineer of Record prior to mounting the Annunciator.
4. System power supplies, including necessary Booster Power Supplies, transformers rectifiers, regulators, filters and surge protection required for system operation, with the capacity to power the system in a worst case condition with all devices in alarm and all local indicating appliances active without exceeding the listed ratings. Provide adequate notification appliance Booster Power Supplies so as to allow for a minimum of 20% spare capacity on each NAC.
 - a. System primary power: Primary power for the FACP and the secondary power battery chargers shall be obtained from a dedicated emergency power circuit. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm. Each circuit used for fire alarm purposes shall be permanently labeled for function.
 - b. Secondary power supply: Provide sealed gelled electrolyte batteries as the secondary power supply for all fire alarm functions. The battery supply shall be calculated to operate loads in a supervisory mode for twenty-four (24) hours no primary power applied and after that time, operate in alarm mode for five (5) minutes. Batteries shall be sized at

- 125% of the calculated size to compensate for deterioration and aging during the battery life cycle. Battery calculations shall be submitted to justify the battery size.
5. The system 16 bit core processor shall incorporate an internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm reception, by system programming or by manual commands. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Systems with single watchdog circuits for all processors shall not be acceptable unless supplied with a "hot" standby CPU. Digital communication capabilities required for the control panel to communicate with remote annunciators, input/output drivers and displays shall be provided.
 6. Manual Addressable Pull Stations (Siemens MSI-10B) shall be the single action type, unless specifically noted otherwise by these specifications or on project drawings, and listed by Underwriters' Laboratories, Inc. The intelligent manual fire station shall operate on any addressable detection circuit. It shall be red in color. Manual fire stations shall be individually annunciated on the control panel. Mounting height shall be 48" inches to the manual station actuation handle from the finished floor.
 7. Intelligent/analog smoke detectors (Siemens FP-11) shall be photoelectric and listed by Underwriters' Laboratories, Inc. The detector shall contain a long life light emitting diode (LED) as its light source, and photo diode as a light receiver. An automatic gain control circuit shall be compensating for detector aging and dirt accumulation. The smoke detector shall be a plug-in twist/lock unit that allows for easy connection to its mounting base. Each smoke detector, when activated, shall have a flashing tri-color LED alarm indicator that shall indicate red for alarm, yellow for trouble and green for normal operational mode. Application Specific Detection environmental settings shall be programmed as directed by the engineer. System programming shall provide multiple output functions from a single initiating multi-criteria smoke detector. This capability shall mean a separate alarm event output for smoke alarm and a separate alarm output function for thermal alarm from a single analog initiating address device. Systems not capable of providing this design requirement shall provide alternate programmable logic accomplishing design performance, acceptable to the Engineer of Record.
 - a. It shall be possible to adjust and/or electronically measure the sensitivity of each individual intelligent analog smoke sensor from the control panel. Relative sensitivity or manual test methods, which check the smoke sensor at the maximum allowable obscuration, will not be considered as being equivalent.
 - b. Smoke detectors shall alarm at their programmed sensitivity settings and shall not revert to a common default setting when their operating system segment is in the fail safe degrade mode.
 8. Intelligent/Analog Duct Smoke Detector (Siemens FP-11/AD2-XHR, or ILP-1/AD-3ILP for rooftop applications) shall be photoelectric and listed by Underwriters' Laboratories, Inc. The detector shall contain a long life light emitting diode (LED) as its light source, and photo diode as a light receiver. An automatic gain control circuit shall be compensating for detector aging and dirt accumulation. The smoke detector shall be a plug-in twist/lock unit that allows for easy connection to its mounting base. Each smoke detector, when activated, shall have a flashing tri-color LED alarm indicator that shall indicate red for alarm, yellow for trouble and green for normal operational mode. Application Specific Detection environmental settings shall be programmed as directed by the Engineer. System programming shall provide multiple out-put functions from a single initiating multi-criteria smoke detector. This capability shall mean a separate alarm event output for smoke alarm and a separate alarm output function for thermal alarm from a single analog initiating address device. Systems not

capable of providing this design requirement shall provide alternate programmable logic accomplishing design performance, acceptable to the Engineer of Record.

- a. It shall be possible to adjust and/or electronically measure the sensitivity of each individual intelligent analog smoke sensor from the control panel. Relative sensitivity or manual test methods, which check the smoke sensor at the maximum allowable obscuration, will not be considered as being equivalent.
 - b. Smoke detectors shall alarm at their programmed sensitivity settings and shall not revert to a common default setting when their operating system segment is in the fail safe degrade mode.
 - c. Coordinate sampling tube sizing with mechanical ducting requirements prior to shipping.
9. Heat detectors (Siemens FPT-11) shall be 135° F fixed temperature or fixed temperature/rate of rise and be listed by Underwriters' Laboratories, Inc. Rate-of-rise alarm threshold rate shall be 15° F per minute with a maximum coverage area of 2,500 sq. ft. Activation of the rate-of-rise heat detector shall be self-restoring. All detectors shall be addressable and have a white finish. The thermal detectors shall be individually annunciated on the control panel. Each heat detector, when activated, shall have a flashing tri-color LED alarm indicator that shall indicate red for alarm, yellow for trouble and green for normal operational mode.
 10. High temperature heat detectors (Siemens DT-200R) shall be conventional 200° R fixed temperature/rate compensated and listed by Underwriters' Laboratories, Inc. The detector shall have a maximum coverage area of 2,500 sq. ft. Upon activation, the detector shall latch in alarm until reset at the main fire control panel and be self-restoring. The detector shall be individually annunciated at the control panel by means of interfacing with a remote addressable monitor module (TRI Series) or an addressable conventional zone module (CZM-4). The detector's interface module address shall be set by electronic means only, no mechanical means such as programming pins, dip-switches or rotary dials shall be used.
 11. Interface modules (Siemens TRI Series) shall be intelligent and listed by Underwriters' Laboratories, Inc. The unit shall incorporate a custom microprocessor based integrated circuit that provides communication with main fire control panel. The interface module shall supervise and monitor normally open or normally closed dry contacts and report their status to the control panel. The intelligent interface module shall be used to uniquely identify field devices (contacts) such as kitchen Ansul, suppression system, water flow switches, tamper switches, OS&Y valves or as directed by these specifications and project drawings.
 12. Intelligent interface modules (TRI-R) shall also be used when remote relays are required for system control functions, such as, but not limited to, fan shut down, door holder trip and elevator recall and shunt trip functions. Relay dry contacts shall be rated at 4 AMPS, 120 VAC resistive or 30 VDC resistive and contacts shall be Form "C" type.
 13. The MXL and Booster Power Supplies shall provide NFPA 72, Style Y, two-wire (Class B), notification appliance circuits.
 14. Horns (Wheelock AH Series) shall be installed as shown on the drawings in accordance with the requirements of the UL 1971 standard and NFPA 72. Provide UL listed weatherproof units and their required back boxes where shown on the drawings.
 15. Horn Strobes (Wheelock Z-Series) shall be installed as shown on the drawings in accordance with the requirements of the UL 1971 standard and NFPA 72. Provide UL listed weatherproof units and their required back boxes where shown on the drawings. See Strobe requirements below.
 16. Strobes (Wheelock Z-Series) shall be installed as shown on the drawings in

accordance with the requirements of the UL 1971 standard and NFPA 72. Where multiple visual notification appliances can be seen from any location, circuitry shall be incorporated for the synchronization of flash rate. Strobes shall be of the latest compatible Siemens appliances. See DSA approved drawings for device quantities and locations. Provide UL listed weatherproof units and their required back boxes where shown on the drawings.

- a. Strobes shall produce a flash rate of one (1) flash per second minimum over the listed input voltage (20VDC - 31VDC) range.
 - b. Strobes shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens or equivalent with solid state circuitry.
 - c. Strobe intensity shall be rated per UL 1971 for 15/75, 30/75, 60/75, 75 or 110 Candela. Dual listing strobes of 15/75 intensity for UL 1971/near-axis requirements shall be used where acceptable.
 - d. Strobes shall be available for semi-flush or surface mounting and in conjunction with audible appliances as required.
17. Magnetic Door Hold-Opens (Rixen FM-998) shall be of the wall mount type and capable of operating at three voltages, 120VAC, 24VDC AND 24VAC, shall be provided under this section. They shall operate using local 24VDC power. The power shall be intercepted by a fire alarm system addressable control module or a relay base detector in order to interrupt the circuit so that the door closes in a fail-safe manner. See DSA approved drawings for device quantities and locations.
18. Software and firmware control:
- a. All software and firmware provided with a fire alarm system shall be listed for use with the fire alarm control unit.
 - b. A record of installed software and firmware version numbers shall be maintained at the location of the fire alarm control unit.
 - c. All software and firmware shall be protected from unauthorized changes through the use of "access levels."

B. SYSTEM ALARM OPERATION

1. Activation of any addressable manual fire pull box, area smoke detector, heat detector or waterflow switch shall result in, at a minimum, the following functions and indications:
 - a. Activate "ALARM" status change at the local FACP and annunciate on its LCD display, indicating device address, device type, device location, time and date.
 - b. Indicate "ALARM" status change at the respective building Remote Annunciator indicating device address, device type, device location, time and date
 - c. Activate General "ALARM" status change at the Off-Site Monitoring Station, through the Campus Network System.
 - d. Activate emergency evacuation audible and visual notification appliances within the associated building(s).
 - e. Annunciate "ALARM" status change at the On-site Main Campus Fire Alarm Control Panel location.
 - f. Record event in the non-volatile system historical log.
 - g. Record event system status change on the Main Campus Printer.
2. Elevator Recall:
 - a. Activation of smoke detector in an Elevator Lobby (other than the Lobby designated "Primary Recall Floor) Machine Room or Elevator Shaft shall cause the associated elevator(s) to be recalled to the designated Primary Recall Floor.
 - b. Activation of the Lobby Smoke detector on the designated Primary Recall Floor shall cause the associated elevators to be recalled to the designated Secondary Recall Floor.
 - c. Activation of any Elevator Machine Room heat detector shall shunt trip

the respective elevator main breaker.

C. SYSTEM SUPERVISORY FUNCTIONS

1. Activation of any Supervisory circuit, (i.e.; duct detector, supervised fire sprinkler valve closure, fire suppression system air pressure abnormal, low temperature, fire pump trouble, emergency fuel tank level alarm, as applicable to this project), shall cause the following actions and indications:
 - a. Activate "SUPERVISORY" status change at the FACP and annunciate on its LCD display, indicating device address, device type, device location, time and date
 - b. Indicate "SUPERVISORY" status change at the respective building Remote Annunciator indicating device address, device type, device location, time and date
 - c. Activate General "SUPERVISORY" status change at the Off-Site Monitoring Station, through the Campus Network System.
 - d. Annunciate "SUPERVISORY" status change at the On-site Main Campus Fire Alarm Control Panel location.
 - e. Record event in the non-volatile system historical log.
 - f. Record event system status change on the Main Campus Printer location.

D. SYSTEM TROUBLE FUNCTIONS

1. Receipt of a system trouble alarm, shall cause the following actions and indications:
 - a. Activate "TROUBLE" status change at the FACP and annunciate on its LCD display, indicating device address, device type, device location, time and date
 - b. Indicate "TROUBLE" status change at the respective building Remote Annunciator indicating device address, device type, device location, time and date.
 - c. Activate General "TROUBLE" status change at the Off-Site Monitoring Station, through the Campus Network System.
 - d. Annunciate "TROUBLE" status change at the On-site Main Campus Fire Alarm Control Panel location.
 - e. Record event in the non-volatile system historical log.
 - f. Record event system status change on the Main Campus Printer location.
2. The fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the FACP.
3. System addressable devices shall be supervised for placement and normal operation. Removal of an addressable device or the failure of its internal electronic circuitry shall initiate a system trouble condition.
4. The FACP shall initiate a system trouble condition when the following occurs:
 - a. Primary 120/220 VAC power loss.
 - b. Battery disconnect.
 - c. Battery low voltage.
 - d. LCD annunciator panel power loss.
5. Operating an Off-Site Station agency alarm disconnect switch or any manual control commands that alter the system from its normal programmed standby configuration shall initiate a trouble condition.
6. Trouble conditions shall automatically activate an audible signal and flash the general system trouble LED indicator at the FACP. Pressing the trouble acknowledge key on the FACP shall silence the audible signal and continuously light the LED indicator, until the trouble condition is repaired. Subsequent trouble conditions shall re-sound the audible signal and again flash the LED. Each trouble condition must be individually acknowledged.
7. Removal of or failure of internal electronic circuitry of any addressable device

shall initiate a system trouble condition.

E. INSTALLATION SHOP/AS-BUILT DRAWINGS

1. Show general layout of complete system including equipment arrangement. It shall be the responsibility of the fire alarm installing contractor to verify dimensions and ensure compatibility of all system interfaces. Shop drawings shall be maintained at the job site and shall be updated on an as needed basis. During the project life cycle, the Architect/Engineer may require updated drawings as reference during scheduled project meetings.
 - a. Identify on the drawings, conduit and conductor sizes and types with number of conductors in each conduit. Provide each conduit and device with a unique identification. For addressable alarm initiation devices, the system identifier shall be the system address for that device. Signals shall be sequentially numbered with the address of the associated control module.
2. As-built drawings shall indicate point to point wiring diagrams of interconnecting wiring within all system control panels and termination enclosures showing wiring between modules and connecting field device terminals. All field numbering and/or labeling shall be reflected on As-built drawings.
3. Provide mounting details of FACP, remote transponder control panels (if any), system terminal enclosures and other boxes to building structure, showing fastener type, sizes, material and embedded depth.

F. CONDUIT, BOXES, ENCLOSURES AND WIRING DEVICES

1. All system wiring shall be in conduit and shall comply with all applicable article of the current California-amended NEC edition.
2. Boxes shall be installed plumb and firmly in position.
3. Extension rings with blank covers shall be installed on junction boxes where required.
4. Junction boxes served by concealed conduit shall be flush mounted.
5. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
6. All junction boxes shall be painted fire department red and be affixed with a decal or silk-screened label "Fire Alarm System."
7. Wet or damp locations shall require a NEMA rated enclosure suitable for the environment in which an addressable field device or module are to be installed. (i.e. monitoring of sprinkler water flow, tamper switches and OS&Y valves)
8. Electrical conduits shall enter only at the side or the bottom of control cabinets, unless designed and approved for entry on the top.
9. All conduits shall be grounded to a water main by approved ground clamps with a conductor equal in size to the largest conductor used in the system; but in no case shall the ground conductor be smaller than no. 10 AWG.
10. All openings in fire rated walls, floors or ceilings where conduits, cables or wiring trays pass through shall be fire stopped with an approved fireproofing material rated to meet or exceed the rating of the assembly penetrated.

G. CONDUCTORS

1. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
2. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer-wiring guides.
3. Wiring for analog loop circuits, conventional detection circuits, speaker circuits and telephone circuits shall be based on the fire alarm manufacturer's wiring guidelines, but shall not be smaller than #16 AWG.

4. Notification Device Circuits: Minimum wire size shall be 12 AWG for horn and strobe circuits.
5. Splices shall be made with UL listed mechanical connectors to assure reliable service.
6. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
7. Wire nuts or other solderless splicing devices shall not be used.
8. A consistent color code for fire alarm system conductors throughout the installation shall be provided. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
9. All nominal voltage branch circuit power feeds (120/220 VAC) shall be identified "labeled" at both ends of the circuit to indicate its source and purpose. Each FACP and control panels shall have a dedicated branch circuit with shunt trip disconnect, labeled as such.
10. Wiring within system control panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance and to isolate nominal voltage wiring from system low voltage wiring.

H. DEVICE DESCRIPTORS

1. Descriptors at SMCCCD MXL panels shall be developed following this standard SMCCCD protocol. No exceptions are allowed.
 - a. Address, Device, Equipment ID (if needed), Building Number, Floor Number, Description
2. Devices shall be identified by an abbreviation or code from the following table below.

Initiating Devices		Communication Devices	
<u>Smoke Detector</u>	<u>SD</u>	<u>Fireman's Phone</u>	<u>FP</u>
<u>Heat Detector</u>	<u>HD</u>	<u>Fireman's Jack</u>	<u>FJ</u>
<u>Duct Detector</u>	<u>DD</u>		
<u>Beam Detector</u>	<u>BD</u>	Panels	
<u>Air Sampling</u>	<u>AS</u>	<u>Fire Alarm Control Panel</u>	<u>FACP</u>
<u>Monitoring Device (By Name)</u>	<u>MSC</u>	<u>Printer</u>	<u>PRT</u>
<u>Pull Station</u>	<u>PS</u>	<u>Annunciator</u>	<u>ANN</u>
<u>Tamper Switch</u>	<u>TS</u>	<u>Video Display Terminal</u>	<u>VDT</u>
<u>Water Flow</u>	<u>WF</u>	<u>Voice Evac Panel</u>	<u>EVAC</u>
<u>Fire Smoke Damper</u>	<u>FSD</u>	<u>Fan Control Panel</u>	<u>FAN</u>
		<u>Network Control Center</u>	<u>NCC</u>
Notification Devices		<u>Aux Power Supply</u>	<u>PWR</u>
<u>Audible</u>	<u>AUD</u>	<u>Dialer</u>	<u>DIAL</u>
<u>Visual</u>	<u>VIS</u>	<u>Foreign System Interface</u>	<u>FSI</u>
<u>Audible/Visual</u>	<u>AV</u>		
<u>Voice Evac Speaker</u>	<u>SPKR</u>		

3. If the device is monitoring or controlling a piece of equipment, then that equipment's ID shall immediately follow the Device. (e.g., TRI HV-5A).
4. If the description is to contain a single compass point, it should be spelled out (e.g., North). If the description uses multiple compass points such as North East it should be abbreviated (e.g., N.E.).
5. If the description contains a room number, then state the building number followed by a dash and then the three digit room number. (e.g., 2-105)

6. Examples:
 - a. 02:002-007 PS B2 F1 RM 2-105
 - b. 02:001-047 SD B1 F3 MECH RM
 - c. 02:004-034 DD B7 F3 N.E. CORRIDOR
 - d. 02:004-059 TRI HV-5A B7 F1 MCC

PART 3 - TESTING AND ACCEPTANCE

3.1 FIELD QUALITY CONTROL

A. CERTIFICATE OF COMPLIANCE

1. Complete and submit to the project engineer in accordance with NFPA 72, paragraph 1.7.2.

B. FIELD - TESTING GENERAL

1. Each addressable analog smoke detector shall be individually field tested prior to installing the device at its designated location to ensure reliability after shipment and storage conditions. A dated log indicating correct address, type of device, sensitivity and initials of the technician performing the test - using test equipment specifically designed for that purpose - shall be prepared and kept for final acceptance documentation. After testing, the detection devices and base shall be labeled with the system address, date and initials of installing technician. Labeling shall not be visible after installation is complete.
2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance (Megger), current and voltage readings shall be made as work progresses.
 - a. A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.
 - b. The acceptance inspector shall be notified before the start of any required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
 - c. Test reports shall be delivered to the acceptance inspector as completed.
3. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multimeter for reading voltage, current and resistance.
 - c. Intelligent device programmer-tester.
 - d. Laptop computer with programming software for any required program revisions.
 - e. Two way radios, flashlights, smoke generation devices and supplies.
 - f. An approved device for measuring air flow through air duct smoke detector sampling assemblies.
 - g. Decibel meter.
 - h. Testing documentation.
4. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

C. FINAL ACCEPTANCE TESTING

1. A written "Acceptance Test Procedure" (ATP) for testing the fire alarm system components and installation will be prepared by the Engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying

- the correct operation of all system components, circuits and programming.
2. The acceptance inspector shall use the system record drawings in combination with the documents specified under sections (2.01-G and 3.01-C.) during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
 - a. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - 1) Open, shorted and grounded intelligent analog signaling line circuit.
 - 2) Open, shorted and grounded conventional initiating device circuits.
 - 3) Intelligent device removal.
 - 4) Primary power or battery disconnected.
 - 5) Incorrect device address.
 - b. System evacuation alarm indicating appliances shall be demonstrated as follows:
 - 1) All alarm notification appliances actuate as programmed.
 - 2) Audibility and visibility at required levels.
 - c. System indications shall be demonstrated as follows:
 - 1) Correct message display for each alarm input, at the control panel alphanumeric LCD display.
 - d. System on-site and/or off-site reporting functions shall be demonstrated as follows:
 - 1) Correct alarm custom message display, address, device type, date and time transmitted for each alarm input.
 - 2) Correct trouble custom message display, address, device type, date and time transmitted for each alarm input.
 - 3) Trouble signals received for disconnect.
 - e. Secondary power capabilities shall be demonstrated as follows:
 - 1) System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - 2) System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - 3) System battery voltages and charging currents shall be checked at the fire alarm control panel using the test codes and displayed on the LCD display.
 3. In the event of system failure to perform as specified and programmed during the ATP procedure, at the discretion of the acceptance inspector, the test shall be terminated.
 - a. The installing contractor shall retest the system, correcting all deficiencies and providing test documentation to the acceptance inspector.
 - b. In the event that software changes are required during the ATP, the system manufacturer to compare the edited program with the original shall furnish a utility program. This utility shall yield a printed list of the changes and all system functions, inputs and outputs effected by the changes. The items listed by this program shall be the minimum acceptable to be retested before calling for resumption of the ATP. The printed list and the printer log of the retesting shall be submitted before scheduling of the ATP.
 - c. The acceptance inspector may elect to require the complete ATP to be performed again if, in his opinion, modifications to the system hardware or software warrant complete retesting.

D. DOCUMENTATION

1. System documentation shall be furnished to the owner and shall include but not be limited to the following:
 - a. System record drawings and wiring details including 3 sets of as-builts as well as as-builts on a CD-ROM in the current version of AutoCAD.
 - b. System operation, installation and maintenance manuals.
 - c. Written documentation for all logic modules as programmed for system operation with a matrix showing interaction of all input signals with output commands.
 - d. System program "hard copy" showing system functions, controls and labeling of equipment and devices.
 - e. All specified documentation as required under sections (2.01.E. and 3.01.C.).

E. CLEANING

1. Contractor shall thoroughly clean all areas in which it works at the end of each work day and upon completion of installation.

F. WARRANTY/SERVICES

1. The contractor shall warrant the entire system against system hardware and electrical defects including programming software defects for a period of one year. This period shall begin upon Substantial Completion of the project by the Architect of Record/Engineer of Record, but not prior to certification of final acceptance testing of the system. Contractor shall provide to owner a letter stating the start-date and end-date of warranty period. In addition, the contractor shall also provide an updated list of name(s) and phone number(s) for normal and off-hours contacts necessary to respond to warranty issues. Response to warranty notification shall require a reply within 24 hours of initial contact.

G. TRAINING

1. The fire alarm contractor shall furnish training as follows for a minimum of four employees of the system user:
 - a. Training in the receipt, handling and acknowledgment of alarms.
 - b. Training on system operation including manual control of output functions from the FACP.
 - c. The total training requirement shall be a minimum of 4 hours, but shall be sufficient to cover all items specified.

END OF SECTION

KEY	TYPICAL ROOM	FLOOR	BASE	WALLS	WAINSCOT	
A	OFFICES	CARPET	RUBBER	GYP. BOARD W/ P-1 CONCRETE COLUMNS W/P-2	-	
B	CONF. ROOMS/ MEETING ROOM	CARPET	RUBBER	GYP. BOARD W/ P-1 CONCRETE COLUMNS FACE W/P-4 CONCRETE COLUMN EDGE W/P-2	RIGID VINYL SHEET	
C	KITCHEN/BREAK RM.	RESILIENT FLOORING 2	RUBBER	GYP. BOARD W/ P-1 CONCRETE COLUMNS W/P-2	-	
D	FLEX SPACE	CARPET (RESILIENT FLOORING WHERE SHOWN)	RUBBER	GYP. BOARD W/ P-1 CONCRETE COLUMNS W/P-2 GYP. BOARD WALL ACCENT W/P-3	-	SU (W/
E	RESTROOMS (STAFF)	CERAMIC TILE (BLEND OF ALL FIELD/BORDER COLORS)	CERAMIC TILE COVE	GYP. BOARD W/ P-6	CERAMIC TILE TO +7'-6"	
F	FILES & WORK ROOM	RESILIENT FLOORING 2	RUBBER	GYP. BOARD W/ P-1 CONCRETE COLUMNS W/P-2	-	
G	TEL/DATA ELECTRICAL/MECHANICAL	SEALED CONCRETE	N/A	GYP. BOARD W/ LEVEL 1 FINISH (NO PAINT)	-	
-	EXISTING FINISHES TO REMAIN, UNLESS NOTED OTHERWISE					

REMARKS:

- 1) ACOUSTIC WALL PANELS TO BE LOCATED AT VERTICAL FACE OF EXPOSED ROOF STRUCTURE ABOVE (SEE BUILDING SECTIONS AND WALL SECTIONS), AND DTLS 6&7/A10.61.
- 2) ACOUSTIC WALL PANELS MOUNTED ABOVE CHAIR RAIL (SEE INTERIOR ELEVATIONS). SEE DETAILS 6 & 7/A10.61
- 3) ACOUSTIC CEILING PANELS SHALL HAVE A MIN. NRC RATING OF 0.95
- 4) PROVIDE CONCRETE VAPOR CONTROL BARRIER TO (E) CONCRETE SLAB SUBSTRATE PRIOR TO INSTALLATION OF FINISH FLOORING

ADD #2
FILE NO. 41-C1
APPL. NO. 01-109554

FINISH LEGEND

FLOOR	CARPET: COLLINS & AIKMAN, STYLE: "ODYSSEY"	COLOR: 14520 "GANYMED"
	RESILIENT FLOORING 1: TARKETT SHEET LINOLEUM	COLOR: VENETO 0687 "SAND DOLLAR"
	RESILIENT FLOORING 2: ALTRO MAXIS SUPREMA	COLOR: SU2019 "ULL"
	CERAMIC TILE: DALTILE	COLORS: FIELD A - D138 "GOLD DUST"
		FIELD B - D050 "MOTTLED MEDIUM BROWN"
		FIELD C - D156 "BROWNSTONE RANGE"
		FIELD D - D311 "EBONY"
		BORDER E - D311 "EBONY"
BASE	RUBBER: BURKE RUBBER BASE	COLOR: 523 "BLACK BROWN"
	CERAMIC TILE COVE: DALTILE	COLOR: D311 "EBONY"
WALLS	P-1: EGG SHELL INTERIOR LATEX PAINT	COLOR: FIELD - KELLY-MOORE OW-27 "BONE"
	P-2: EGG SHELL INTERIOR LATEX PAINT	COLOR: ACCENT #1 - KELLY-MOORE 06-435-SMT "PUTTY"
	P-3: EGG SHELL INTERIOR LATEX PAINT	COLOR: ACCENT #2 - KELLY-MOORE 06-437-SMT "INDIAN CORN"
	P-4: EGG SHELL INTERIOR LATEX PAINT	COLOR: ACCENT #3 - KELLY-MOORE 06-439-SMT "KHAKI GREEN"
	P-5: EGG SHELL INTERIOR LATEX PAINT	COLOR: DOOR/WINDOW TRIM - KELLY-MOORE RUSTOLEUM "BRONZETONE"
	P-6: SEMI-GLOSS INTERIOR LATEX PAINT	COLOR: KELLY-MOORE OW-27 "BONE"
WAINSCOT	CERAMIC TILE: DALTILE	FIELD, BULLNOSE AND LINER COLORS: 190 "ARCTIC WHITE"
	VINYL: INPRO SANPARREL RIGID VINYL SHEET	COLOR: "CLAM SHELL"
CEILING	SUSPENDED ACOUSTICAL PANEL:	COLOR: USG MILLENIA CLIMPLUS ILLUSION TWO/24 PANELS - WHITE
	GYP. BOARD P-11	COLOR: KELLY-MOORE OW-27 "BONE"
	GYP. BOARD P-12	COLOR: KELLY-MOORE 06-435-SMT "PUTTY"

THE FOLLOWING SIG

- (A) ROOM IDENTIFI
- NOTE: TEXT ON ROO FOR ACTUAL TEXT
- (B) INTERNATIONAL ARROW - SEE DETA

- (C) EXIT SIGN, W/ ALL SIGNAGE-GRADE

(17) SIGN



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Title: FINISH SCHEDULE (FROM A9.1)

Project Name: CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Revision:

Addendum:

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Date
06/12/08

Drawing Number

Scale
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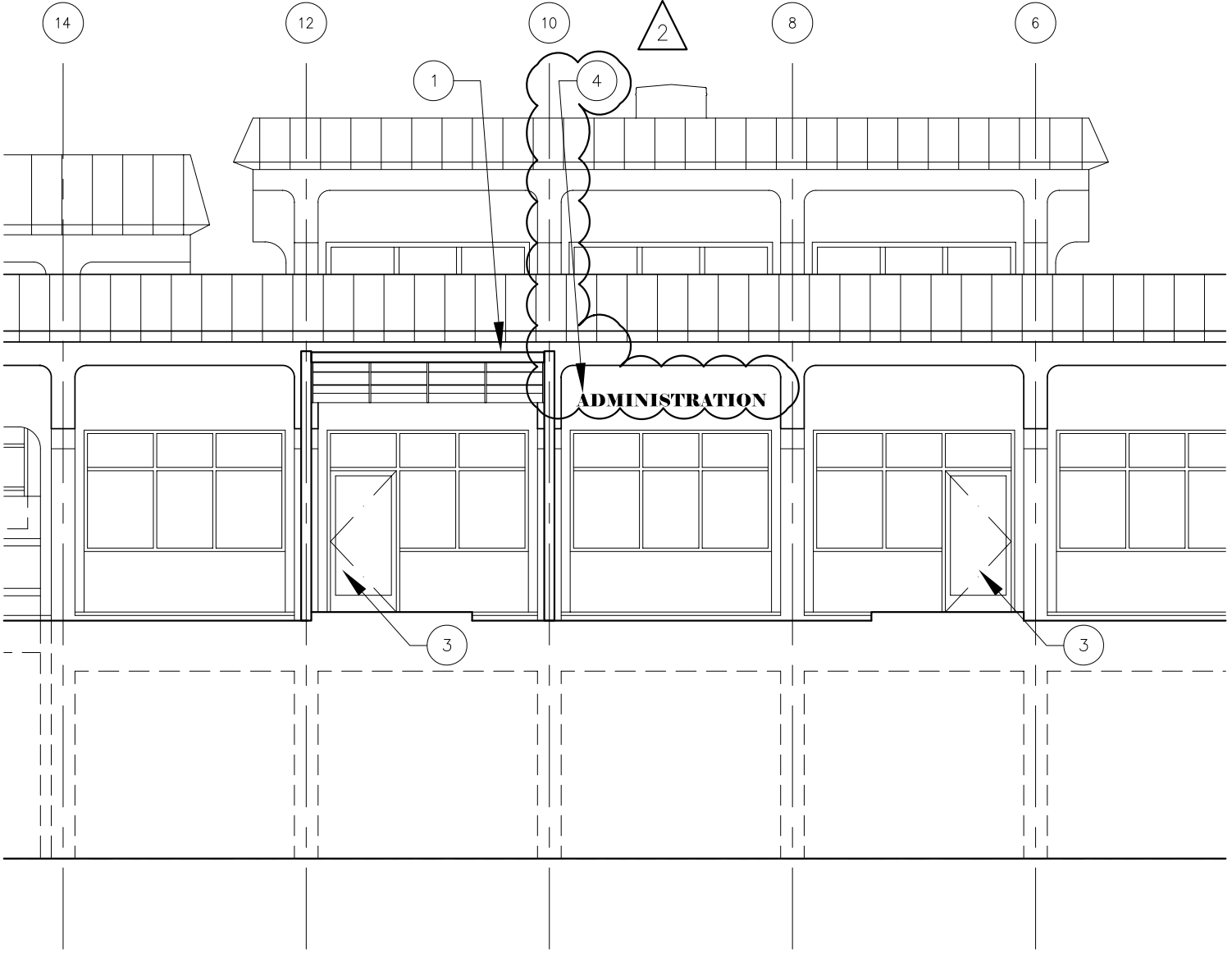
AD2-A1

Project Number
07014

2

4 REMOVE (E) BUILDING SIGNAGE LETTERS FROM BEHIND NEW CANOPY LOCATION. RELOCATE (E) SIGNAGE LETTERS ONE STRUCTURAL BAY TO THE NORTH. PATCH AND PAINT (E) WALL WHERE SIGNAGE LETTERS WERE REMOVED.

ADD #2
FILE NO. 41-C1
APPL. NO. 01-109554



SCALE: N.T.S.



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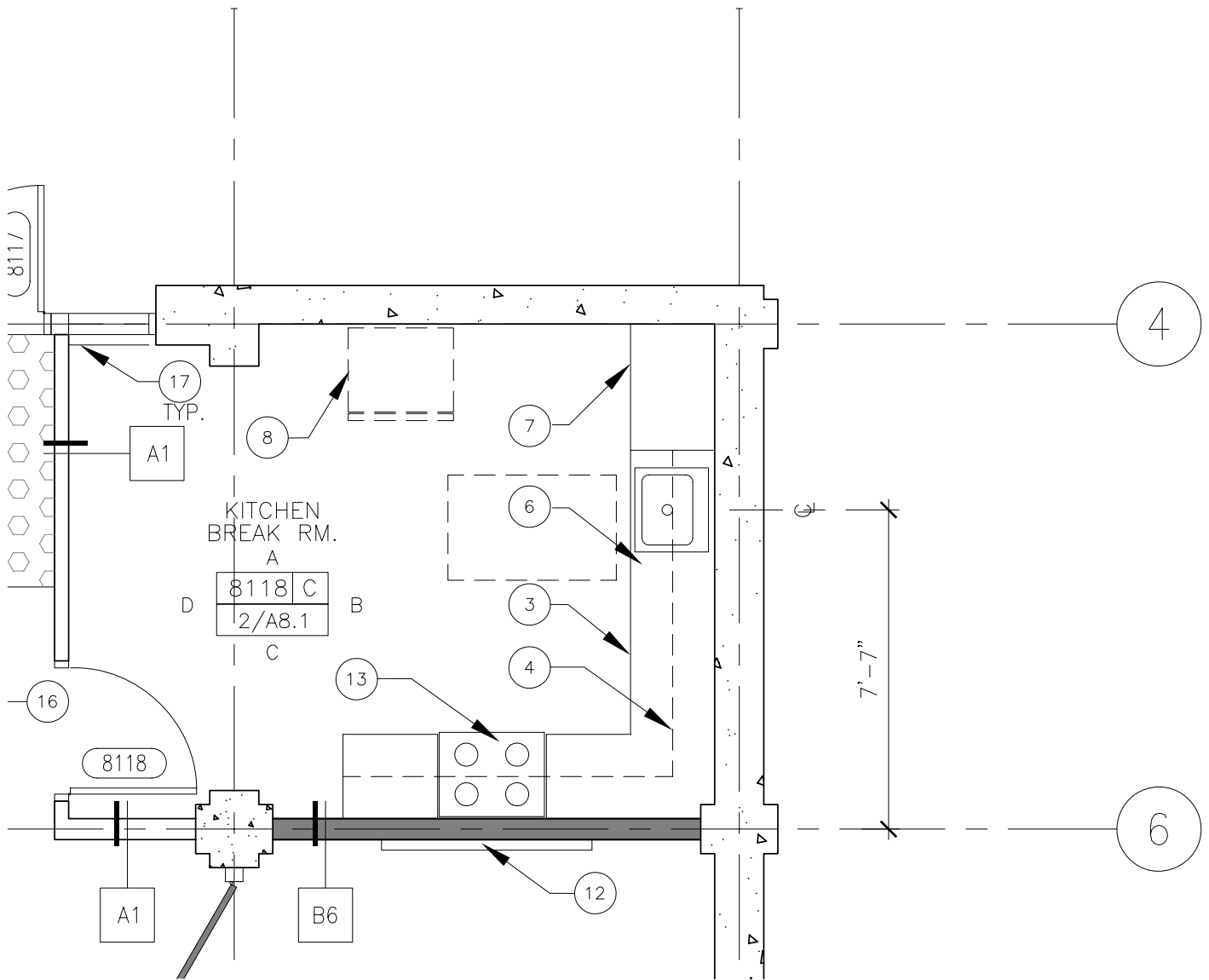
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Title:
EAST ELEVATION (FROM 4/A5.1)

Project Name:
CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION
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Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Revision: Addendum:
2

Date: 06/12/08
Scale: N.T.S.
Project Number: 07014
Drawing Number: AD2-A2



13 ELECTRIC RANGE/OVEN W/ HOOD ABOVE, N.I.C. 2



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Title:

NEW 1ST FLOOR PLAN (FROM A2.1)

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
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Scale
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Project Number
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Addendum:

2

Drawing Number

AD2-A3

PLUMBING SYMBOL LIST

VALVES

			HOSE BIBB
	VALVE, GENERAL		WALL CLEANOUT
	CHECK VALVE		FLOOR CLEANOUT/ GRADE CLEANOUT
	QUARTER TURN VALVE		FLOOR DRAIN
	GLOBE VALVE		FLOOR SINK
	BALANCING VALVE		VENT THROUGH ROOF

FITTINGS

PIPING SYSTEMS

	PIPE RISE		COLD WATER PIPING
	PIPE DROP		HOT WATER PIPING
	TEE UP ON PIPE		GAS PIPING
	TEE DOWN ON PIPE		CONDENSATE PIPING
	CONTINUATION		SANITARY PIPING BELOW GRADE OR FINISHED FLOOR
	CAP		

SCALE: NONE



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Title: MO.1 PLUMBING LEGENDS,
NOTES, ABBREVIATIONS
AND DRAWING INDEX

Project Name:

CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
06/12/08

Scale
AS NOTED

Project Number
07014

ASI No.:-

2

Drawing Number

AD2-M1

PLUMBING SYMBOL LIST

—————	SANITARY PIPING ABOVE GRADE OR FINISHED FLOOR
—— SD ——	STORM DRAIN PIPING ABOVE GRADE OR FINISHED FLOOR
- - - SD - - -	STORM DRAIN PIPING BELOW GRADE OR FINISHED FLOOR
-----	SANITARY VENT PIPING

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
BFP	BACKFLOW PREVENTER
BFF	BELOW FINISHED FLOOR
CD	CONDENSATE DRAIN
CONT.	CONTINUATION
CV	CHECK VALVE
CW	COLD WATER
DIA	DIAMETER
DN	DOWN
ELECT	ELECTRICAL
FT	FEET

SCALE: NONE

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Title: MO.1 PLUMBING LEGENDS,
NOTES, ABBREVIATIONS
AND DRAWING INDEX

Project Name:

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2

Drawing Number

AD2-M2

PLUMBING SYMBOL LIST

GAL	GALLONS	NTS	NOT TO SCALE
GPH	GALLONS PER HOUR	OC	ON CENTER
GPM	GALLONS PER MINUTE	OD	OUTSIDE DIAMETER
HD	HEAD	PD	PRESSURE DROP
HP	HORSE POWER	PDI	PLUMBING & DRAINAGE INSTITUTE
HTG	HEATING	PRV	PRESSURE REDUCING VALVE
HTR	HEATER	PSI	POUNDS PER SQUARE INCH
HW	HOT WATER	QTY	QUANTITY
HWR	HOT WATER RETURN	SF	SQUARE FEET
ID	INSIDE DIAMETER	SOV	SHUT OFF VALVE
IE	INVERT ELEVATION	SP	STATIC PRESSURE
IN	INCHES	TEMP	TEMPERATURE
LBS.	POUNDS	TP	TRAP PRIMER
MIN	MINIMUM	V	VENT
N/A	NOT APPLICABLE	W/	WITH
NIC	NOT IN CONTRACT	WC	WATER COLUMN
NO.	NUMBER	W/O	WITHOUT

SCALE: NONE

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Title: MO.1 PLUMBING LEGENDS,
 NOTES, ABBREVIATIONS
 AND DRAWING INDEX

Project Name:

**CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION**

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Drawing Number

AD2-M3

MECHANICAL SYMBOL LIST

ABBREVIATIONS

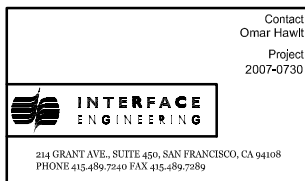
SEER	SEASONAL ENERGY EFFICIENCY RATING	V	VOLT OR VENT
SF	SQUARE FEET	VD	VOLUME DAMPER
SH	SENSIBLE HEAT	W	WATT
SOV	SHUT OFF VALVE	W/	WITH
SP	STATIC PRESSURE	WB	WET BULB
TD	TEMPERATURE DIFFERENCE	WC	WATER COLUMN
TEMP	TEMPERATURE	W/O	WITHOUT
TH	TOTAL HEAT	(N)	NEW
TP	TOTAL PRESSURE	(E)	EXISTING 

SCALE: NONE

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Title: MO.1 MECHANICAL
 ABBREVIATIONS

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

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Date
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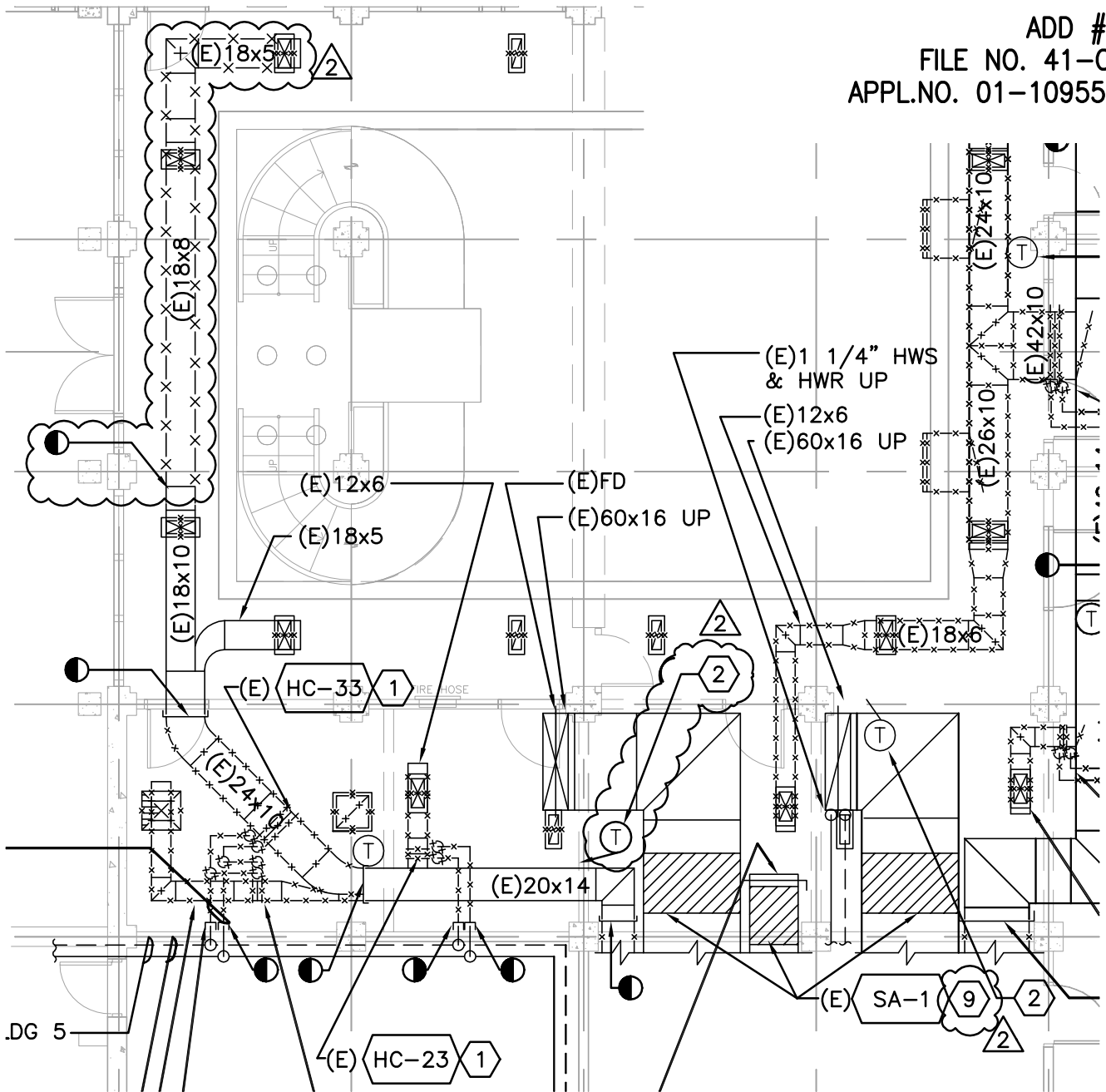
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Drawing Number

AD2-M4

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1ST FLOOR
1 MECHANICAL DEMOLITION FLOOR PLAN

SCALE: 1/8"=1'-0"

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Title: MD1.1 MECHANICAL
 DEMOLITION FLOOR PLAN
 1ST FLOOR

Project Name:

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Revision:

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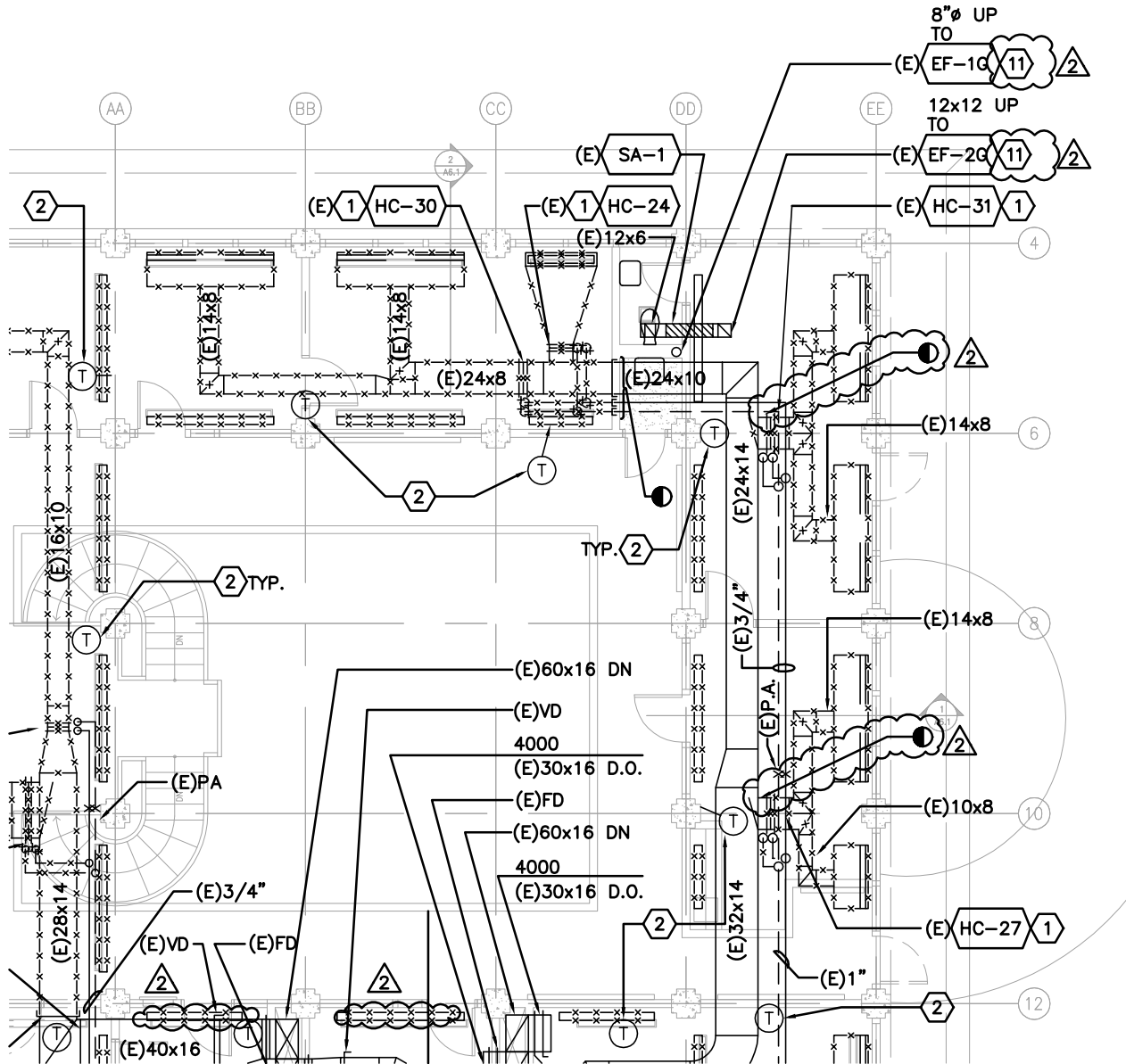
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AD2-M5

Project Number
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 FILE NO. 41-C1
 APPL.NO. 01-109554



2ND FLOOR 2 MECHANICAL DEMOLITION FLOOR PLAN

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Title: MD1.1 MECHANICAL
 DEMOLITION FLOOR PLAN
 2ND FLOOR

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

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Date
 06/12/08



Drawing Number

Scale
 AS NOTED

AD2-M6

Project Number
 07014

SHEET KEYNOTES

- ① DEMOLISH (E) HEATING COIL, BRANCH DUCTWORK, DIFFUSERS, TEMPERATURE SENSORS, BRANCH PIPING, AND ALL APPURTENANCES.
- ② DEMOLISH (E) TEMPERATURE SENSOR, WIRING, TUBING, AND APPURTENANCES. PATCH WALL WHERE TEMPERATURE SENSOR HAS BEEN DEMOLISHED.
- ③ DEMOLISH (E) EXHAUST DUCTWORK, SUPPORTS, ANCHORS, ETC.
- ④ DEMOLISH (E) AIR HANDLING UNITS, ISOLATION PAD, ANCHORAGE, ~~CONTROLS~~, AND ALL RELATED APPURTENANCES. DEMOLISH (E) HEATING COIL, PIPE TRIM, ~~CONTROLS~~ AND RELATED APPURTENANCES. 
- ⑤ DEMOLISH (E) MAIN DUCTWORK IN MECHANICAL ROOM. SEE DRAWING ~~4&5/M2.1~~ FOR POINT OF CONNECTION FOR NEW (N) DUCTWORK.
- ⑥ (E) MAIN HEATING HOT WATER TO REMAIN.
- ⑦ DEMOLISH (E) HWS/HWR BRANCH PIPING TO/FROM AC-1G AND AC-2G.
- ⑧ (E) FRESH AIR INTAKE TO REMAIN. (E) RAIN PAN IN MECHANICAL ROOM BELOW FRESH AIR INTAKE TO BE DEMOLISHED AND REPLACED WITH NEW.
- ⑨ (E) SOUND ATTENUATOR TO REMAIN.
- ⑩ (E) SINK TO BE REMOVED. CAP AND SAVE PLUMBING PIPING TO BE REUSED FOR (N) SINK.
- ⑪ DEMOLISH (E) EXHAUST FAN. REROUTE EXISTING DUCTWORK TO (N) EXHAUST FAN. 

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Title: MD1.1 MECHANICAL
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SHEET KEYNOTES

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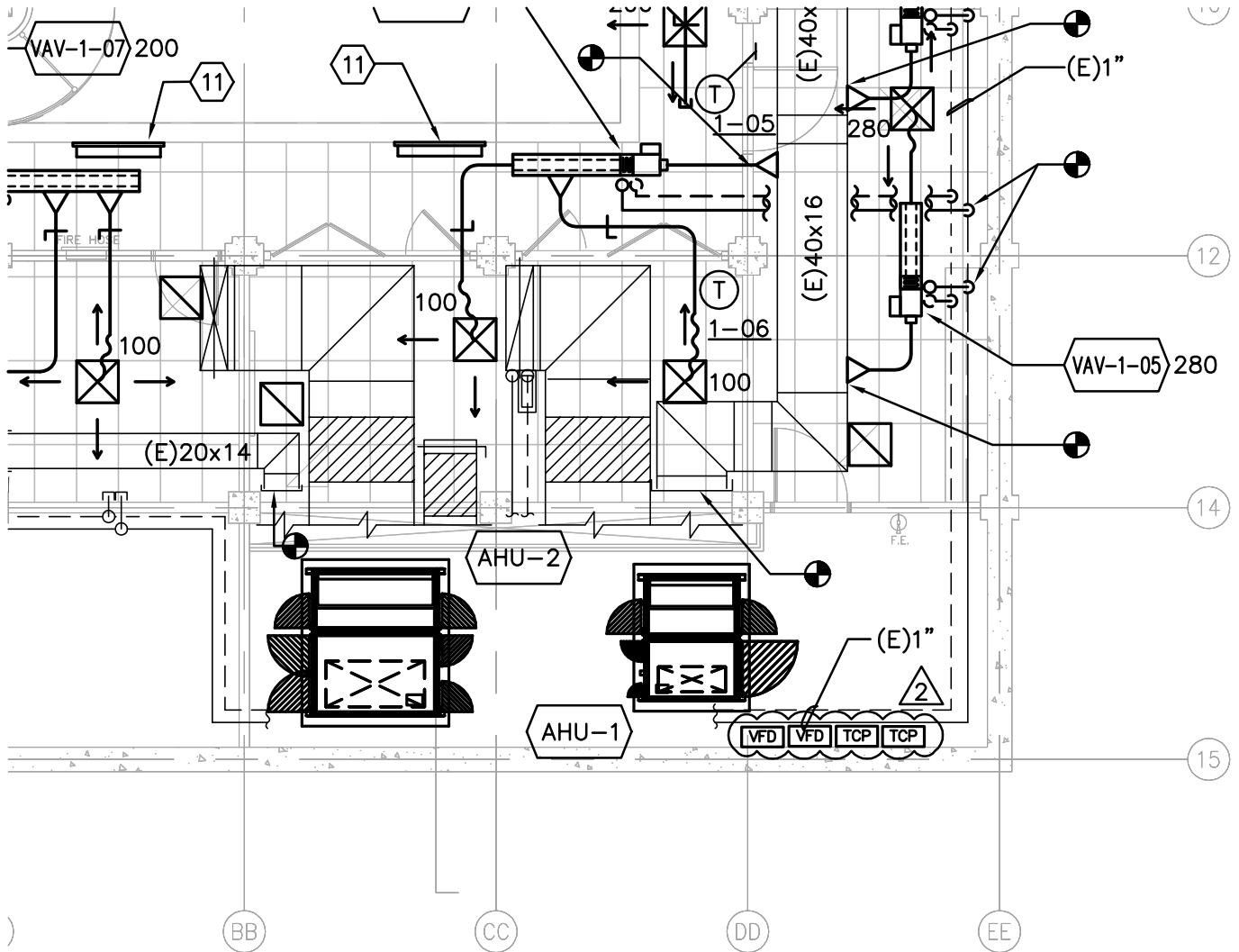
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Drawing Number

AD2-M7

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 MECHANICAL FLOOR PLAN - 1ST FLOOR

SCALE: 1/8"=1'-0"

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Title: M2.1 MECHANICAL
 FLOOR PLAN - 1ST FLOOR

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
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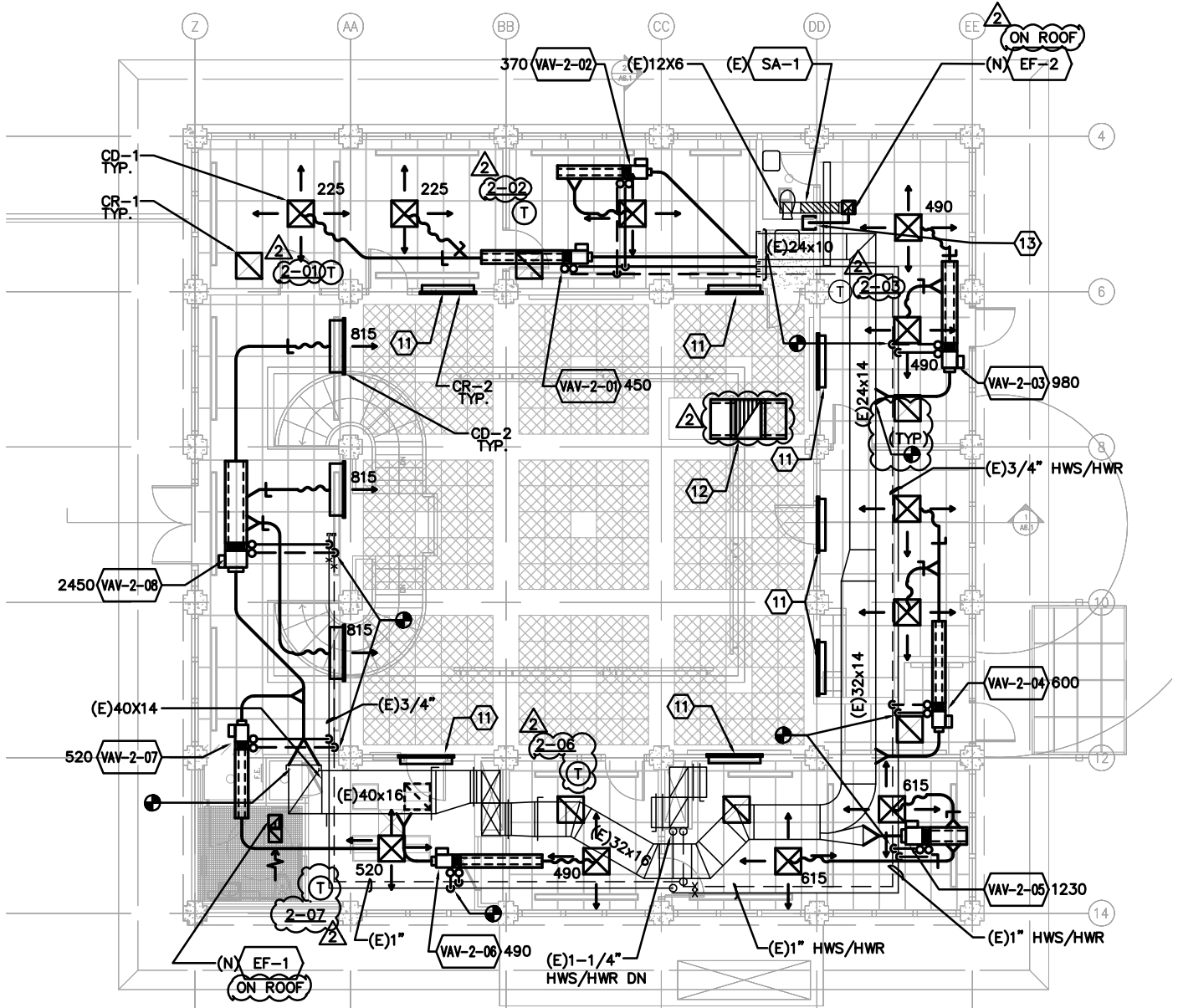
ASI No.:-

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Drawing Number

AD2-M8

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



2 MECHANICAL FLOOR PLAN - 2ND FLOOR

SCALE: N.T.S.

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Title: M2.1 MECHANICAL
 FLOOR PLAN - 2ND FLOOR

Revision:

ASI No.:-

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Project Name:

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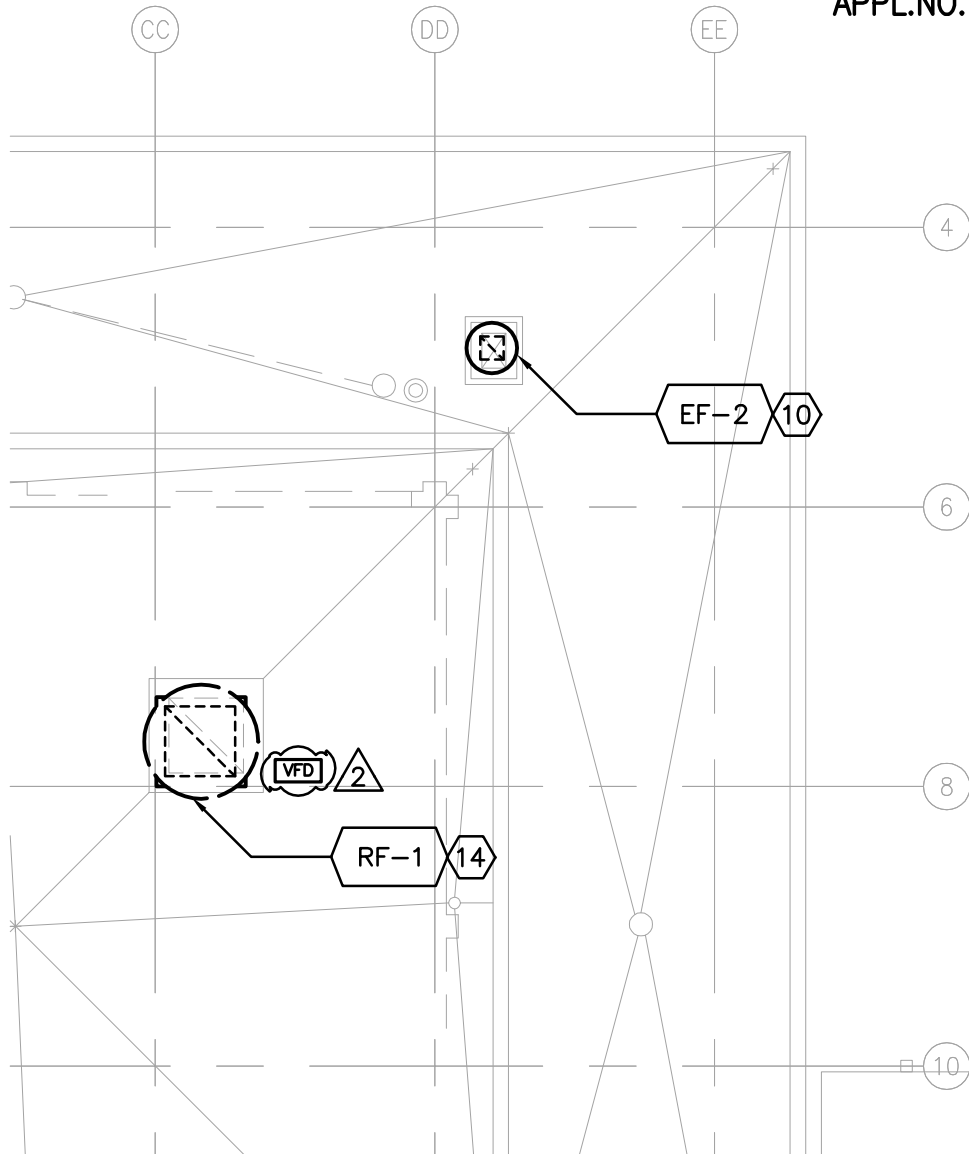
Scale
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Project Number
 07014

Drawing Number

AD2-M9

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



3 MECHANICAL ROOF PLAN

SCALE: 1/8"=1'-0"

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Title: M2.1 MECHANICAL
 ROOF PLAN

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

ASI No.:-

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Date
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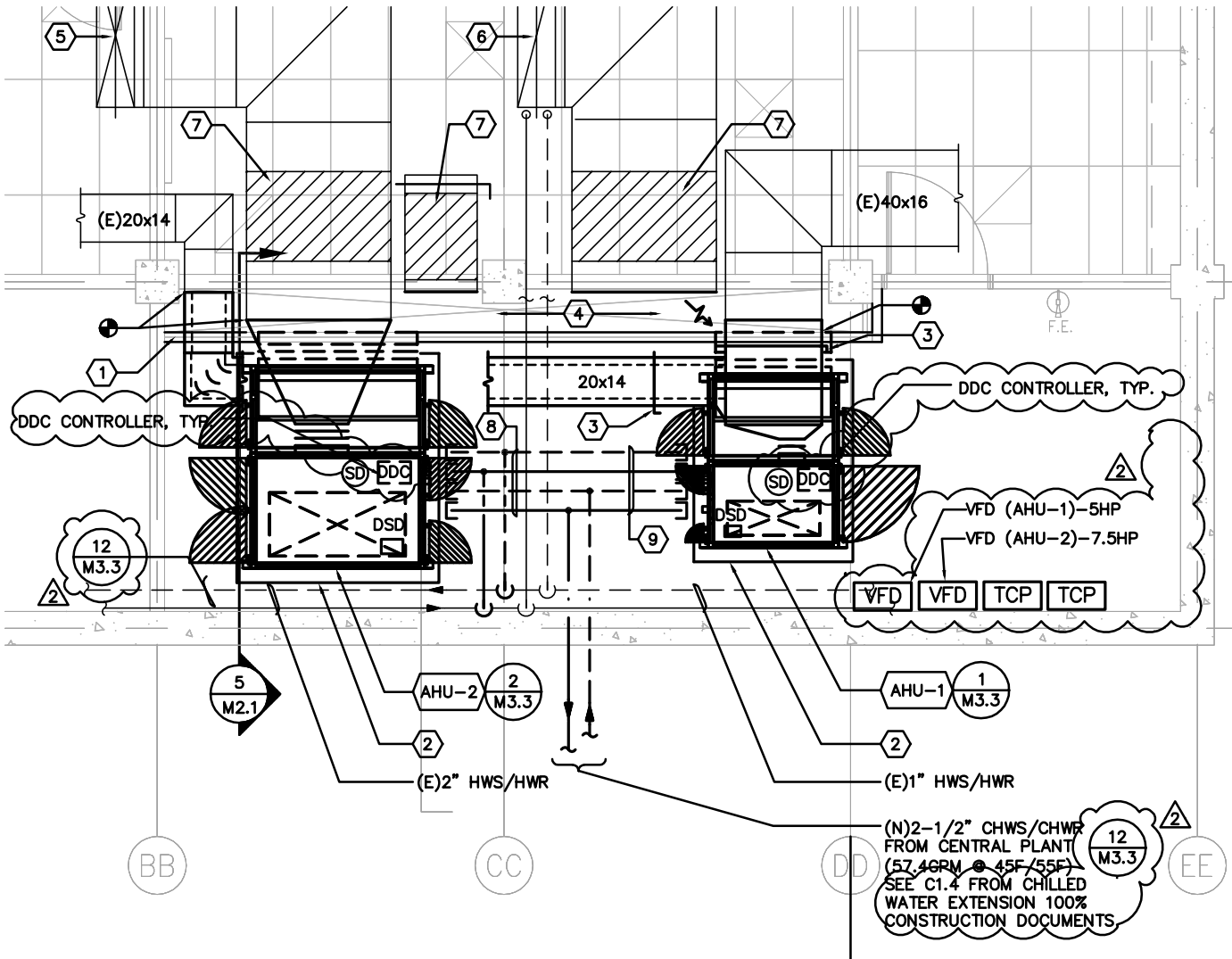
Drawing Number

Scale
 AS NOTED

AD2-M10

Project Number
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ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



4 ENLARGED MECHANICAL ROOM PLAN

SCALE: N.T.S.

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Title: M2.1 ENLARGED
 MECHANICAL ROOM PLAN

Project Name:

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
 06/12/08

Scale
 AS NOTED

Project Number
 07014

ASI No.:-

2

Drawing Number

AD2-M11

2

SUPPLY DIFFUSER SIZING TABLE			RETURN/EXHAUST REGISTER SIZING TABLE		
TAG	NECK SIZE	CFM RANGE	TAG	NECK SIZE	CFM RANGE
CD-1	8"∅	0-210	CR-1	8"∅	0-175
CD-1	10"∅	211-325	CR-1	10"∅	176-275
CD-1	12"∅	326-425	CR-1	12"∅	275-400
CD-1	14"∅	426-560	CR-1	14"∅	400-540
CD-1	16"∅	551-710	CR-1	16"∅	540-700

<p>NOTES:</p> <p>1. ALL 24x24 CEILING SUPPLY DIFFUSERS SHALL BE OF TYPE CD-1 UNLESS OTHERWISE NOTED.</p> <p>2. ALL BRANCH DUCTWORK SHALL BE THE SAME SIZE AS THE DIFFUSER NECK SIZE UNLESS OTHERWISE NOTED.</p> <p>3. SEE DETAIL 9/M3.3.</p>			<p>NOTES:</p> <p>1. ALL CEILING 24X24 RETURN/EXHAUST REGISTERS SHALL BE OF TYPE CR-1 UNLESS OTHERWISE NOTED.</p> <p>2. ALL BRANCH DUCTWORK SHALL BE THE SAME SIZE AS THE REGISTER NECK SIZE UNLESS OTHERWISE NOTED.</p> <p>3. SEE DETAIL 9/M3.3.</p>		
---	--	--	---	--	--

SCALE: NONE



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Title: M2.1 MECHANICAL SIZING TABLES

Project Name:

Revision:

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Date
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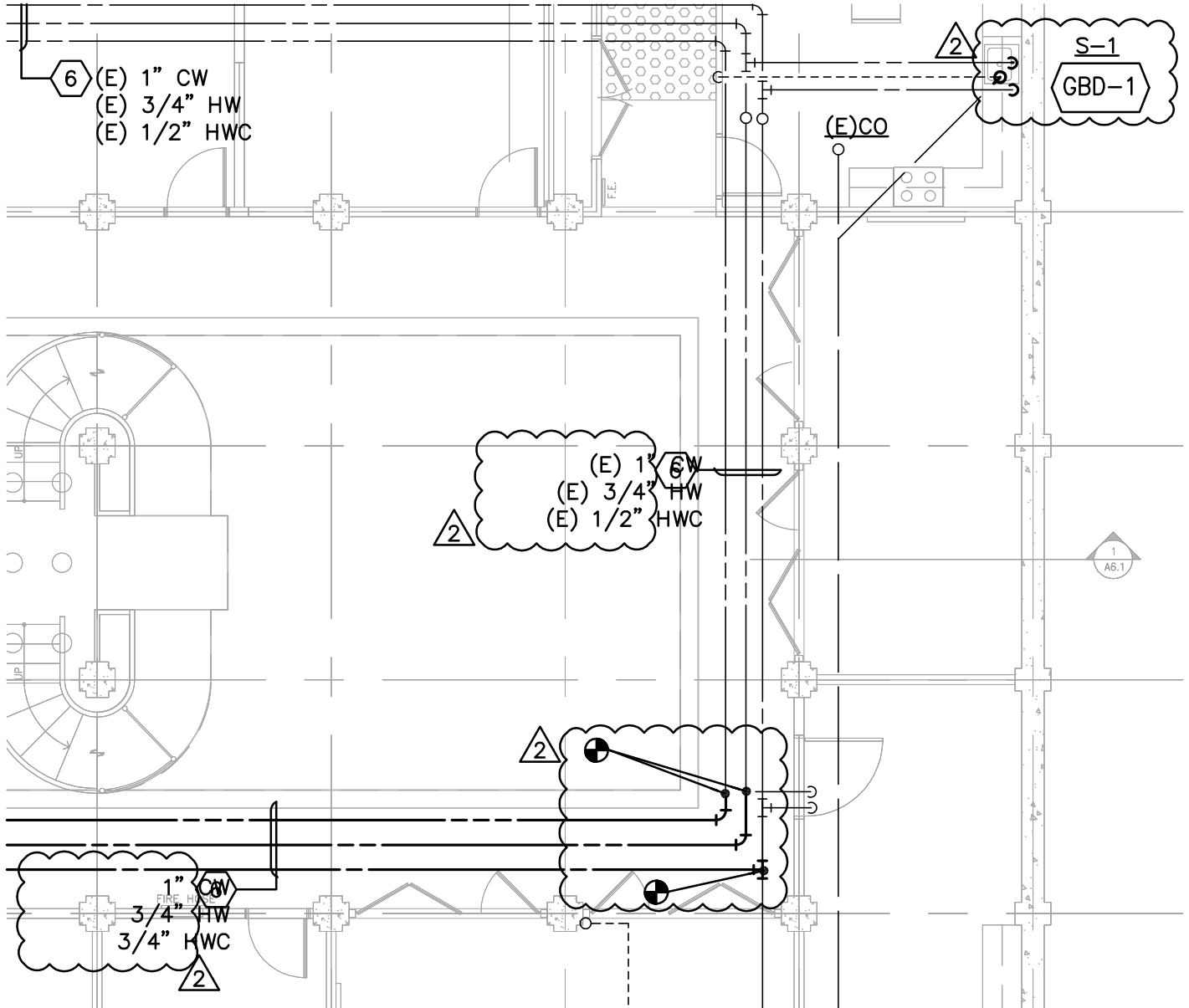
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Project Number
07014

Drawing Number

AD2-M12

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 PLUMBING FLOOR PLAN - 1ST FLOOR

SCALE: 1/8"=1'-0"

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Title: M2.2 PLUMBING
 FLOOR PLAN - 1ST FLOOR

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

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 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
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Project Number
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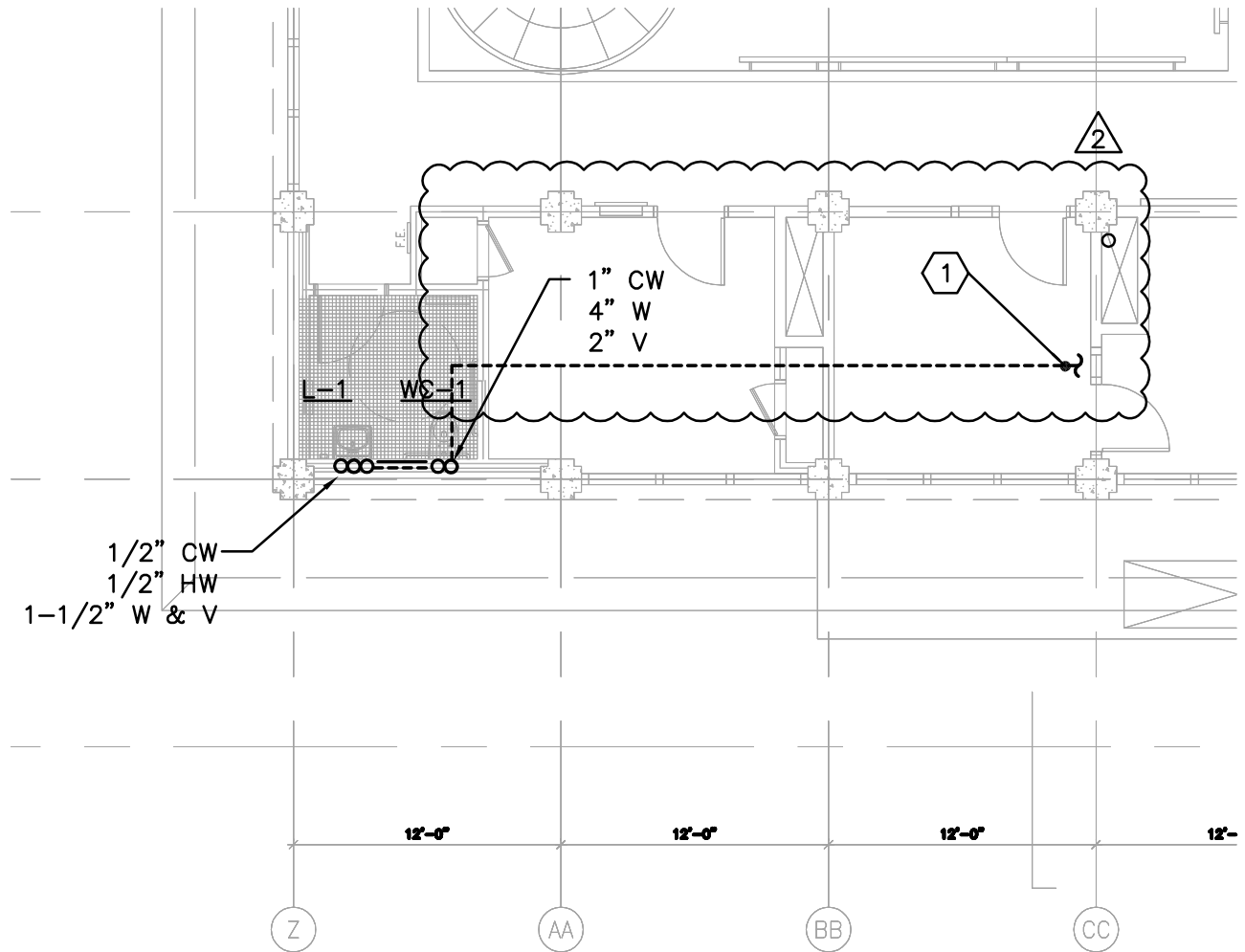
ASI No.:-

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Drawing Number

AD2-M13

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



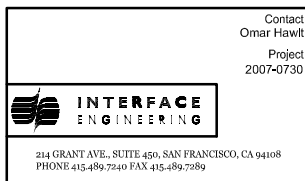
2 PLUMBING FLOOR PLAN - 2ND FLOOR

SCALE: 1/8" = 1'-0"

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Title: M2.2 PLUMBING
 FLOOR PLAN - 2ND FLOOR

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
 06/12/08

Scale
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Project Number
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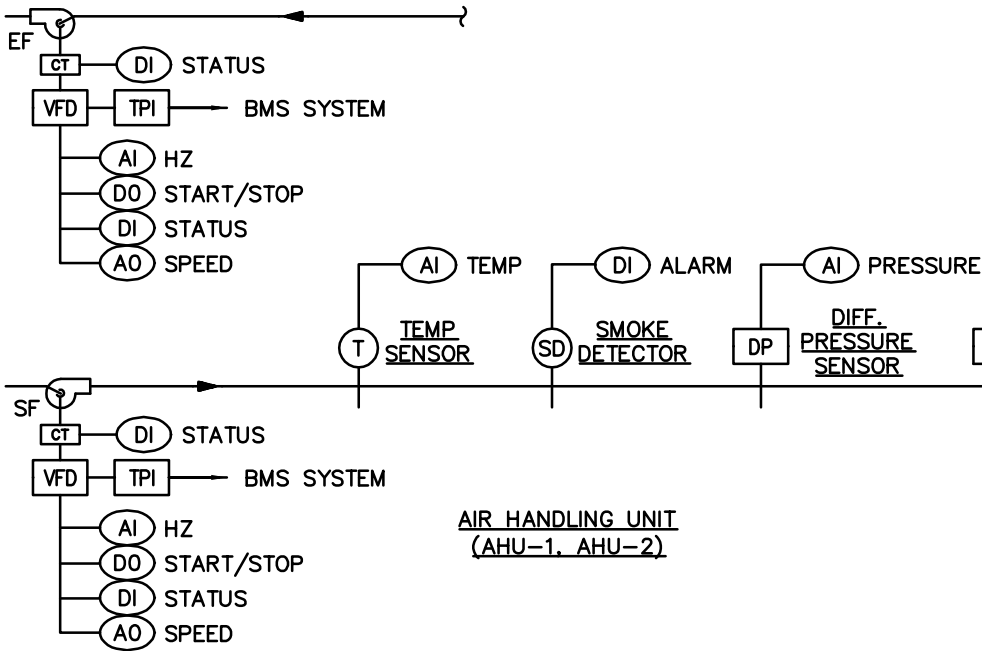
ASI No.:-

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Drawing Number

AD2-M14

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



AIR HANDLING UNIT
 (AHU-1, AHU-2)

THE DISCHARGE TEMPERATURE SHALL BE MAINTAINED AT AN ADJUSTABLE SETPOINT THROUGH THE MODULATION OF THE RETURN AIR (RA), HOT WATER VALVE, OUTSIDE AIR (OA) DAMPERS, EXHAUST FAN AND CHILLED WATER VALVE IN SEQUENCE.

UNOC
 AREA

THE OUTSIDE, DISCHARGE, RETURN, AND MIXED AIR TEMPERATURES SHALL ALL BE MONITORED THROUGH THE AHU FOR USE IN THE FOLLOWING ENERGY MANAGEMENT SEQUENCES:

DURIN
 BE DF
 OPENI
 ADJU:
 NORM

ECONOMIZER

WHEN THE OUTSIDE AIR TEMPERATURE (OAT) < FREE COOLING ADJUSTABLE SETPOINT:

DURIN
 FULLY
 AND I
 ADJU:

THE OUTSIDE(OA), RETURN(RA) DAMPERS, AND EXHAUST FAN SHALL MODULATE TO MAINTAIN THE DESIRED DISCHARGE TEMPERATURE. IF ADDITIONAL COOLING IS REQUIRED, THE COOLING COIL SHALL BE USED TO MAINTAIN THE DESIRED DISCHARGE TEMPERATURE.

UPON
 EXHAI
 SYSTE

WHEN THE OAT > FREE COOLING ADJUSTABLE SETPOINT, OA, RA DAMPERS, EXHAUST FAN AND COOLING COIL SHALL MODULATE IN SEQUENCE TO MAINTAIN THE DESIRED DISCHARGE TEMPERATURE.

1 AIR HANDLING SYSTEM CONTROL DIAGRAM

SCALE: NONE



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Title: M3.1 MECHANICAL
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Revision:

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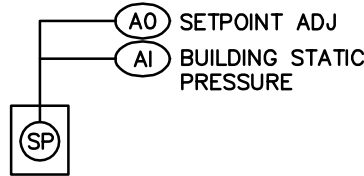
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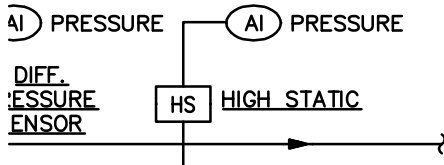
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AD2-M16

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SPACE PRESSURE SENSOR
 (INITIAL 0.05" H2O)



STABLE, HOT FILLED AREA UNOCCUPIED OVERRIDE
 WARM-UP OR COOL-DOWN ONE HOUR PRIOR TO OCCUPANCY.

DURING WARM-UP, THE EXHAUST FAN SHALL BE OFF. THE OA DAMPER SHALL BE DRIVEN CLOSED POSITION AND THE RA DAMPER SHALL BE DRIVEN OPENED. THIS WILL CONTINUE UNTIL THE SPACE TEMPERATURE IS AT THE ADJUSTABLE SETPOINT. THE SYSTEM AT THIS POINT SHALL RETURN TO NORMAL OPERATION.

DURING COOL-DOWN, IF OAT < RAT, THE OA DAMPER AND EA FAN SHALL BE FULLY OPENED AND THE RA DAMPER SHALL BE CLOSED. THE SUPPLY FAN AND EXHAUST FAN SHALL BE STARTED. WHEN THE SPACE TEMPERATURE < ADJUSTABLE SETPOINT, THE SYSTEM SHALL RETURN TO NORMAL OPERATION.

UPON SMOKE INDICATION IN THE SUPPLY AIR DUCT, THE SUPPLY AND EXHAUST FAN SHALL BE STOPPED THROUGH THE DDC CONTROLLERS. SYSTEM WILL OPERATE IN SHUT DOWN MODE.

1 AIR HANDLING SYSTEM CONTROL DIAGRAM

SCALE: NONE

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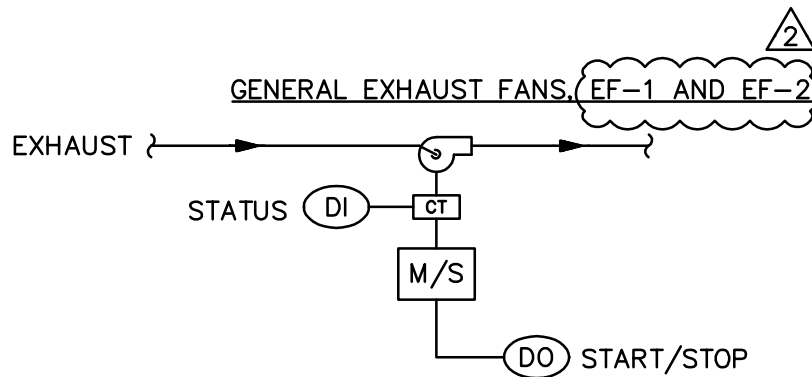
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AD2-M17



SEQUENCE OF OPERATION:
 THE EXHAUST FANS SHALL BE START/STOPPED THROUGH THE BMS SCHEDULE. A CURRENT RELAY WILL PROVIDE AN ALARM IF THERE IS NO PROOF OF STATUS WITHIN 20 SECONDS OF ENERGIZING THE FAN.

2 GENERAL EXHAUST CONTROL DIAGRAM

SCALE: NONE

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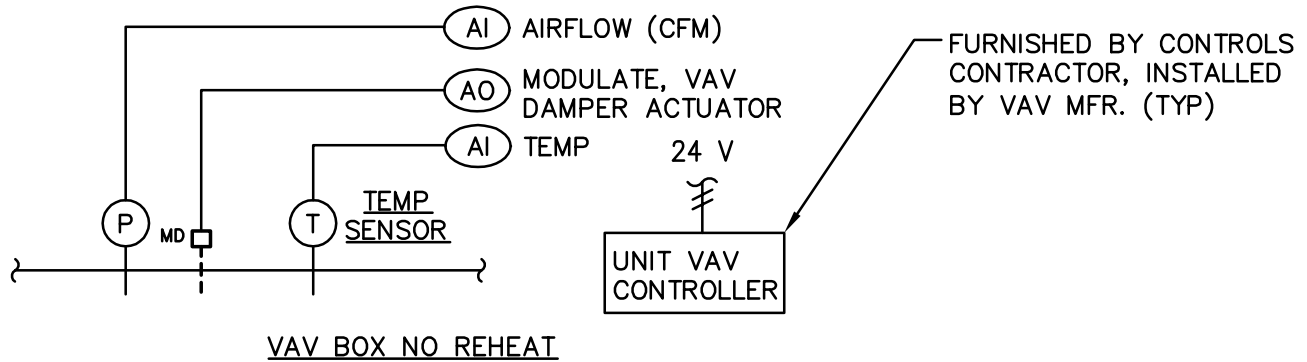
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AD2-M18



2

SEQUENCE OF OPERATION:

OCCUPIED COOLING:

THE TERMINAL UNIT CONTROLLER SHALL TAKE AN INPUT FROM THE ROOM TEMPERATURE SENSOR TO MODULATE THE VAV DAMPER ACTUATOR TO MAINTAIN THE SPACE ROOM TEMPERATURE.

OCCUPIED HEATING:

ONCE THE ZONE TEMPERATURE DROPS BELOW THE HEATING SETPOINT THE TERMINAL UNIT WILL GO INTO THE HEATING MODE, PRIMARY CFM SETPOINT WILL CHANGE TO THE HEATING FLOW INDICATED IN THE VAV TERMINAL UNIT SCHEDULE. THE HEATING HOT WATER VALVE (V-1) WILL MODULATE TO MAINTAIN SPACE SETPOINT TEMPERATURE (OPERATOR DEFINABLE), A TWO (2) DEGREE ABOVE SETPOINT DEADBAND WILL BE UTILIZED TO MINIMIZE CYCLING (OPERATOR DEFINABLE).

UNOCCUPIED MODE: T-1 SET TO TITLE 24 SET-BACK TEMPERATURE; V-1 CLOSED.

ALARMS: SEND AN ALARM IF VALVES ARE COMMANDED OPEN/CLOSE BUT DISCHARGE TEMPERATURE DOES NOT INDICATE CHANGE IN TEMPERATURE.

3 VAV BOX CONTROL DIAGRAM

SCALE: NONE



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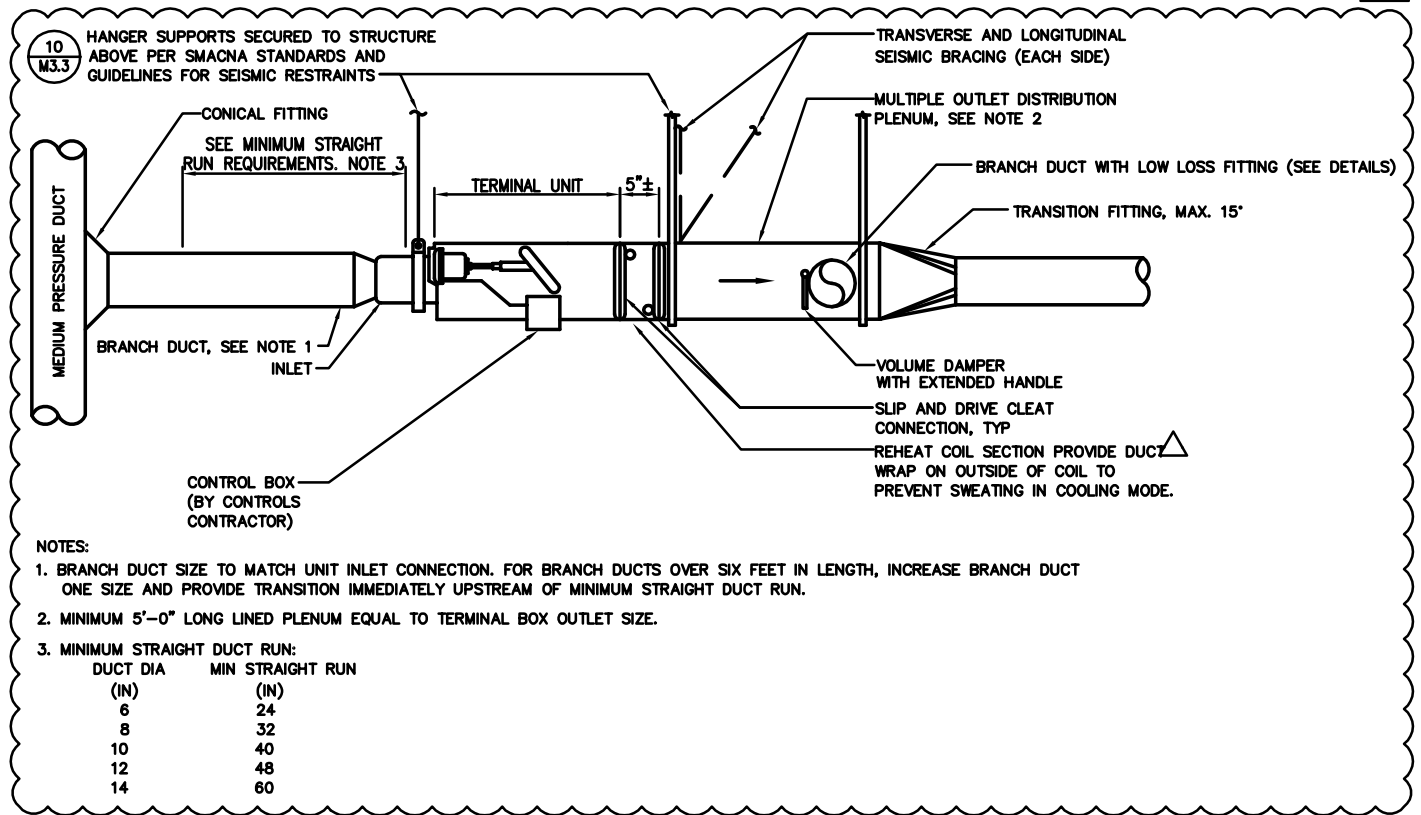
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4 VAV TERMINAL UNIT DETAIL

SCALE: NONE

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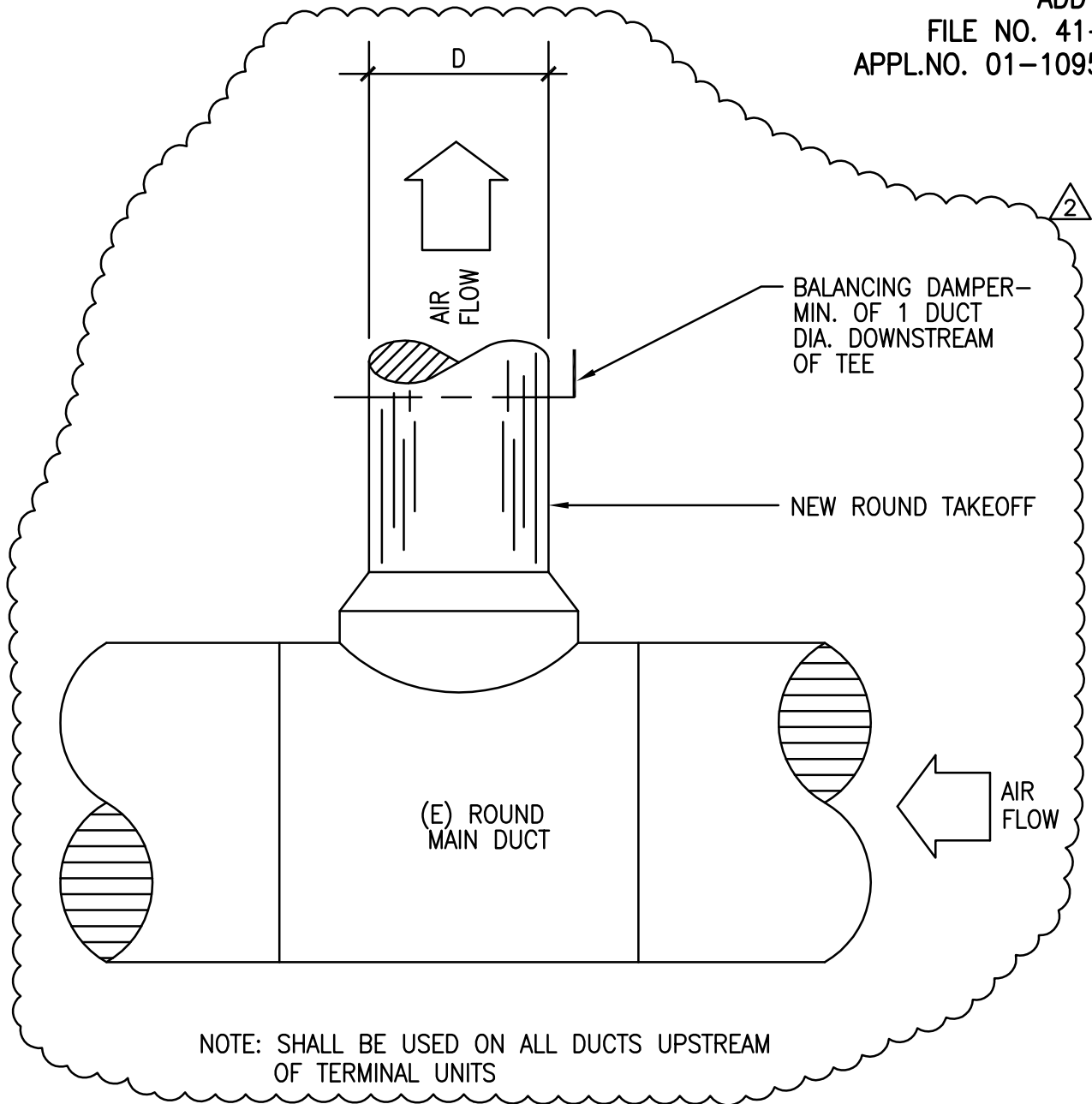
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5 DUCT TAPPING DETAIL

SCALE: NONE

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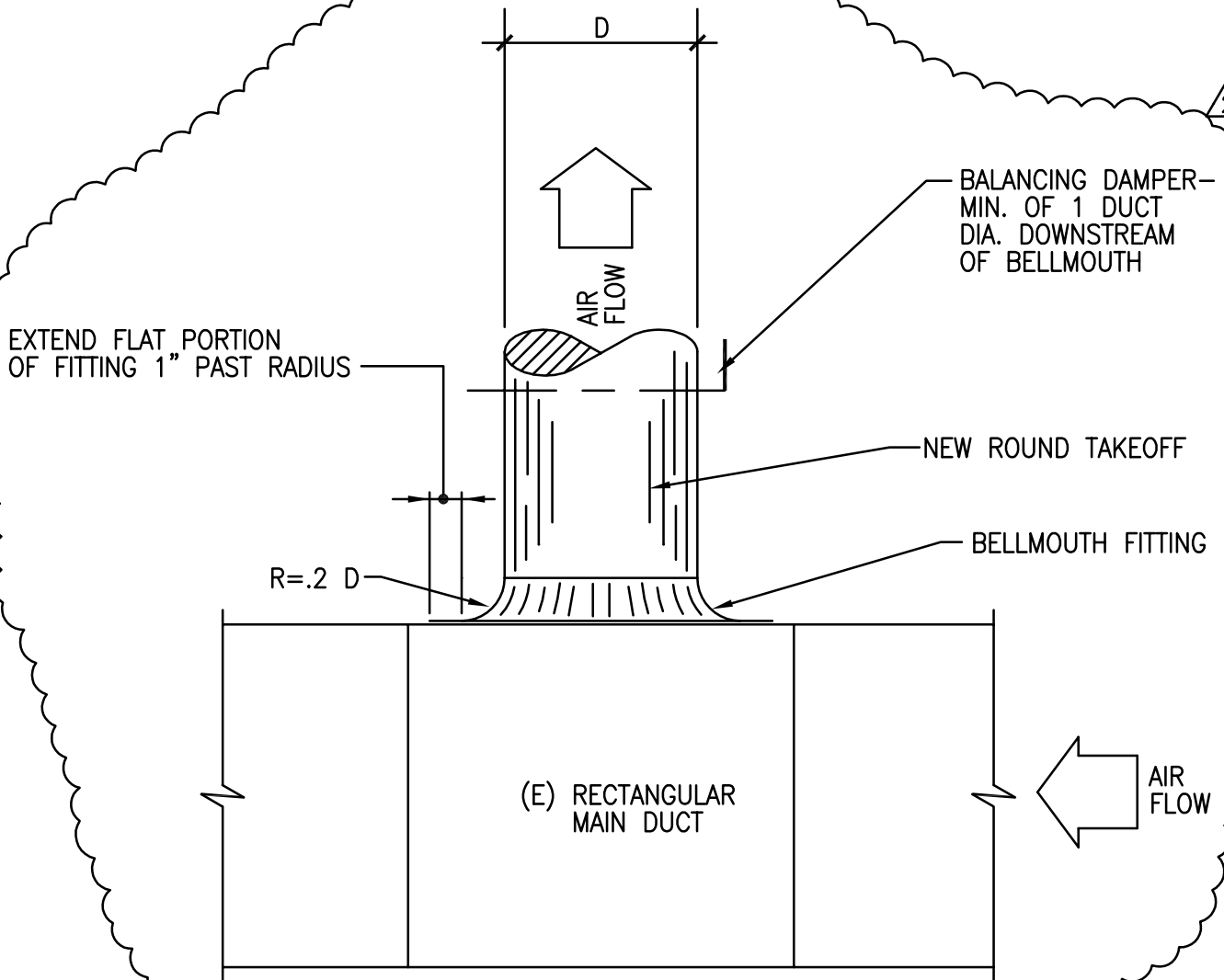
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Drawing Number

AD2-M21

ADD #2
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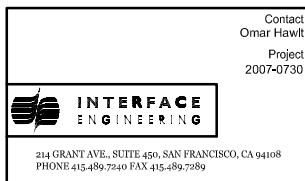
5 DUCT TAPPING DETAIL

SCALE: NONE

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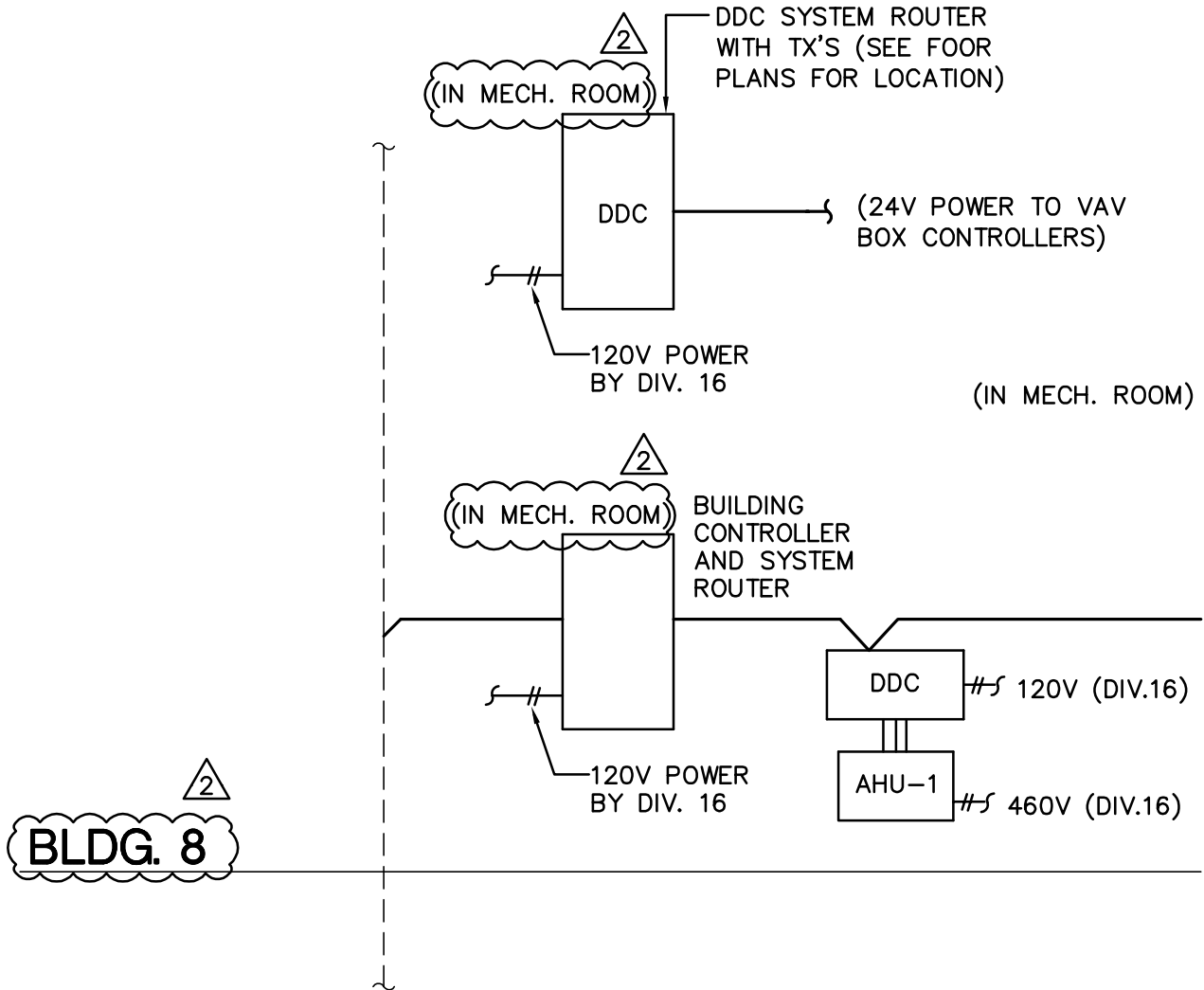
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6 CONTROL ARCHITECTURE DIAGRAM

SCALE: NONE

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AD2-M23

NOTES:

- 1.) ALL NEW CONTROLS SHALL TIE INTO THE EXISTING CAMPUS BUILDING MANAGEMENT SYSTEM (BMS). ANY THIRD PARTY INTERFACES REQUIRED TO TIE INTO THE EXISTING BMS SYSTEM SHALL BE FURNISHED AND INSTALLED BY THE CONTROLS CONTRACTOR AT NO ADDITIONAL COST.
- 2.) ALL CONTROL WIRING SHALL BE FURNISHED AND INSTALLED BY THE CONTROLS CONTRACTOR PER DIV. 16 SPECIFICATIONS. PLENUM RATED CABLE ABOVE REMOVABLE TILE CEILING, RACEWAY ABOVE HARD LID CEILINGS.
- 3.) CONTROLS CONTRACTOR SHALL PROVIDE 24 V POWER TO ALL THEIR CONTROL DEVICES.
- 4.) PROVIDE DEVICES/PROGRAMMING OF EXISTING BMS SYSTEM FOR OCCUPANT OVERRIDE OF HVAC SYSTEM.
- 5.) CAMPUS BUILDING CONTROLS IS YAMAS/TAC.

2

- 6.) PROVIDE ALL POWER REQUIREMENT FOR AIRFLOW MEASURING STATIONS AND BUILDING MANAGEMENT CONTROL SYSTEMS.
- 7.) MISCELLANEOUS POINTS: CONTROL POINTS FOR BUILDING LIGHTING CONTROLS, TEMPERATURE (CHILLED WATER SUPPLY AND RETURN MAIN, HEATING HOT WATER SUPPLY AND RETURN MAIN, SEE 12/M3.3), DIFFERENTIAL PRESSURE (CHILLED WATER MAIN AND HEATING HOT WATER MAIN, SEE 12/M3.3)
- 8.) SEE CONTROLS SPECIFICATIONS FOR BTU METER, THERMOWELLS, AND UNIVISION MONITORING SYSTEM DETAILS.
- 9.) DUE TO THE NEW INSTALLATION OF CONTROLS ON EXISTING HEATING COILS IN BUILDING 8, IT IS ACCEPTABLE TO REUSE EXISTING CONTROL VALVES AND TEMPERATURE SENSORS WHERE SYSTEM INSTALLATION WILL BE LIKE NEW UPON COMPLETION OF PROJECT. VERIFY WITH NEWLY INSTALLED SYSTEM AND EXISTING CONTROL SYSTEM AS-BUILTS.

SCALE: NONE

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Title: M3.1 MECHANICAL
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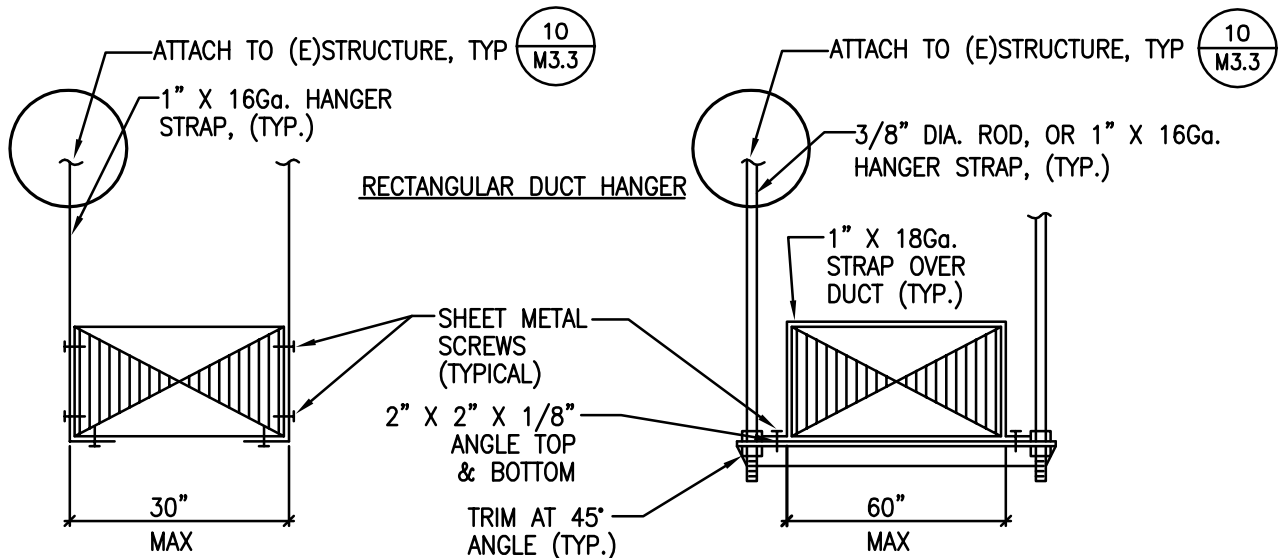
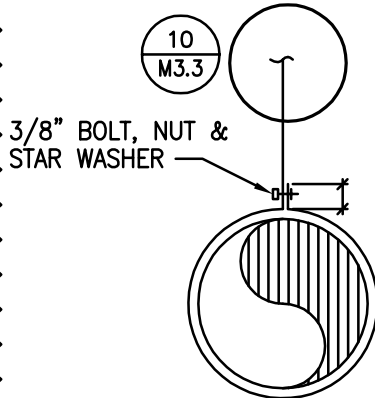
Drawing Number

AD2-M24

THIS HANGER IS FOR
 DUCTS 24" DIA. &
 SMALLER

NOTES:

1. REFER TO SPECIFICATIONS FOR HANGER SPACINGS.
2. ATTACHMENTS TO OVERHEAD STRUCTURE SHALL BE MADE IN ACCORDANCE WITH STRUCTURAL ENGINEERS REQUIREMENTS AND WEIGHT LIMITATIONS. ALL ATTACHMENT METHODS TO STRUCTURE SHALL BE SUBMITTED TO ARCHITECT AND STRUCTURAL ENGINEER FOR REVIEW.
3. PROVIDE SWAY & SEISMIC BRACING PER SMACNA SEISMIC GUIDELINES AND THE LATEST EDITION OF CALIFORNIA BUILDING CODE. CONTRACTOR SHALL INDICATE LOCATIONS OF SEISMIC BRACING ON THE SHOP DRAWING SUBMITTALS.
4. HANGER MATERIAL SUPPORTING FLEXIBLE DUCT SHALL IN NO CASE BE LESS THAN 1 1/2 INCHES WIDE. FLEXIBLE DUCT SHALL BE SUPPORTED PER MANUFACTURER'S RECOMMENDED MATERIALS, BUT AT NO GREATER DISTANCE THAN 4 FEET MAX. PERMISSIBLE SAG IS MAX. 1/2 INCHES PER FOOT OF SPACING BETWEEN SUPPORTS.



7 DUCT HANGER DETAILS

NO SCALE



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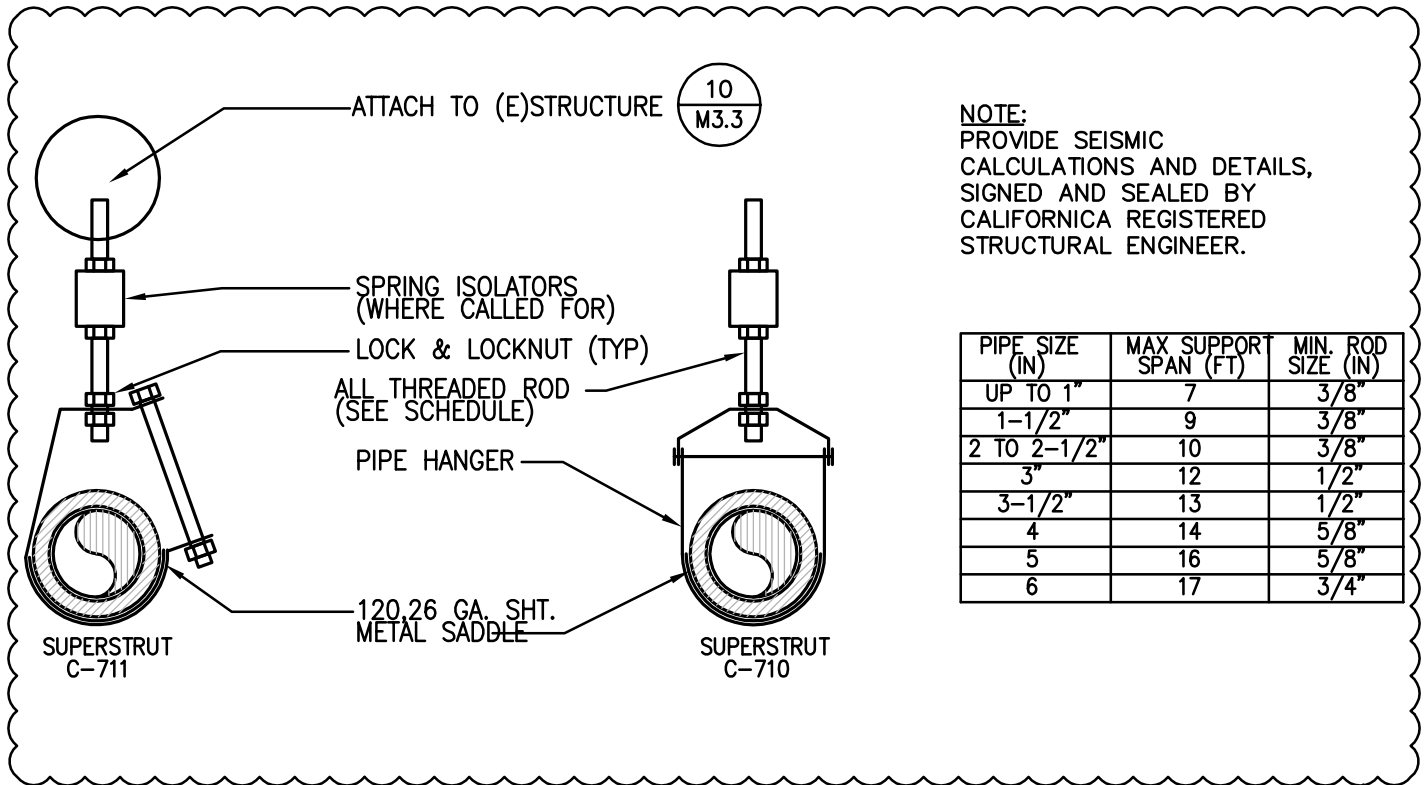
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AD2-M25

ADD #2
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NOTE:
 PROVIDE SEISMIC
 CALCULATIONS AND DETAILS,
 SIGNED AND SEALED BY
 CALIFORNIA REGISTERED
 STRUCTURAL ENGINEER.

PIPE SIZE (IN)	MAX SUPPORT SPAN (FT)	MIN. ROD SIZE (IN)
UP TO 1"	7	3/8"
1-1/2"	9	3/8"
2 TO 2-1/2"	10	3/8"
3"	12	1/2"
3-1/2"	13	1/2"
4	14	5/8"
5	16	5/8"
6	17	3/4"

2

8 PIPE HANGER DETAILS

NO SCALE

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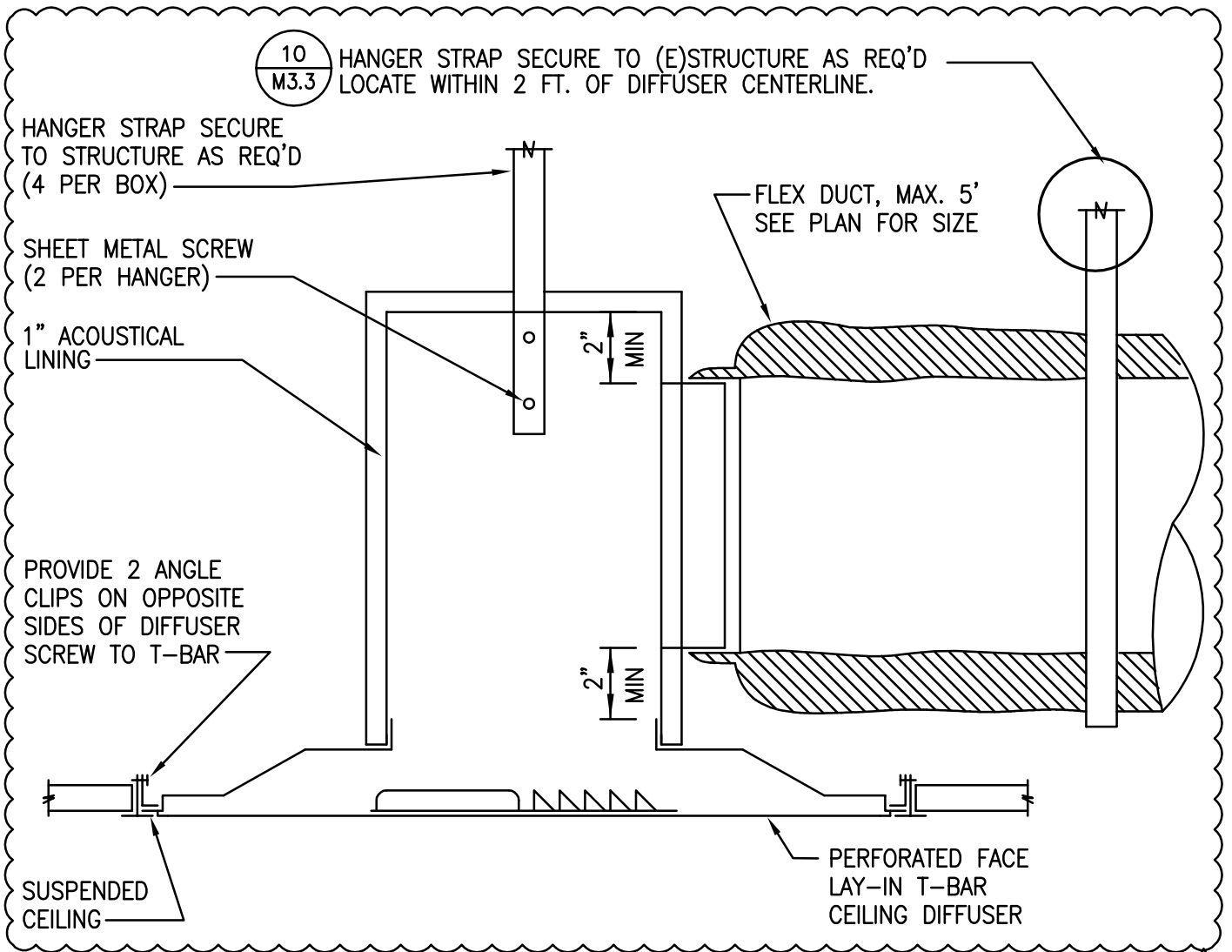
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AD2-M26

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2

9 CEILING DIFFUSER CONNECTION DETAIL

NO SCALE

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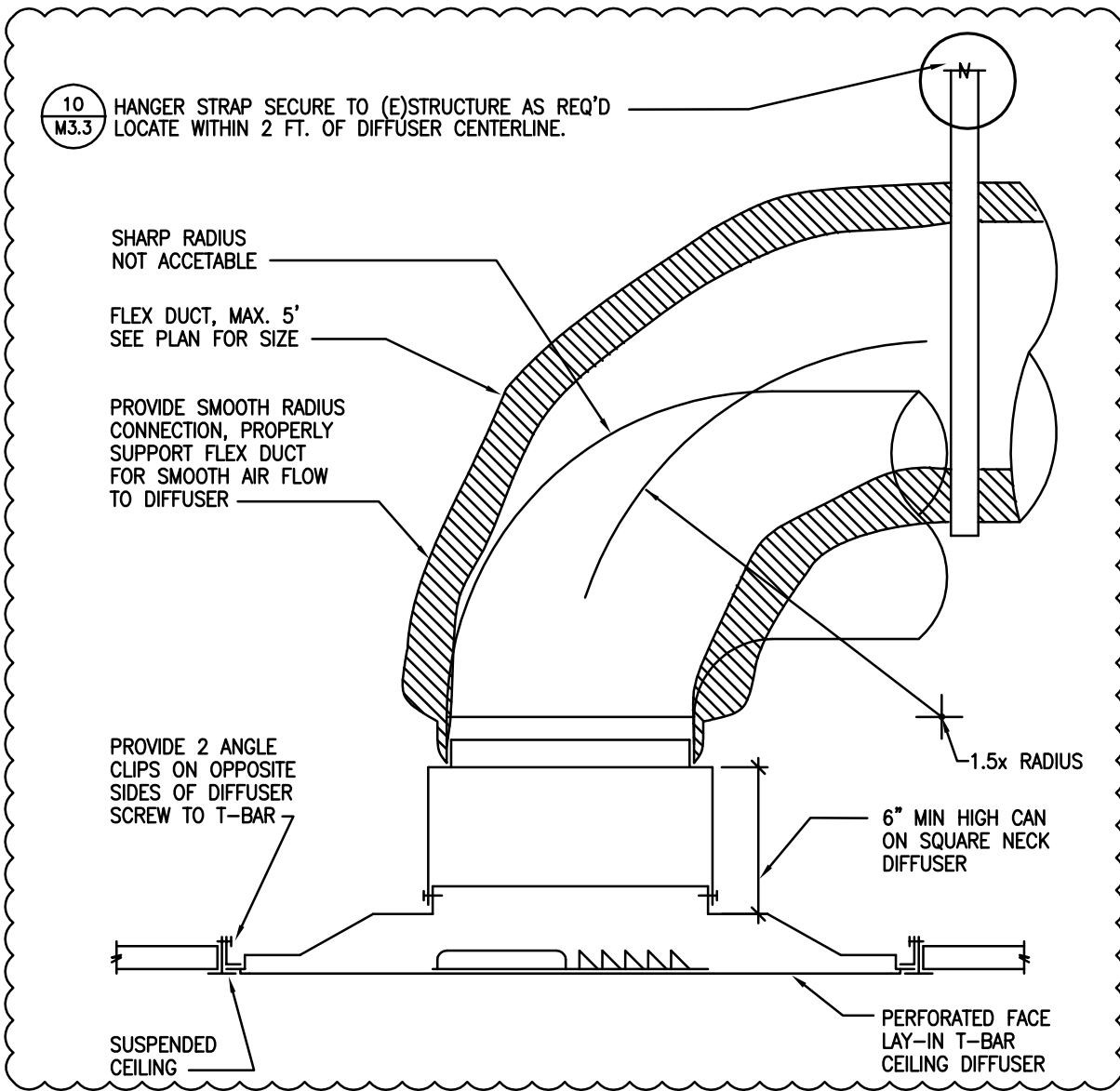
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AD2-M27



9 CEILING DIFFUSER CONNECTION DETAIL

NO SCALE

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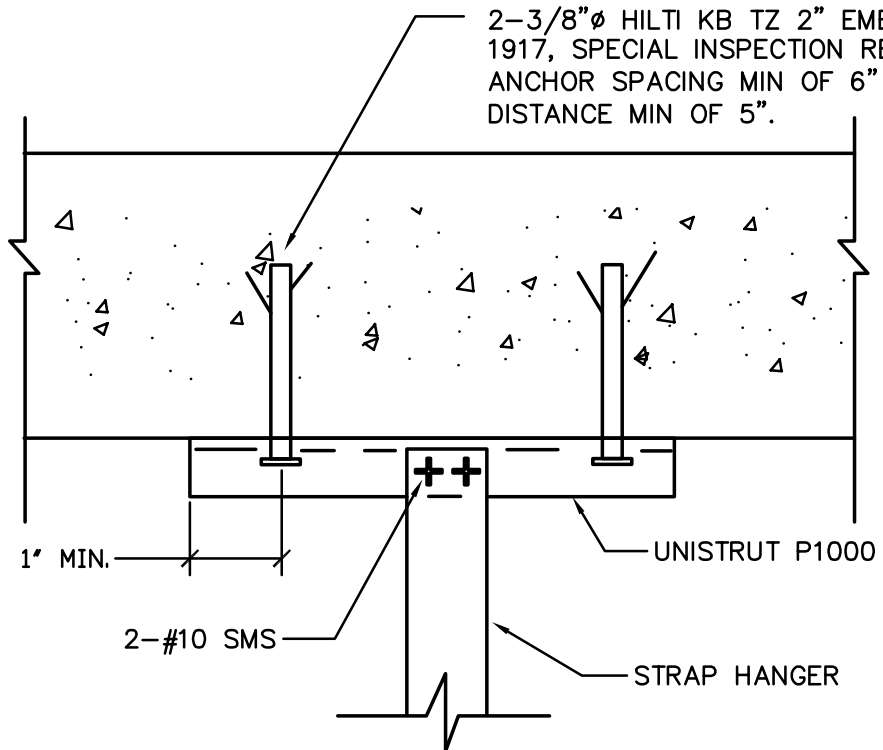
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AD2-M28

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2



2-3/8"Ø HILTI KB TZ 2" EMBED, ESR 1917, SPECIAL INSPECTION REQUIRED.
 ANCHOR SPACING MIN OF 6" AND EDGE DISTANCE MIN OF 5".

1' MIN.

UNISTRUT P1000

2-#10 SMS

STRAP HANGER

STRAP HANGER

NOTE:
 PROVIDE SEISMIC CALCULATIONS AND DETAILS, SIGNED AND SEALED BY CALIFORNIA REGISTERED STRUCTURAL ENGINEER. NO CUTTING OR DAMAGING OF REBAR.

10 CONNECTION TO EXISTING STRUCUTRE

NO SCALE

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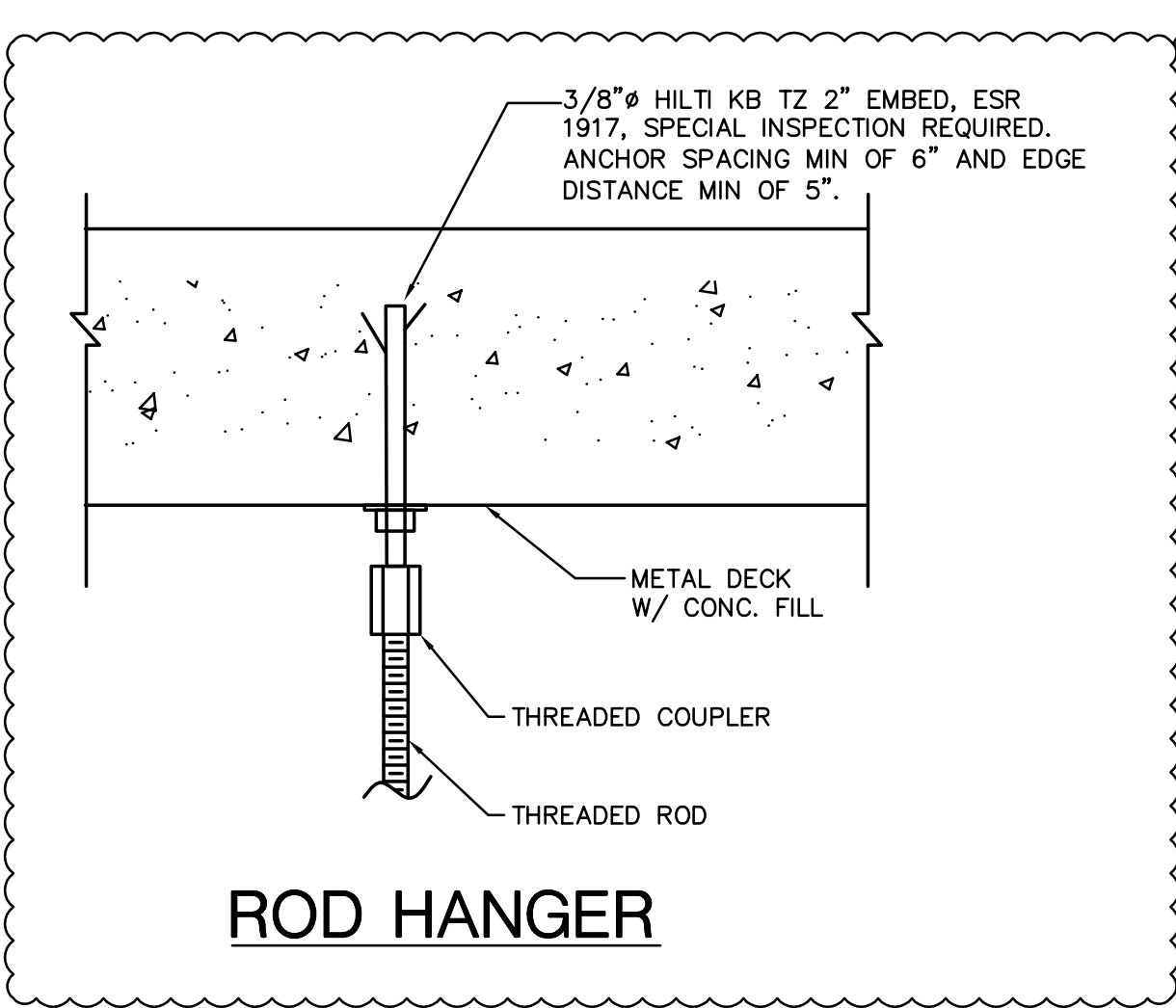
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ROD HANGER

10 CONNECTION TO EXISTING STRUCUTRE

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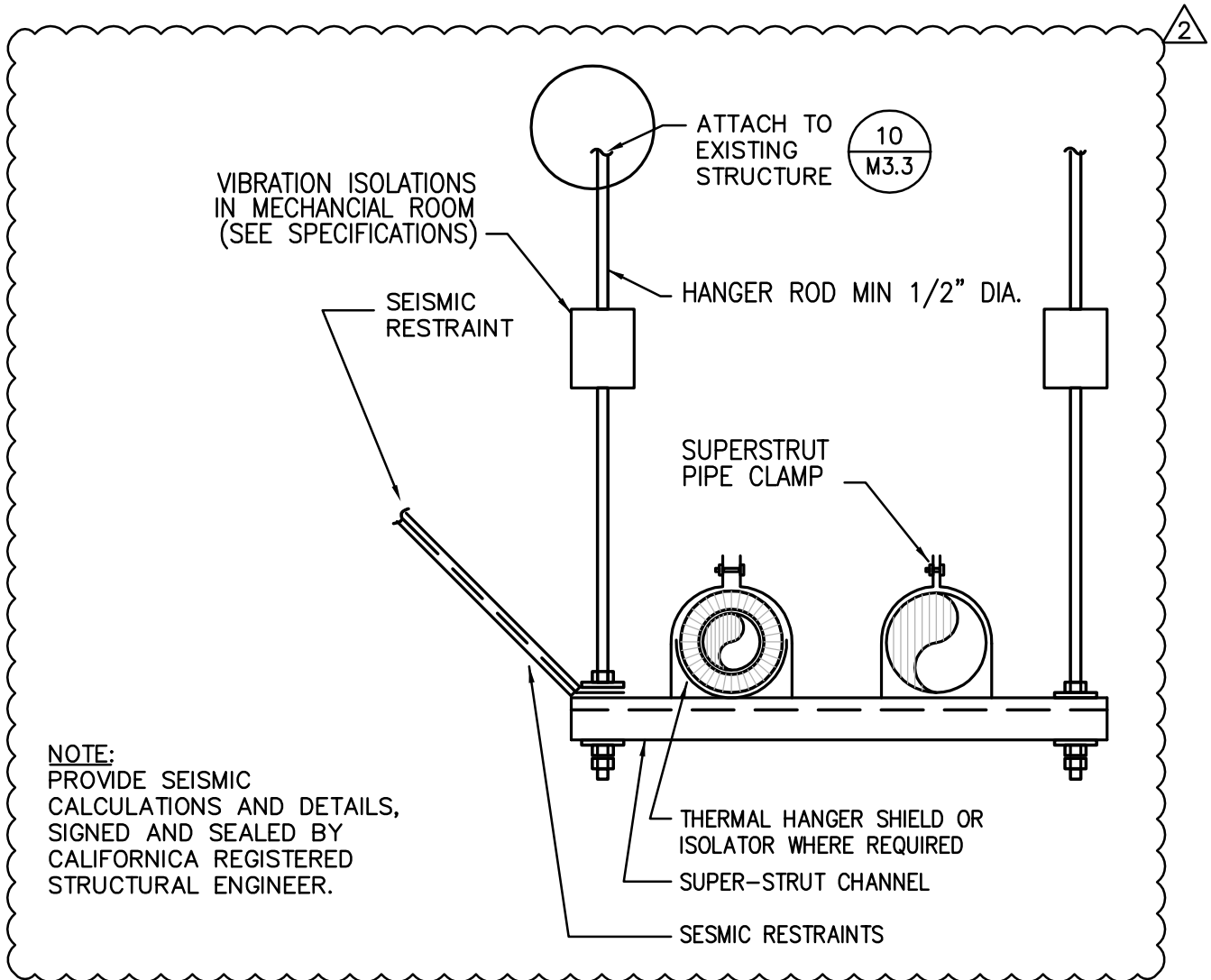
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11 TRAPEZE PIPE HANGER DETAIL

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Title: M3.3
 MECHANICAL DETAILS

Project Name:
CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION
 4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
 06/12/08

Scale
 AS NOTED

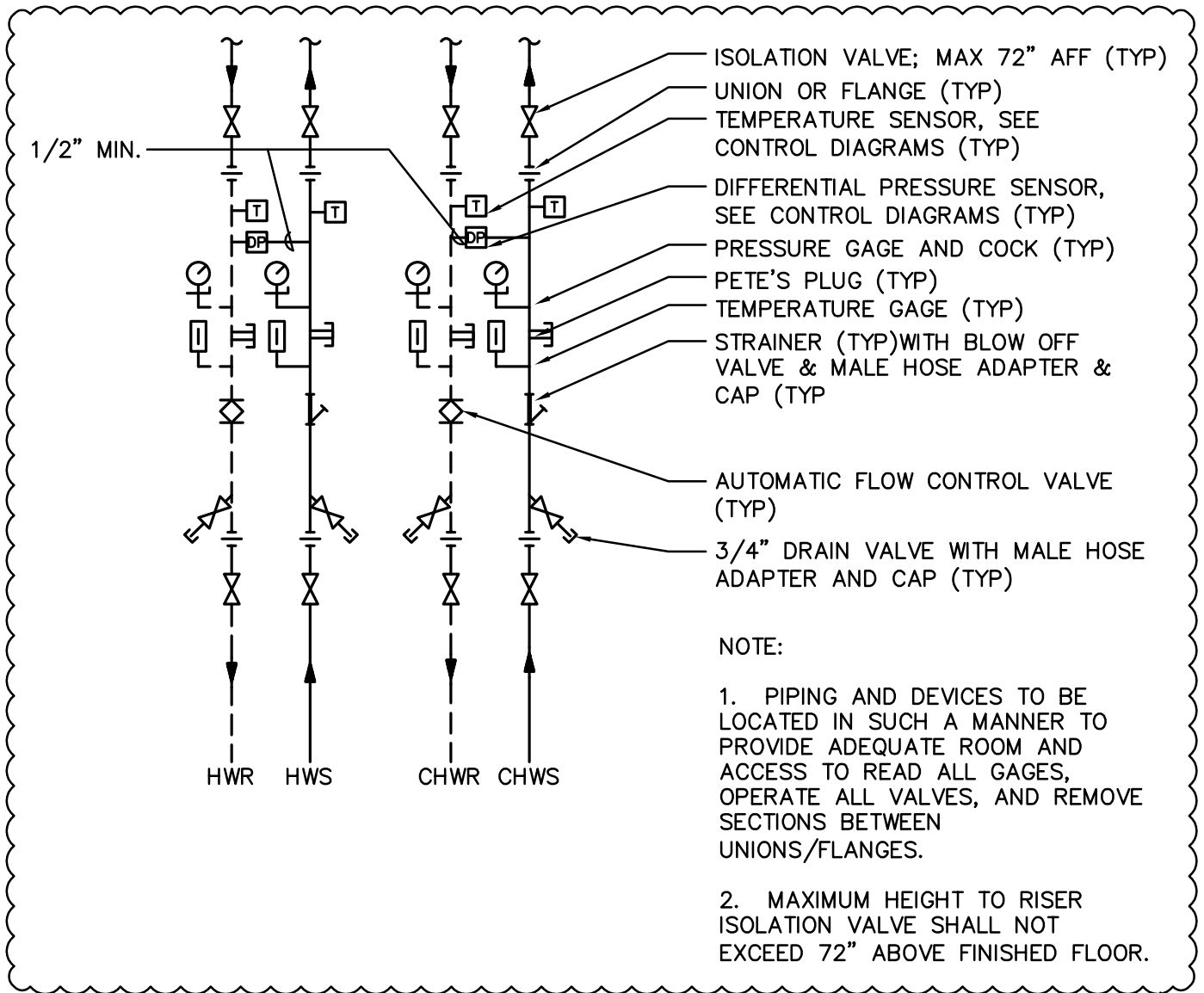
Project Number
 07014

ASI No.:-

2

Drawing Number

AD2-M31



2

12 CHW AND HW WATER BLDG ENTRY DIAGRAM

NO SCALE



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Title: M3.3
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Drawing Number

AD2-M32

ADD #2
FILE NO. 41-C1
APPL.NO. 01-109554

PLUMBING FIXTURE SCHEDULE

	CONNECTION	W	V	CW	HW
SYMBOL	DESCRIPTION				
WC-1 ADA	<p>WATER CLOSET: WALL HUNG, SIPHON JET ACTION, VITREOUS CHINA, ELONGATED BOWL, 1-1/2 IN. TOP SPUD FOR EXPOSED FLUSH VALVE, BOLT CAPS. MOUNTING HEIGHT ADA COMPLIANT. KOHLER K-4330 "KINGSTON" SEAT: OPEN FRONT, COMMERCIAL WEIGHT HEAVY-DUTY PLASTIC, STAINLESS STEEL CHECK HINGE, WHITE, WITHOUT COVER. CHURCH 9500C. FLUSH VALVE: 1.6 GAL. PER FLUSH DOWN/1.1 GAL. PER FLUSH UP, TOP SPUD. SLOAN WES-111 (MANUAL OPERATION) CARRIER: J.R. SMITH 0100 SERIES TO 0200 SERIES.</p>	4"	2"	1"	---
 L-1 ADA	<p>LAVATORY: WALL HUNG, VITREOUS CHINA, 20-3/4 IN. BY 18-3/4 IN., FRONT OVERFLOW, ANTI-BACKSPASH. KOHLER K-2032 "GREENWICH" WITH 4 IN. CENTER FAUCET HOLES. FITTINGS: 1-1/4 IN. BY 1-1/2 IN. P-TRAP. SUPPLIES AND STOPS. FOR ADA COMPLIANT, PROVIDE INSULATION KIT TO P-TRAP AND SUPPLIES. SEE SPECIFICATIONS. CARRIER: FLOOR MOUNTED WITH CONCEALED ARMS, J.R. SMITH AS APPLICABLE. FAUCET: CHICAGO 844-669 METERING/SELF-CLOSING TYPE, 4 IN. CENTERS, ADJUSTABLE SLOW CLOSING, TEMPERATURE LIMIT STOP, IN-LINE CHECK/SCREEN ASSEMBLIES, 0.5 GPM AERATOR, GRID STRAINER, CHROME. SYMMONS S-60-1-H WITH POP-UP DRAIN INSTEAD OF GRID STRAINER</p>	1-1/2"	1-1/2"	1/2"	1/2"
TPV-1	<p>TRAP PRIME/VALVE MIFAB MODEL MR-500</p>	---	---	1/2"	---
WHA-1	<p>WATER HAMMER ARRESTOR JAY R. SMITH-5000 SERIES</p>	---	---	---	---
S-1 ADA	<p>SINK: JUST MODEL SL-ADA-2225-GR, 18 GAUGE TYPE 304 18-8 STAINLESS STEEL, 6-1/2" DEPTH, WITH FAUCET AND BUBBLE LEDGE. SOUND DEADENED, 25 IN. LEFT TO RIGHT BY 22 IN. FRONT FOR ADA COMPLIANT, PROVIDE INSULATION KIT TO P-TRAP AND SUPPLIES. SEE SPECS. FAUCET: CHICAGO MODEL 201-AGN8AE3-317CP, DECK-MOUNTED, GN2A RIGID/SWING GOOSENECK SPOUT, E3-SOFT FLO AERATOR, 317 WIRST BLADE HANDLES. DRAIN: JUST J-35, STAINLESS STEEL CUP STRAINER WITH REMOVABLE STEEL BASKET.</p> <p> GBD-1</p> <p>GBD: IN-SINK-ERATOR MODEL 555SS 3/4HP - 120V, 8.1A 3/4-HP MOTOR OFFEST GARBAGE DISPOSAL TO ALLOW FOR REQUIRED ADA CLEARANCE.</p>	2"	1-1/2"	1/2"	1/2"

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Title: M4.1 MECHANICAL
EQUIPMENT SCHEDULES

Revision:

ASI No.:-

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Project Name:

**CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION**

4200 Farm Hill Blvd.
Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Date
06/12/08

Scale
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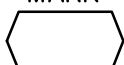

Project Number
07014

Drawing Number




AD2-M33

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554

FAN SCHEDULE

MARK 	MFR	MODEL	CFM	RPM	TSP	TYPE
RF-1	GREENHECK	GB-300	9150	633	0.35	 MUSHROOM
EF-1	GREENHECK	GB-071	100	-	0.35	MUSHROOM
EF-2	GREENHECK	GB-071	200	-	0.35	MUSHROOM

NOTE:


-  PROVIDE 12" ROOF CURB, TIE-DOWNS, ALUMINUM BIRD SCREEN, MOTORIZED CONTROL DA
-  PROVIDE VFD TO MODULATE WITH AHU-1 AND AHU-2 TO MAINTAIN SPACE PRESSURIZATI
-  AMCA CERTIFIED FOR AIRFLOW AND SOUND.



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Title: M4.1 MECHANICAL
 EQUIPMENT SCHEDULES

Revision:

ASI No.:-

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Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
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Drawing Number

AD2-M34

GENERAL ELECTRICAL NOTES

INSTRUCTED IN ACCORDANCE WITH CODES.

SPECIFICATIONS REPRESENT COMPLETE AND READY FOR USE. WIRING, RACEWAY, CONNECTIONS ALTHOUGH NOT EXPLICITLY STATED PROPER SYSTEM OPERATION OR TO ARE TO BE INCLUDED AS A PART OF THE CONTRACT WITHOUT ADDITIONAL

L. OMISSIONS OR CONFLICTS BETWEEN VARIOUS ELEMENTS OF THE DRAWINGS, NOTES, AND DETAILS ARE TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND BEFORE PROCEEDING WITH THE WORK.

M. PROVIDE FLUSH MOUNTED INSTALLATION OF ALL DEVICES AND EQUIPMENT IN ALL AREAS U.O.N.

N. NOT USED.

O. FOR 120 VOLT, 20 AMP CIRCUITS WHERE THE CIRCUIT DISTANCE FROM THE PANEL BOARD TO THE FARTHEST DEVICE/FIXTURE EXCEEDS 75 FEET PROVIDE #10 SIZE CONDUCTOR.

P. PROVIDE AS-BUILT DRAWINGS IN AUTOCAD FORMAT PER SPECIFICATIONS.

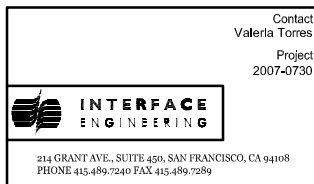
NOTES ARE DIAGRAMMATIC AND INDICATE GENERAL LOCATION AND ARRANGEMENT OF DEVICES, AND OUTLETS IS TO BE DETERMINED FROM ARCHITECTURAL DRAWINGS AND FINAL ARRANGEMENT OF EQUIPMENT.

SCALE: NONE



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Title: E0.1 ELECTRICAL LEGENDS,
 NOTES, ABBREVIATIONS
 AND DRAWING INDEX

Revision:

ASI No.:-

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 BLDG 8 PHASE 2 RENOVATION

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 FILE NO. 41-C1 APPL. 01-109554

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Scale
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

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 07014

Drawing Number

AD2-E1

ELECTRICAL SYMBOL LIST

SECURITY

-  DIGITAL VIDEO RECORDER
-  CEILING MOUNTED GLASS BREAK SENSOR 
-  SECURITY SYSTEM CEILING MOUNTED MOTION DETECTOR


SCALE: NONE

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Title: E0.1 ELECTRICAL LEGENDS, Revision: Notes, ABBREVIATIONS AND DRAWING INDEX

ASI No.:-
2

Project Name:
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AD2-E2

LUMINAIRE SCHEDULE

TYPE: B MANUFACTURERS: LITHONIA WC-2-32-MVOLT-GEB10IS (OR APPROVED.) 2

TYPE: E MANUFACTURERS: INSIGHT LINEA SERIES LIN-T5/WB/WMM-6/4/2 (OR LENGTHS AS REQUIRED) (OR APPROVED.) 2

TYPE: G DESCRIPTION: CEILING MOUNT DECORATIVE FLUORESCENT
 HOUSING: COLD ROLLED STEEL TRIM AND MOUNTING PAN
 LENS: WHITE MATTE ACRYLIC DIFFUSER
 BALLAST: ELECTRONIC
 LAMP: TWO 13W CFL
 INPUT WATTS: 34
 MANUFACTURERS: SHAPER 248 SERIES 248-EL-16-CFL/2/13-277V-MW
 OR APPROVED. 2

LUMINAIRE SCHEDULE GENERAL NOTES

1. VERIFY LUMINAIRE VOLTAGE WITH BRANCH CIRCUIT SUPPLYING POWER TO LUMINAIRE PRIOR TO ORDERING.
2. T8 FLUORESCENT LAMPS TO BE 3500K WITH A MINIMUM CRI OF 80.
3. COMPACT FLUORESCENT LAMPS TO BE 3500K WITH A MINIMUM CRI OF 82.
4. VERIFY AND COORDINATE ALL CEILING TYPES WITH LUMINAIRE LOCATIONS.
5. SPECIFIED MANUFACTURERS ARE APPROVED TO SUBMIT BID WHERE SPECIFIED. INCLUSION DOES NOT RELIEVE MANUFACTURER FROM PROVIDING PRODUCT AS DESCRIBED.
6. ALL LUMINAIRES OF LINEAR FLUORESCENT TYPE SHALL BE PROVIDED WITH AN INTEGRAL BALLAST DISCONNECT IN COMPLIANCE WITH CEC 410.73(G).


SCALE: NONE

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Title: E0.2 LUMINAIRE SCHEDULE, Revision:
 AND TITLE 24

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 2

Project Name:
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 AD2-E3

GENERAL SHEET NOTES

- A. CONTRACTOR SHALL COORDINATE ALL DEMOLITION WORK WITH THE ARCHITECT AND THE DISTRICT PRIOR TO COMMENCEMENT OF WORK.

2

SHEET KEYNOTES

5 ALL MECHANICAL EQUIPMENT IN THIS ROOM TO BE REMOVED UNDER MECHANICAL SCOPE OF WORK. DISCONNECT AND REMOVE FEEDERS AND ASSOCIATED DISCONNECT SWITCHES COMPLETE, BACK TO SOURCE.

2

6 EXISTING LUMINAIRE AND LIGHTING CONTROL TO REMAIN AND CONNECTED UNDER NEW WORK. REFER SHEET E.21 FOR NEW WORK.

7 EXISTING LUMINAIRE TO BE DISCONNECTED AND REMOVED. REFER TO SHEET E2.1 FOR NEW WORK.

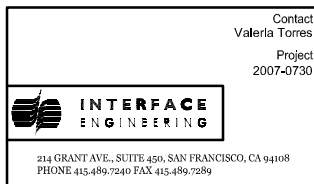
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SCALE: NONE

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Title: ED1.1 1ST AND 2ND FLOOR
PLAN - DEMOLITION

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
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FILE NO. 41-C1 APPL. 01-109554

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Drawing Number

AD2-E4

SHEET KEYNOTES

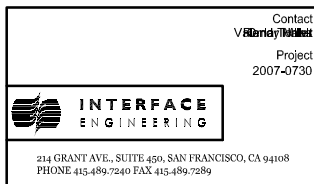
- ① AREA INDICATED IS NOT IN SCOPE OF WORK, UNLESS OTHERWISE NOTED. LUMINAIRES AND LIGHTING CONTROLS IN THIS AREA TO REMAIN. INTERCEPT AND EXTEND BRANCH CIRCUITS TO NEW PANEL '8H1' VIA NEW LCP '8H1', AND CONNECT COMPLETE TO PLACE BACK INTO SERVICE. △ 2
- ② COORDINATE LOCATION OF LUMINAIRES AND OCCUPANCY SENSORS IN MECHANICAL ROOM WITH DIVISION 15. DO NOT MOUNT LUMINAIRE WHERE LIGHT OUTPUT IS BLOCKED BY DUCTWORK OR EQUIPMENT.
- ③ EMERGENCY LUMINAIRE TO BE SERVED FROM BATTERY INVERTER IN ROOM F312 VIA TO 277V EMERGENCY PANEL 'FE3A.' USE SPARE CIRCUIT TO FEED ALL EMERGENCY LUMINAIRES IN BUILDING 8.
- ④ NOT USED.
- ⑤ INTERCEPT AND EXTEND EXISTING LIGHTING CIRCUIT AND LIGHTING CONTROLS TO NEW LUMINAIRE AND CONNECT COMPLETE AS REQUIRED TO PLACE INTO SERVICE.
- ⑥ NOT USED. △ 2
- ⑦ CONNECT EXISTING LUMINAIRES TO NEW LIGHTING CONTROLS AND SWITCHING PATTERN AS INDICATED TO PLACE BACK INTO SERVICE. INTERCEPT AND EXTEND EXISTING CIRCUIT TO PANEL '8L1'.

SCALE: NONE



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Title: E2.1 1ST AND 2ND FLOOR
 PLAN - LIGHTING

Revision:

ASI No.:-

2

Project Name:

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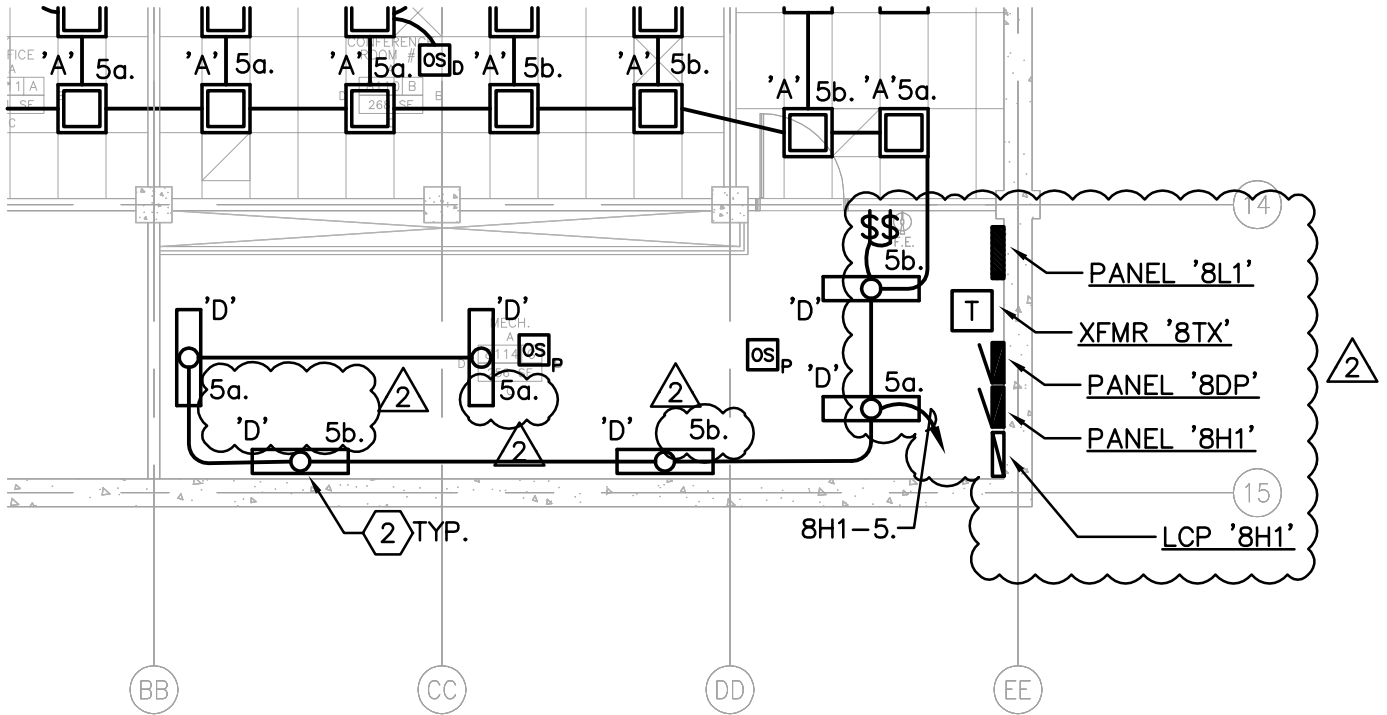
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Scale
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AD2-E5

Project Number
 07014

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 1ST FLOOR PLAN - LIGHTING

0 4' 8' 16'



SCALE: 1/8"=1'-0"

SCALE: NONE

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Title: E2.1 1ST AND 2ND FLOOR
 PLAN - LIGHTING

Revision:

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Project Name:

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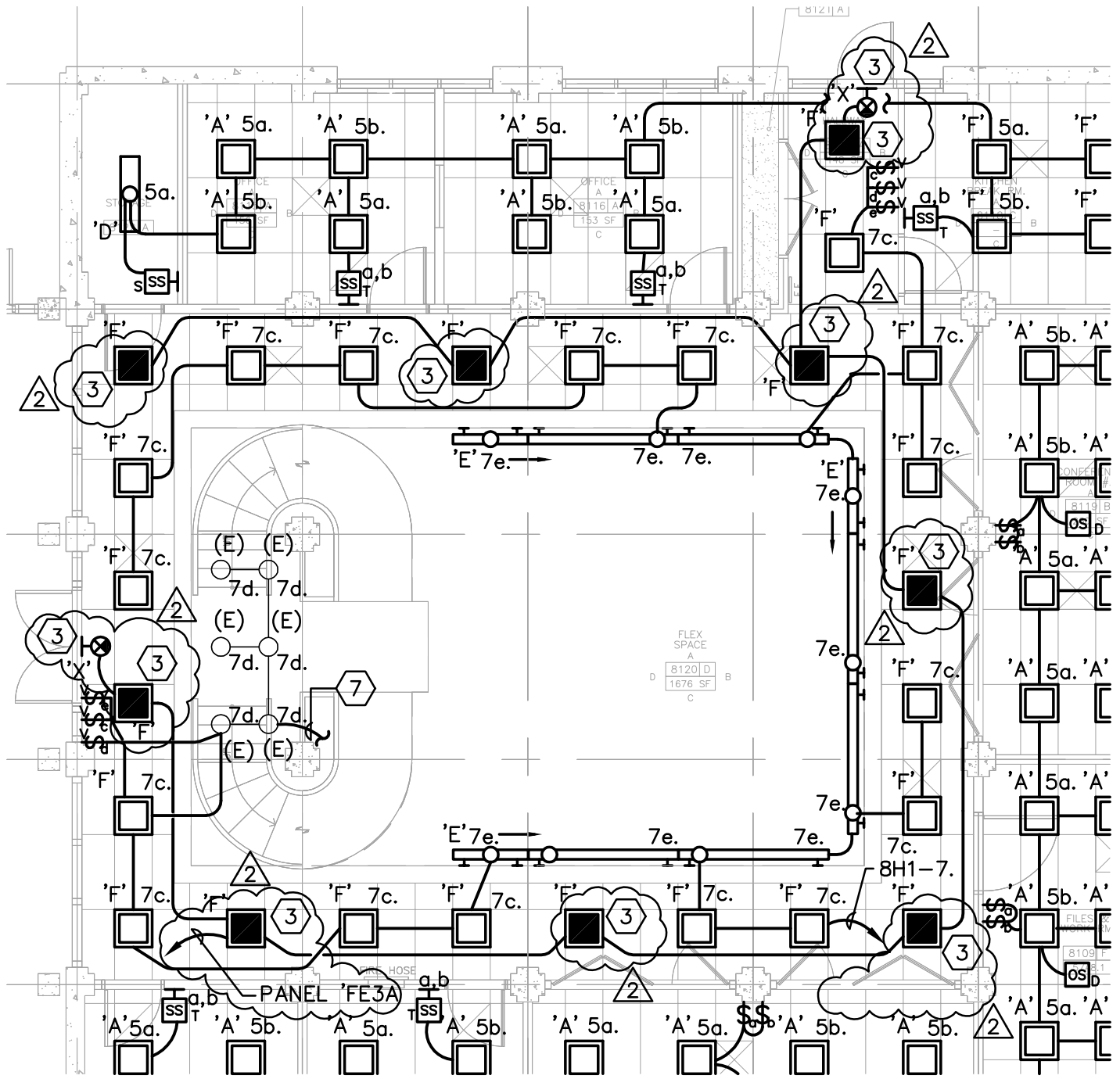
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1 1ST FLOOR PLAN - LIGHTING

ADD #2
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SCALE: NONE



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Title: E2.1 1ST AND 2ND FLOOR
 PLAN - LIGHTING

Revision:

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Project Name:

**CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION**

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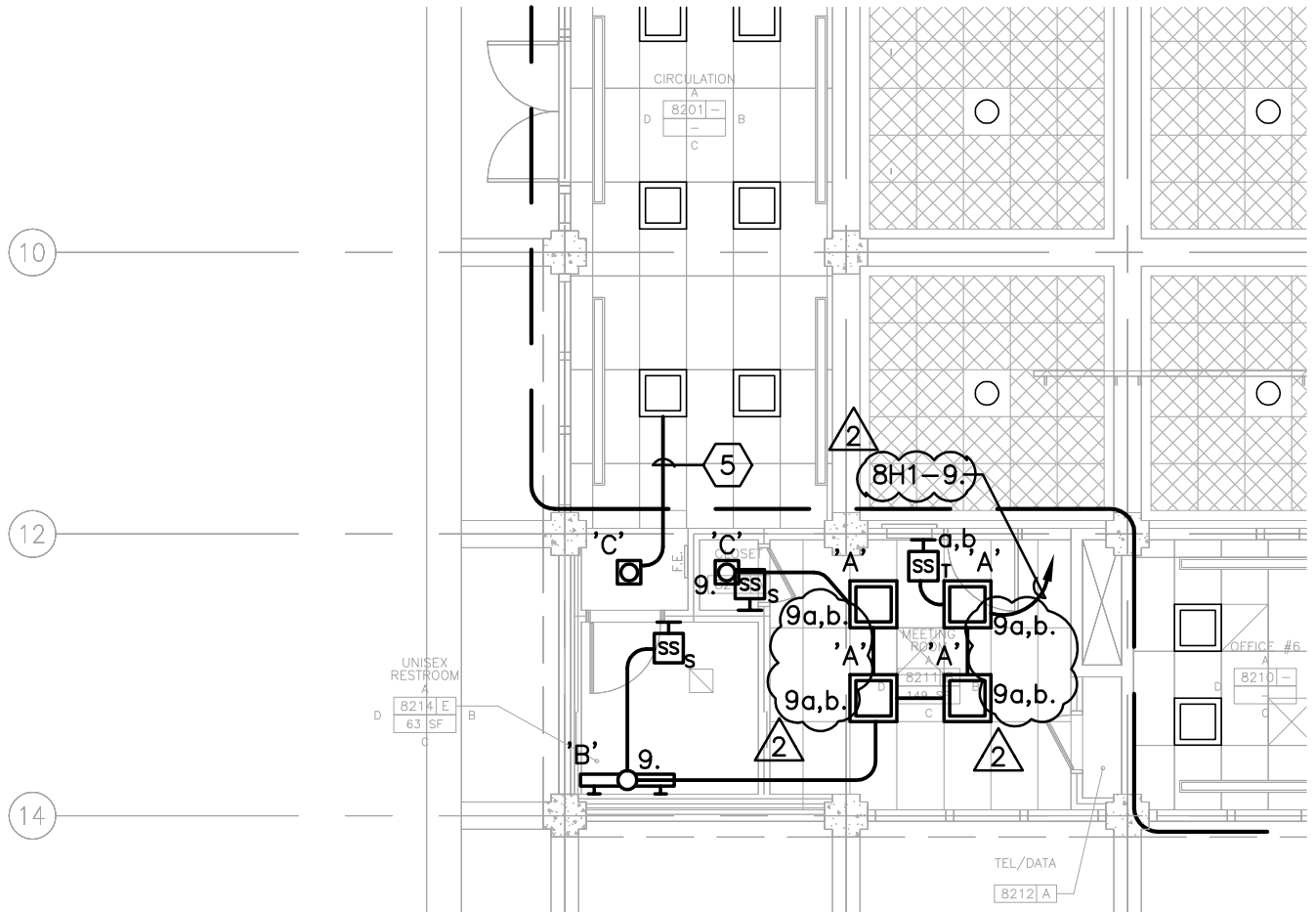
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Scale
 AS NOTED

AD2-E7

Project Number
 07014

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



2 2ND FLOOR PLAN - LIGHTING

0 4' 8' 16'



SCALE: 1/8"=1'-0"

SCALE: NONE

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Title: E2.1 1ST AND 2ND FLOOR
 PLAN - LIGHTING

Revision:

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Project Name:

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AD2-E8

Project Number
 07014

SHEET KEYNOTES

2

- 1 PROVIDE QUAD RECEPTACLE FOR SMART BOARD. COORDINATE EXACT LOCATION AND POWER REQUIREMENTS PRIOR TO INSTALLATION.
- 2 PROVIDE RECEPTACLE UNDER SINK AND TOGGLE SWITCH ABOVE COUNTER FOR GARBAGE DISPOSAL. PROVIDE LAMACOID NAMEPLATE ON SWITCH TO READ "GARBAGE DISPOSAL." VERIFY EXACT POWER REQUIREMENTS PRIOR TO ROUGH-IN.
- 3 PROVIDE CONNECTION TO VFD WITH INTEGRAL DISCONNECT FURNISHED BY DIVISION 15.
- 4 SAW CUT CONCRETE AND PROVIDE 3/4" CONDUIT AND WIRING FOR POWER FROM ADJACENT WALL MOUNTED RECEPTACLE. COORDINATE EXACT LOCATION WITH EXISTING REBAR IN CONCRETE. PATCH CONCRETE TO MATCH EXISTING.
- 5 PROVIDE JUNCTION BOX FOR RANGE HOOD. VERIFY POWER REQUIREMENTS PRIOR TO INSTALLATION.
- 6 PROVIDE NEW LAMACOID NAMPLATE FOR EXISTING PANEL 'GR2A'. RENAME TO PANEL '8L2'. REFER TO SINGLE LINE DIAGRAM, SHEET E5.1, FOR NEW WORK.
- 7 PROVIDE JUNCTION BOX FOR 120V POWER TO DDC CONTROLLER.
- 8 AREA INDICATED IS NOT IN SCOPE OF WORK, UNLESS OTHERWISE NOTED. ALL DEVICES ARE EXISTING TO REMAIN. RECONNECT POWER TO ANY EXISTING DEVICES THAT MAY BE INADVERTENTLY DISCONNECTED DURING DEMOLITION OF THE FIRST FLOOR SPACE.
- 9 PROVIDE UNISTRUT SUPPORTS TO MOUNT VFD.

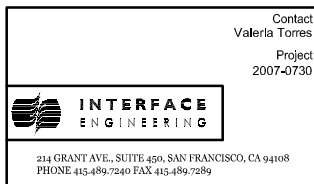
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SCALE: NONE



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Title: E3.1 1ST, 2ND, AND ROOF
 PLAN - POWER

Revision:

ASI No.:-

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Project Name:

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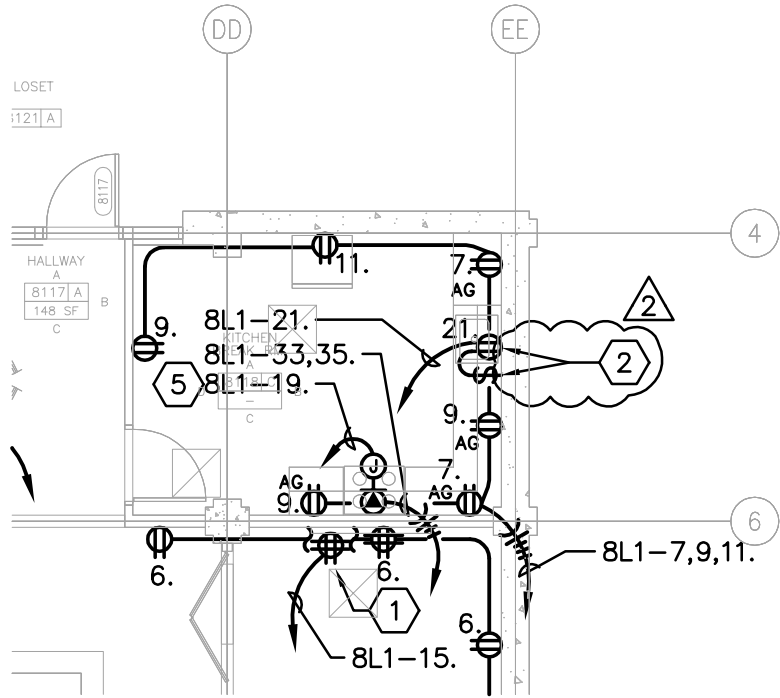
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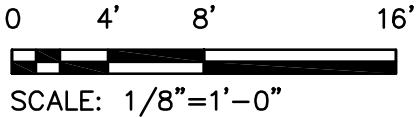
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ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 1ST FLOOR PLAN - POWER



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Title: E3.1 1ST, 2ND, AND ROOF
 PLAN - POWER

Revision:

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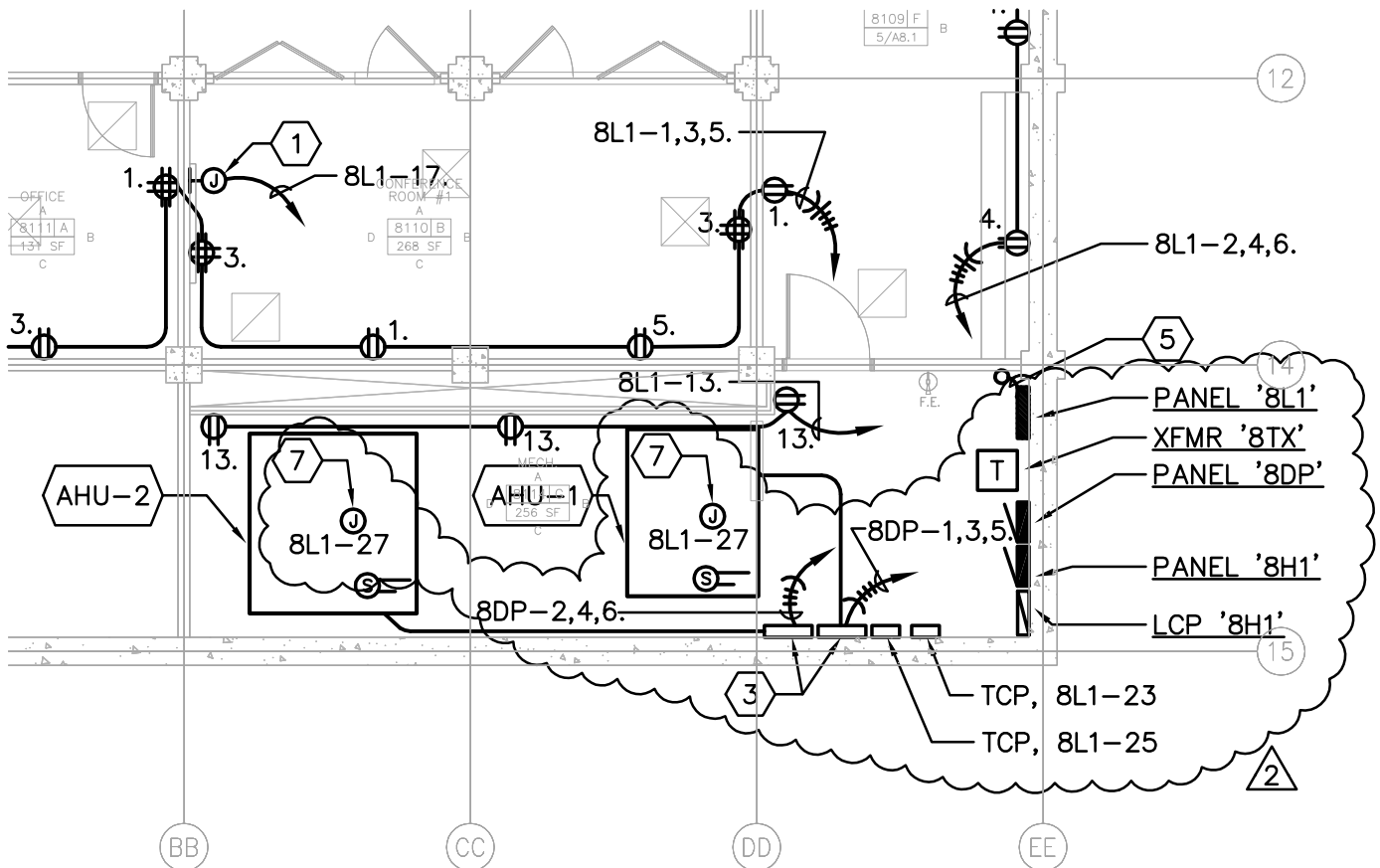
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Project Name:
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 4200 Farm Hill Blvd.
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 FILE NO. 41-C1 APPL. 01-109554

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 07014

Drawing Number
AD2-E10

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 1ST FLOOR PLAN - POWER

0 4' 8' 16'



SCALE: 1/8"=1'-0"

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Title: E3.1 1ST, 2ND, AND ROOF
 PLAN - POWER

Revision:

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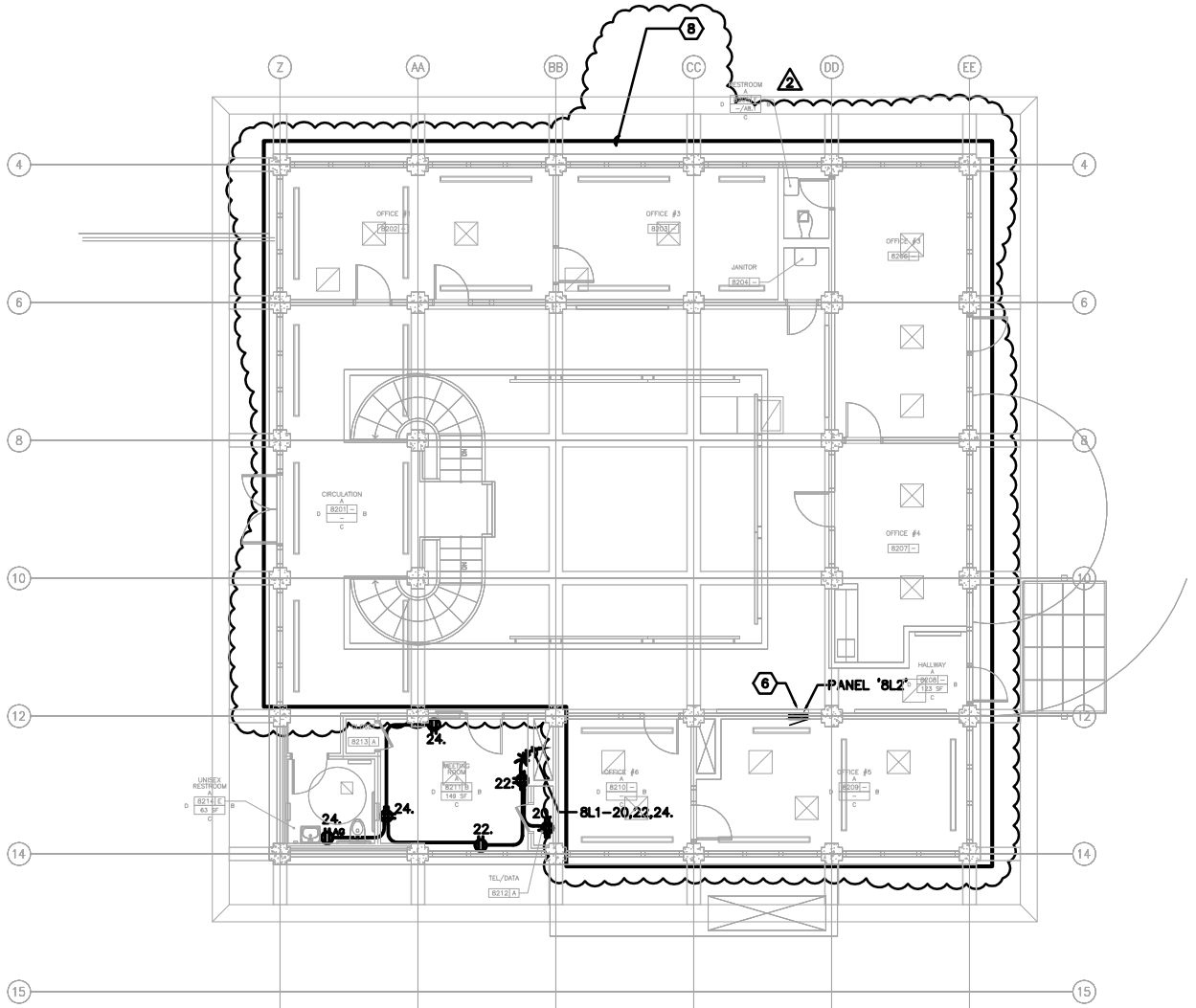
Project Number
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Drawing Number

AD2-E11

- 6 PROVIDE NEW LAMACOID NAMPLATE FOR EXISTING PANEL 'GR2A'. RENAME TO PANEL '8L2'. REFER TO SINGLE LINE DIAGRAM, SHEET E5.1, FOR NEW WORK.
- 8 AREA INDICATED IS NOT IN SCOPE OF WORK, UNLESS OTHERWISE NOTED. ALL DEVICES ARE EXISTING TO REMAIN. RECONNECT POWER TO ANY EXISTING DEVICES THAT MAY BE INADVERTENTLY DISCONNECTED DURING DEMOLITION OF THE FIRST FLOOR SPACE.

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



2 2ND FLOOR PLAN - POWER

0 8' 16' 32'



SCALE: 1/16"=1'-0"

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210 Hammond Ave.
 Fremont, California 94539
 [T] 510.445.1000
 [F] 510.445.1005

Contact
 Valeria Torres
 Project
 2007-0730

INTERFACE
 ENGINEERING

214 GRANT AVE., SUITE 450, SAN FRANCISCO, CA 94108
 PHONE 415-489-7240 FAX 415-489-7289

Title: E3.1 1ST, 2ND, AND ROOF
 PLAN - POWER

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION
 4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Date
 06/12/08

Scale
 AS NOTED

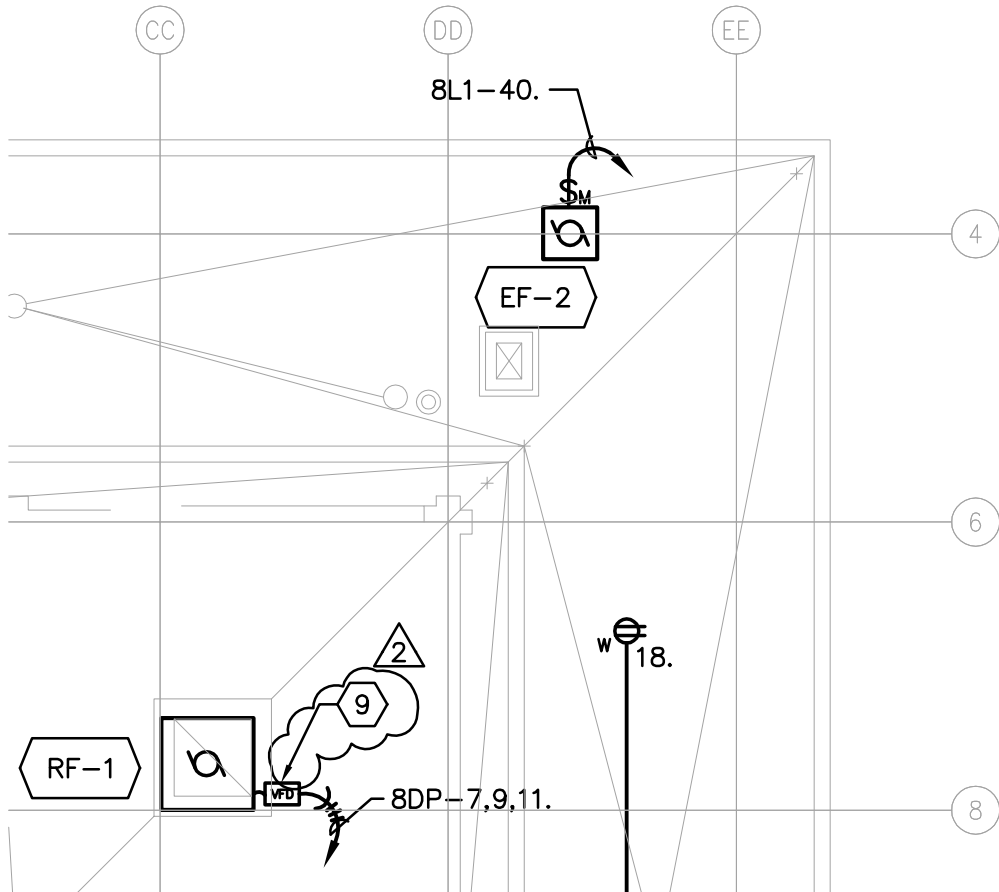
Project Number
 07014

Drawing Number

AD2-E12

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554

9 PROVIDE UNISTRUT SUPPORTS TO MOUNT VFD.



3 ROOF PLAN - POWER

0 4' 8' 16'



SCALE: 1/8"=1'-0"

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214 GRANT AVE., SUITE 450, SAN FRANCISCO, CA 94108
 PHONE 415-489-7240 FAX 415-489-7289

Title: E3.1 1ST, 2ND, AND ROOF
 PLAN - POWER

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION
 4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Date
 06/12/08

Scale
 AS NOTED

Project Number
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Drawing Number

AD2-E13

SHEET KEYNOTES

③ PROVIDE (N) SECONDARY CLOCKS AND ROUTE CABLE TO (E) HEAD END EQUIPMENT IN MDF.

②

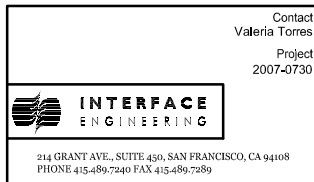
④ ROUTE ALL CABLES ASSOCIATED WITH CAMERAS, GLASS BREAK, CARD READERS, DOOR CONTACTS, ELECTRONIC DOOR LATCHES, AND REX DEVICES TO ACAMS PANELS IN MDF.

SCALE: NONE

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Title: E4.1 1ST AND 2ND
FLOOR PLAN - SIGNAL

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Date
06/12/08

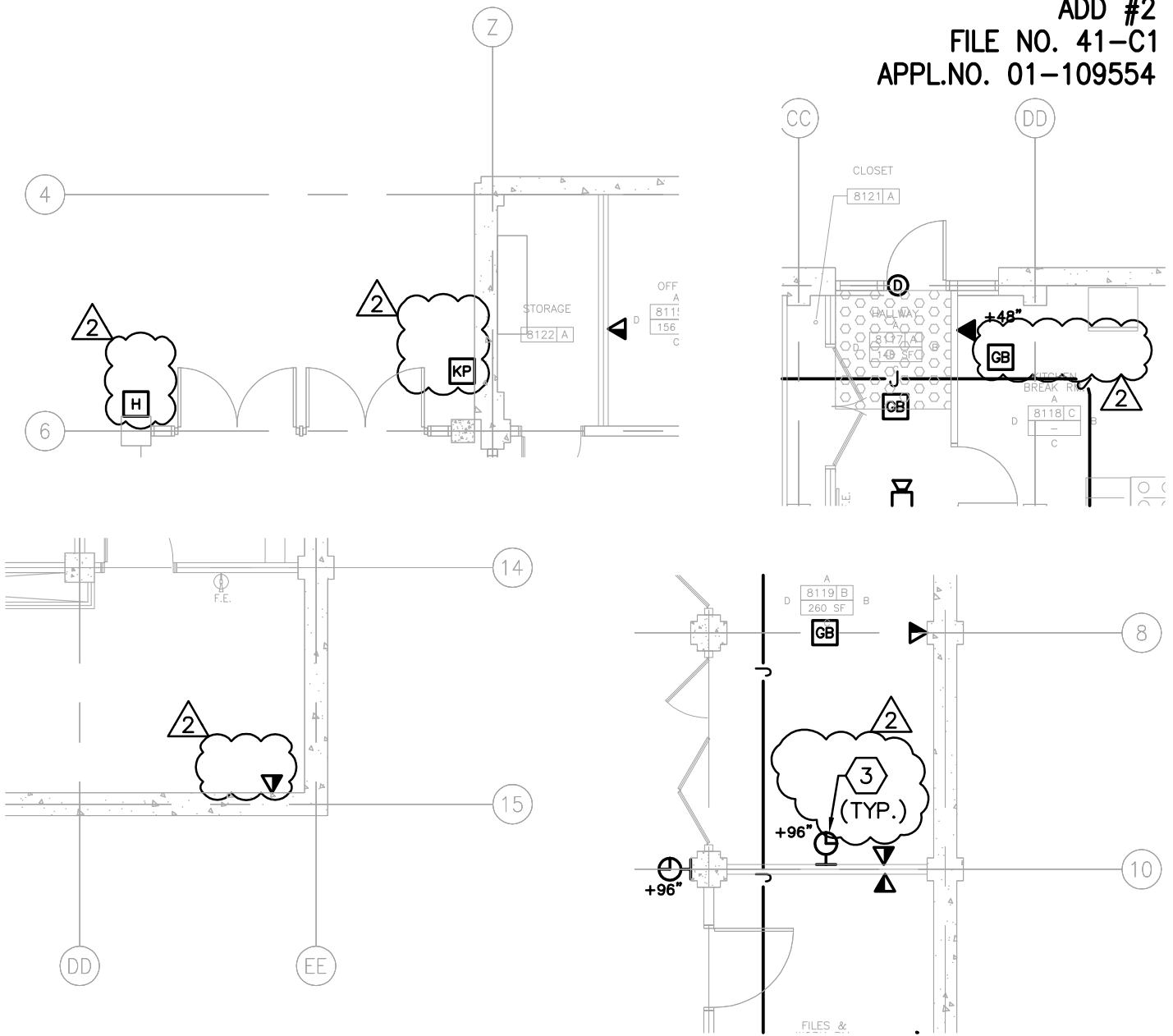
Scale
AS NOTED

Project Number
07014

Drawing Number

AD2-E14

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 1ST FLOOR PLAN - SIGNAL

0 4' 8' 16'



SCALE: 1/8"=1'-0"

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INTERFACE
 ENGINEERING

214 GRANT AVE., SUITE 430, SAN FRANCISCO, CA 94108
 PHONE 415-489-7240 FAX 415-489-7289

Title: E4.1 1ST AND 2ND
 FLOOR PLAN - SIGNAL

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
 Redwood City, CA 94061

FILE NO. 41-C1 APPL. 01-109554

Date
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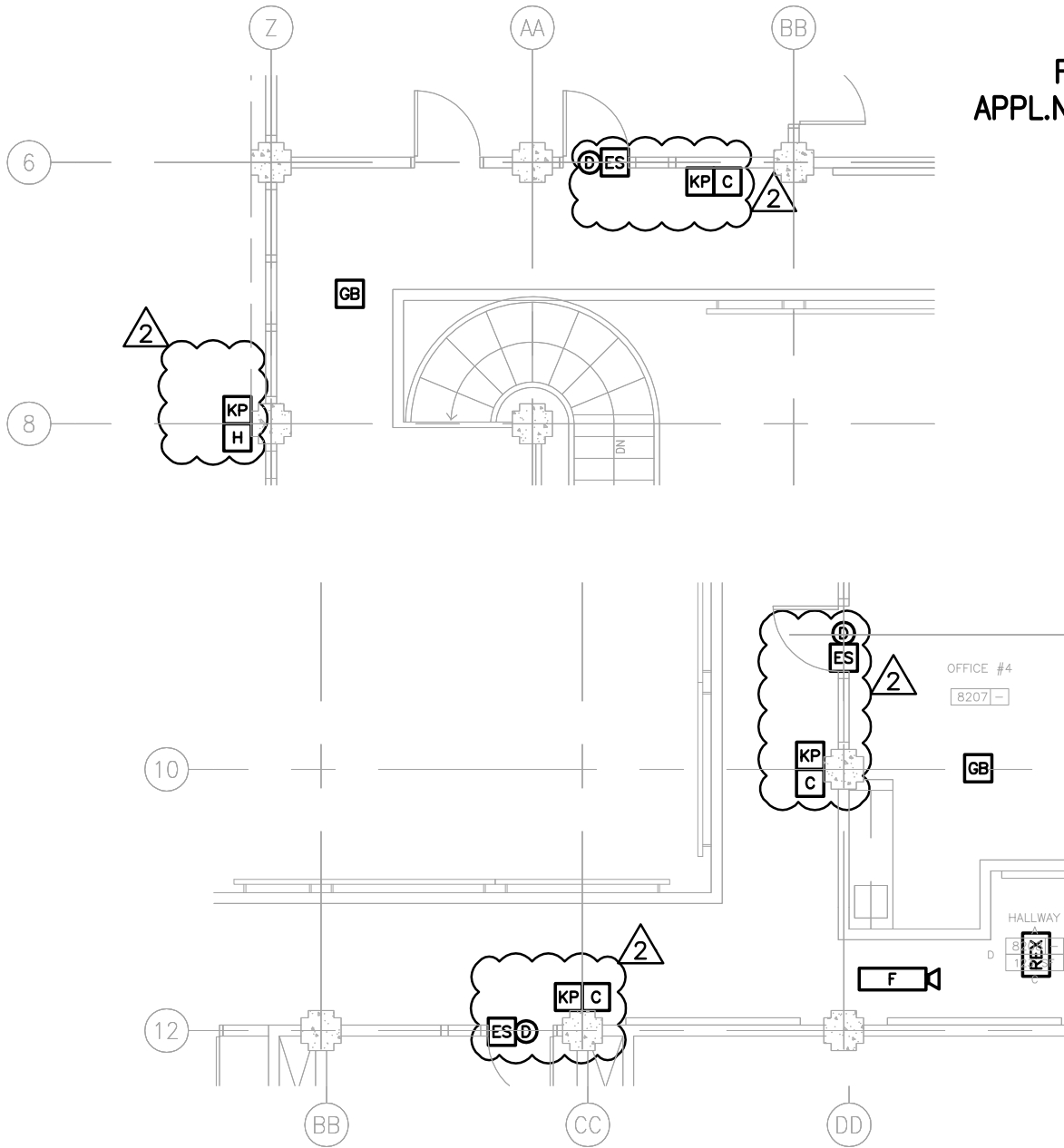
Scale
 AS NOTED

Project Number
 07014

Drawing Number

AD2-E15

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



2 2ND FLOOR PLAN - SIGNAL

0 4' 8' 16'



SCALE: 1/8"=1'-0"

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Title: E4.1 1ST AND 2ND
 FLOOR PLAN - SIGNAL

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
 Redwood City, CA 94061

FILE NO. 41-C1 APPL. 01-109554

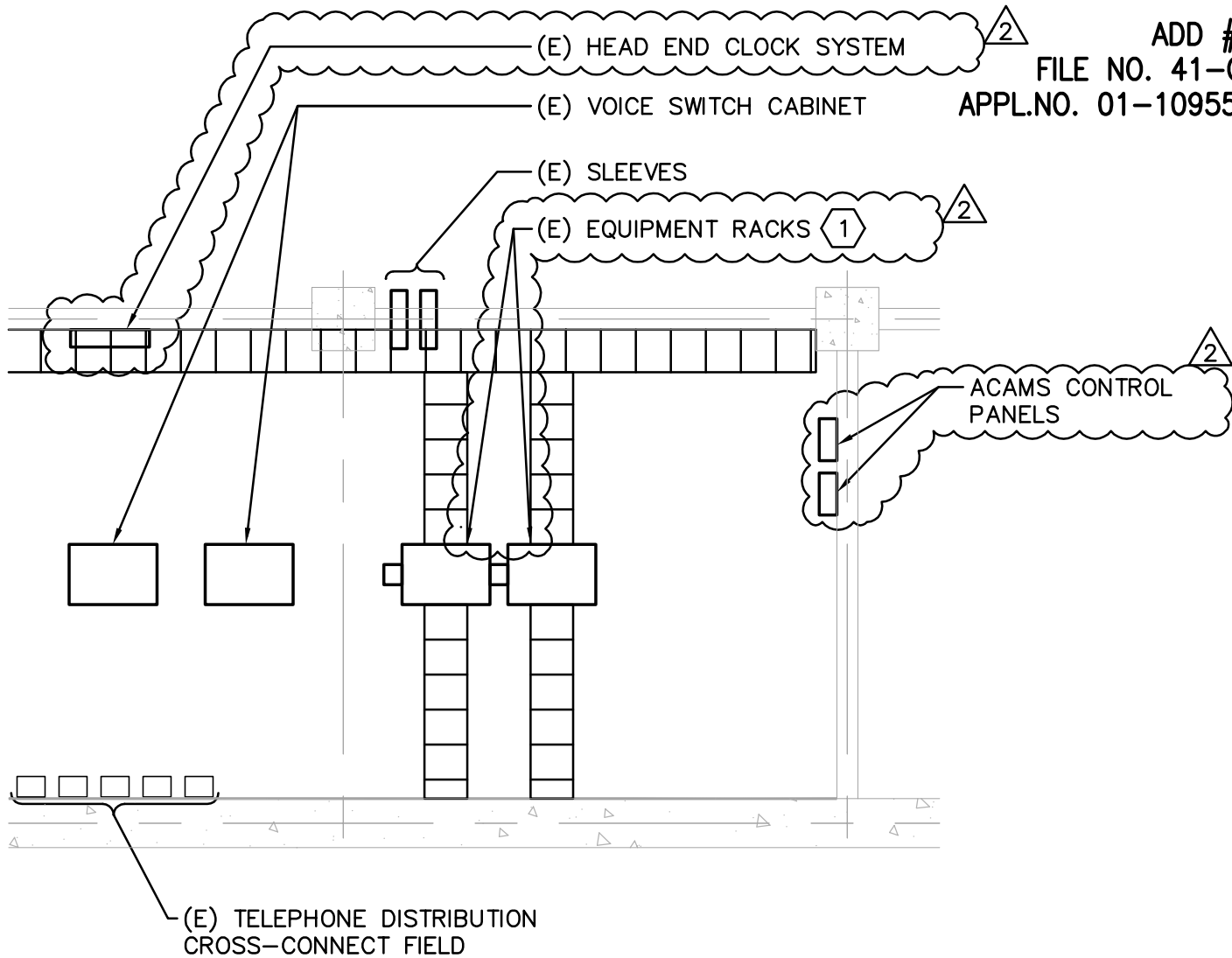
Date
 06/12/08

Scale
 AS NOTED

Project Number
 07014

Drawing Number

AD2-E16



ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



3 ENLARGED MDF FLOOR PLAN

0 2' 4' 8'



SCALE: 1/4"=1'-0"



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214 GRANT AVE., SUITE 430, SAN FRANCISCO, CA 94108
 PHONE 415-489-7240 FAX 415-489-7289

Title: E4.1 1ST AND 2ND
 FLOOR PLAN - SIGNAL

Revision:

ASI No.:-

2

Project Name:

CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION

4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Date
 06/12/08

Scale
 AS NOTED

Project Number
 07014

Drawing Number

AD2-E17

SHEET KEYNOTES

- ① DISCONNECT AND REMOVE EXISTING PANEL 'GL1A' AND ASSOCIATED FEEDER COMPLETE BACK FROM SOURCE.
- ② PROVIDE 225A CIRCUIT BREAKER IN EXISTING SPACE OF 'MCC-F3A' TO SERVE NEW DISTRIBUTION PANEL '8DP'. CIRCUIT BREAKER SHALL MATCH EXISTING IN MANUFACTURER TYPE AND AIC RATING.

②

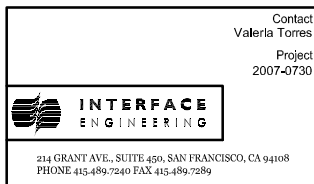
- ⑦ PROVIDE INTERFACE FROM LIGHTING CONTROL PANEL TO BUILDING MANAGEMENT SYSTEM.
- ⑧ INTERCEPT AND EXTEND EXISTING UPS FEEDER TO NEW PANEL '8DP.' PROVIDE NEW CIRCUIT BREAKER TO MATCH EXISTING CIRCUIT BREAKER IN AMP RATING.
- ⑨ MINIMUM SHORT CIRCUIT RATING OF NEW DISTRIBUTION PANELBOARD AND BRANCH CIRCUIT PANELBOARDS IS SHOWN ON DRAWINGS. FINAL RATING OF PANELS SHALL BE BASED SHORT CIRCUIT STUDY TO BE PERFORMED BY THE CONTRACTOR. PROVIDE A COMPLETE SHORT CIRCUIT STUDY FOR ALL NEW EQUIPMENT.
- ⑩ INTERCEPT AND EXTEND CIRCUIT FOR EXTERIOR POLE LIGHTING TO NEW PANEL '8H1.' PROVIDE NEW CIRCUIT BREAKER TO MATCH EXISTING IN AMP RATING.

SCALE: NONE

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Title: E5.1 SINGLE LINE
DIAGRAM, AND PANEL
SCHEDULES

Project Name:

CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION
4200 Farm Hill Blvd.
Redwood City, CA 94061
FILE NO. 41-C1 APPL. 01-109554

Revision:

Date
06/12/08

Scale
AS NOTED

Project Number
07014

ASI No.:-

2

Drawing Number

AD2-E18

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554

PANEL '8H'			PANEL SCHEDULE					PROJECT: 2007-0730 CANADA BLDG 8				
277/480V, 3Ph, 4W.			100A Bus		M.L.O.	SURFACE MOUNTED		LTG & APPLIANCE BRANCH PANELBOARD			10-Jun-08	
Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp/Pole	Notes	Ph.	Notes	C.B. Amp/Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	(E) LTG - 2ND FLOOR (ESTIMATED)	2,500	L	20/1		A		20/1	500	G	LCP	2
3	(E) LTG - 2ND FLOOR (ESTIMATED)	2,500	L	20/1		B		20/1	497	L	LTG - EGRESS_NL	4
5	LTG - OFFICES,CONF. RMS,KITCHEN	2,586	L	20/1		C		20/2	1,500	L	(E)POLE LIGHTING (10)	6
7	LTG - CORR., MECH. RM, FLEX SPACE	2,042	L	20/1		A		"	1,500	L	"	8
9	LTG - 2ND FLR RESTROOM OFFICE	306	L	"		"		"	"	"	"	"
17	SPARE			20/1		C		20/1			SPARE	18
19	SPARE			20/1		A		20/1			SPARE	20
21	SPARE			20/1		B		20/1			SPARE	22
23	SPARE			20/1		C		20/1			SPARE	24
Total Connected Load:Ph A		6,542VA		24A				Short circuit rating: 14KAIC				
Total Connected Load:Ph B		3,303VA		12A								
Total Connected Load:Ph C		4,086VA		15A								
"Maximum" Phase Connected Load: Ph A		6,542VA										
Total Connected Load (3 X Maximum)		19.6KVA		23.6 AMP				Total Demand Load:		17.3KVA	20.8 AMP	

PANEL '8L1			PANEL SCHEDULE					PROJECT: 2007-0730 CANADA BLDG 8				
120/208V, 3Ph, 4W.			225A Bus		150A M.C.B.	SURFACE MOUNTED		LTG & APPLIANCE BRANCH PANELBOARD			10-Jun-08	
Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp/Pole	Notes	Ph.	Notes	C.B. Amp/Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	R -RM. 8109 TO 8112	1,080	R	20/1		A		20/1	900	R	R - FLEX SPACE	2
3	R -RM. 8110 TO 8112	1,080	R	20/1		B		20/1	900	R	R - RM. 8119, 8109	4
5	R -RM. 8110 TO 8112, CORR.	1,080	R	20/1		C		20/1	900	R	R - RM. 8119	6
7	R - RM. 8118 COUNTERTOP	360	R	20/1		A		20/1	720	R	R - RM. 8118	8
9	R - RM. 8118 COUNTERTOP/CONV.	540	R	20/1		B		20/1	900	R	R - RM. 8118,8115	10
11	R - RM. 8118 REF	500	K	20/1		C		20/1	720	R	R - RM. 8115	12
13	R - RM. 8114	540	R	20/1		A		20/1	360	R	R - ACAMS	14
15	SMART BOARD RM. 8119	1,000	G	20/1		B		20/1	360	R	R - ACAMS	16
17	SMART BOARD RM. 8110	1,000	G	20/1		C		20/1	360	R	R-ROOF	18
19	RANGE HOOD	500	K	20/1		A		20/1	360	R	R-TEL/DATA 8212	20
21	GARBAGE DISPOSAL	1,000	K	20/1		B		20/1	540	R	R-RM. 8211	22
23	TCP	500	G	20/1		C		20/1	120	R	R-RM. 8211, 8214	24
25	TCP	500	G	20/1		A		20/1			SPARE	26
27	DDC CONTROLLERS	500	G	20/1		B		20/1			SPARE	28
29	SPARE			20/1		C		20/1			SPARE	30
31	SPARE			20/1		A		20/1			SPARE	32
33	ELECTRIC RANGE	4,000	K	50/3		B		20/1			SPARE	34
35	---	4,000	K			C		20/1			SPARE	36
37	PANEL 8L2 - (E) LOADS (ESTIMATED)	3,600	G	70/3		A		20/1	696	M	EF-1	38
39	---	3,600	G			B		20/1	696	M	EF-2	40
41	---	3,600	G			C						42
Total Connected Load:Ph A		9,616VA		80A				Short circuit rating: 10KAIC				
Total Connected Load:Ph B		15,116VA		126A								
Total Connected Load:Ph C		12,780VA		107A								
"Maximum" Phase Connected Load: Ph B		15,116VA										
Total Connected Load (3 X Maximum)		45.3KVA		126.0 AMP				Total Demand Load:		36.6KVA	101.7 AMP	

SCALE: NONE



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Contact
 Valeria Torres
 Project
 2007-0730

INTERFACE
 ENGINEERING

214 GRANT AVE., SUITE 450, SAN FRANCISCO, CA 94108
 PHONE 415-489-7240 FAX 415-489-7289

Title: E5.1 SINGLE LINE
 DIAGRAM, AND PANEL
 SCHEDULES

Project Name:
CAÑADA COLLEGE
BLDG 8 PHASE 2 RENOVATION
 4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Revision:

ASI No.:-

2

Date
 06/12/08

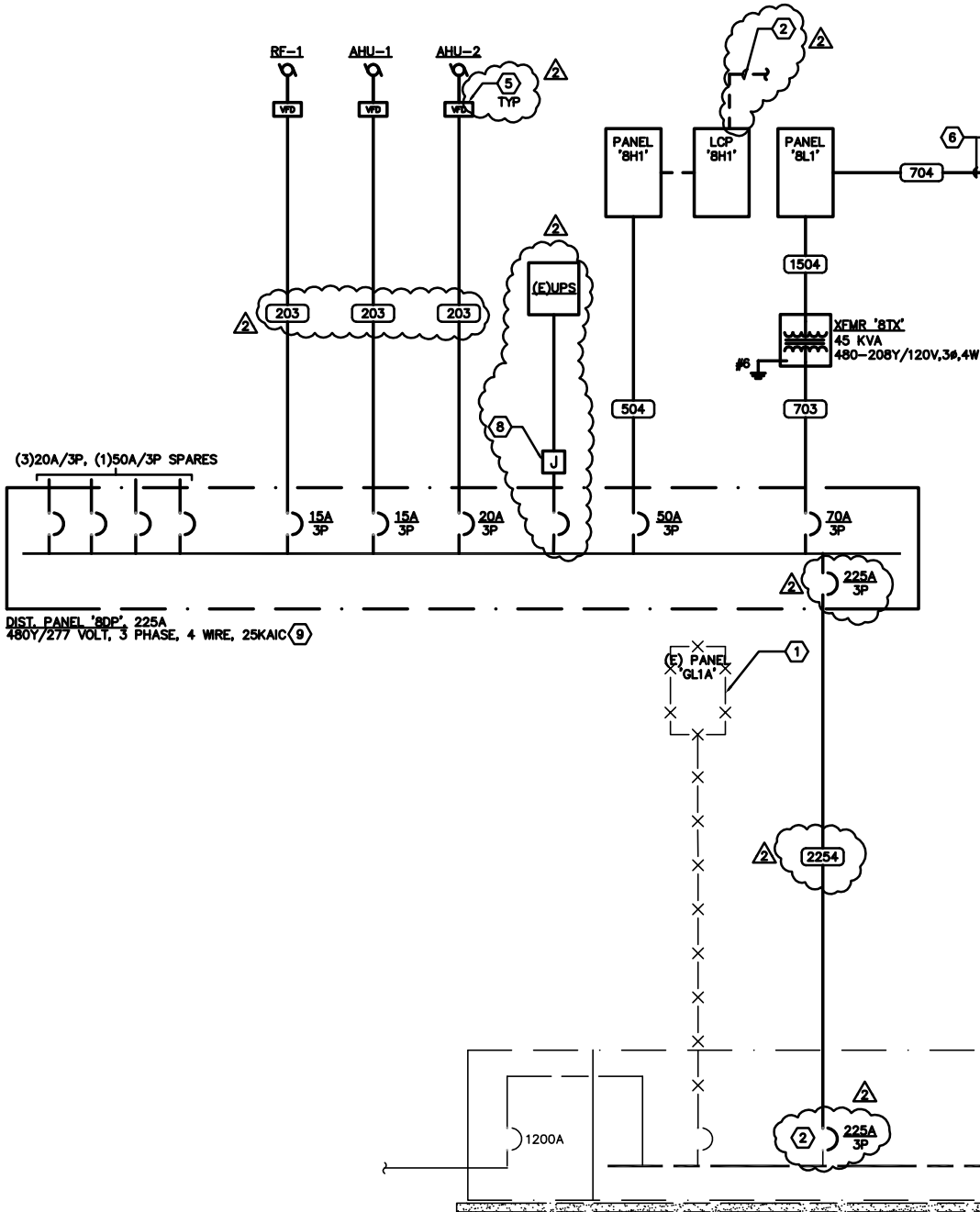
Drawing Number

Scale
 AS NOTED

AD2-E19

Project Number
 07014

ADD #2
 FILE NO. 41-C1
 APPL.NO. 01-109554



1 SINGLE LINE DIAGRAM
 NO SCALE



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 Project
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Title: E5.1 SINGLE LINE
 DIAGRAM, AND PANEL
 SCHEDULES

Project Name:
**CAÑADA COLLEGE
 BLDG 8 PHASE 2 RENOVATION**
 4200 Farm Hill Blvd.
 Redwood City, CA 94061
 FILE NO. 41-C1 APPL. 01-109554

Revision:

ASI No.:-

2

Date
 06/12/08

Drawing Number

Scale
 AS NOTED

AD2-E20

Project Number
 07014



4404396889

SUBSTITUTION REQUEST FORM

ATTN: **Paul Bunton / Jennifer James**
 FIRM: **Bunton Clifford Associates / Swinerton**
 ADDRESS: 210 Hammond Ave.
 Fremont, CA 94539-7465
 PROJECT: **Canada College - Bldg. 8 - Phase 2**
 LOCATION: Redwood City, CA

BID DATE: 6/17/08
 SPECIFICATION SECTION: 12 48 13
 PROPOSED SUBSTITUTE: **KDCM Aluminum Rollout Mat**

Attach complete catalog, spec data, and lab tests (if applicable).

1. What effect will substitution have on dimensions, gauges, etc., indicated in Contract Documents? **None**
2. What effect will substitution have on piping, ductwork, etc., indicated in Contract Documents? **None**
3. What effect will the substitution have on other trades? **None**
4. What effect will substitution have on the construction schedule? **None**
5. What are differences in quality/performance between proposed substitute and specified product? **None**
6. Manufacturer's Guarantees of the specified products and proposed products are:
 Same: Different (explain): _____
7. List availability of:
 Maintenance Services: **None**
 Replacement Materials: **Available Upon Request**
8. If the substitution request is accepted, it will result in: **A possible cost savings**
9. There are ___ are no license fees and royalties pending on the proposed substitute.

SUBMITTED BY: **KADEE Industries** on the web @ www.KadeeIndustries.com
 7160 Krick Rd., Walton Hills, Ohio, 44146
 Telephone: (800) 321-3827 Fax:(440) 439-6889

Signature: **Jim Moore** Date: 06/03/08
 Jim Moore

ARCHITECT'S/ENGINEER'S REVIEW COMMENTS:

- Accepted Received Too Late
 Accepted as Noted Not Accepted
 Rejected Due to Incomplete Information. Resubmit.

Signature: *J. Swinerton* Date: 06/11/08
 Remarks: ADDED TO SPEC 12 48 13

Mat Clean Tread™

4404396889

MODELS KDCM & KDVM

HIGH QUALITY, LOW COST ALUMINUM ROLL-OUT ENTRANCE MAT SYSTEMS

ALUMINUM ROLL-OUT MAT WITH CARPET OR VINYL INSERTS

Applications

ENTRANCE MATS:

- SHALLOW RECESS WITH FRAME
- SURFACE MOUNTED WITH VINYL RAMPS
- SURFACE MOUNTED W/SQUARE NOSING

Specifications

■ **Section 12484**

Furnish and install KDCM or KDVM Aluminum Roll-Out Mat as manufactured by Kadee Industries, Cleveland, Ohio. (800) 321-3827.

■ **Construction**

Tread Surface Carpet or vinyl inserted treads, spaced on 1-1/2" centers.

Tread Rails Mill-finished extruded aluminum with optional drainage holes.

Framing 6063-T5 extruded aluminum. Optional tapered vinyl ramps, for surface mounted units, are attached to first and last panels of each mat. Filler strips are available to adapt mat dimensions to existing recessed areas.

Finishes Standard mill. Anodized finishes available upon request.

■ **Carpet**

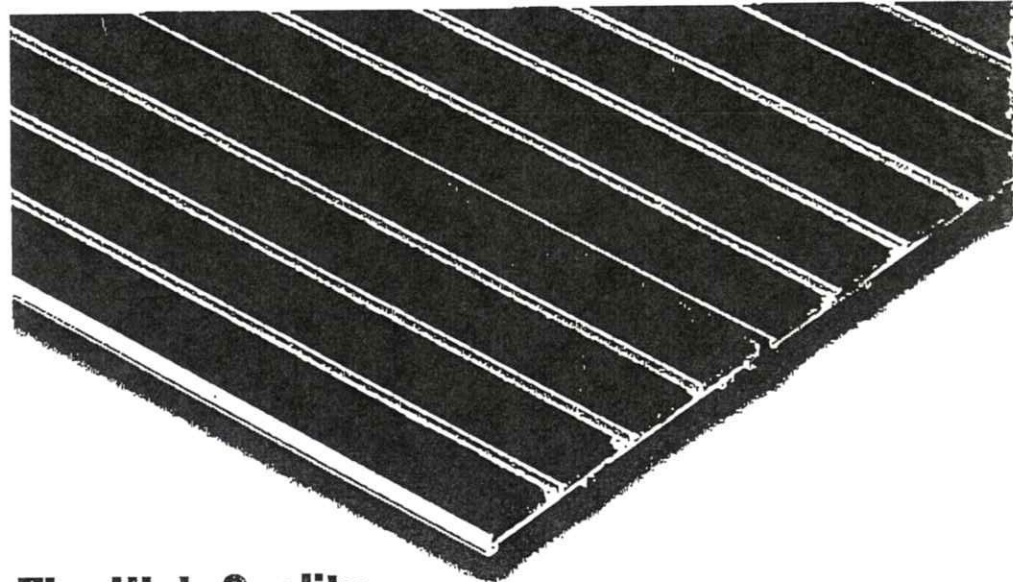
Regular duty: 100% nylon fibers;
Heavy duty: 100% polypropylene fibers.

■ **Vinyl**

Serrated, nonslip surface with a convex design for improved drainage.

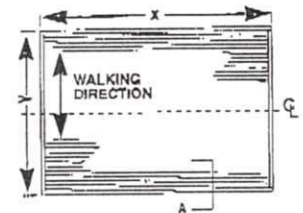
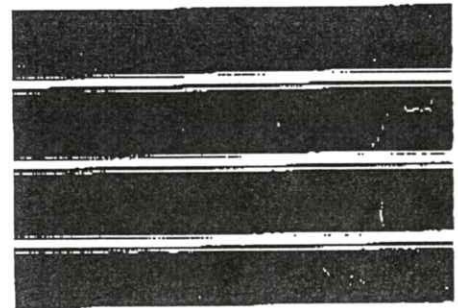
■ **Warranty**

2 years - details on back cover.



The High Quality, low cost alternative

- Reduces tracked-in dirt, slush, and mud.
- Ball and socket hinge design means easy roll-up for cleaning.
- 100% nylon carpet inserts closely spaced to prevent crutch tips and canes from catching.
- Vinyl hinges eliminate metal-to-metal rattle and corrosion lockup.
- Custom designs available to fit almost any application.



KDCM Alum Roll-Out Mat with Alum Subframe, carpet inserts

