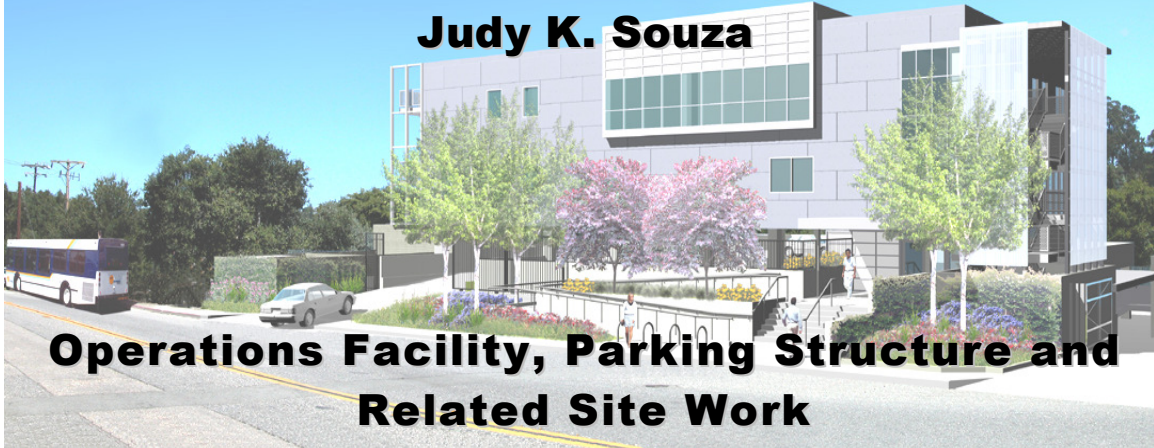


# **SANTA CRUZ METROPOLITAN TRANSIT DISTRICT**

## **Invitation for Bids (IFB) for Construction of the Judy K. Souza**



## **Operations Facility, Parking Structure and Related Site Work**

**Santa Cruz METRO IFB No. 12-23**

**Date Issued: June 29, 2012**

**Bid Deadline: 2:00 p.m., August 23, 2012**



### **Contents of this IFB**

1. Volume 1: Bidding and Contracting Requirements
  - Part I. Instructions to Bidders
  - Part II. Bid Form
  - Part III. General Conditions of the Contract
  - Part IV. Special Conditions of the Contract
  - Part V. Contract
  - Part VI. FTA Requirements for Construction Contracts
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2. Volume 2: Construction Specifications Divisions 1 - 9
3. Volume 3: Construction Specifications Divisions 10 - 16
4. Construction Drawings

## **Volume 3 of 3 Construction Specifications Divisions 10 - 16**



**DOCUMENT 00005**

**CERTIFICATIONS PAGE**

Santa Cruz Metropolitan Transit District  
Metrobase Project, Operations Building

Volume 3 of 3: Introductory Information, Divisions 10 through 16

We hereby certify that these Contract Documents have been prepared by us or under our direct supervision in accordance with the rules and regulations governing the Architects and Engineers practicing in the State of California.

**Architect**

RNL Design  
333 South Grand Ave; Suite. 1480  
Los Angeles, CA 90017

**Mechanical Engineer**

Jacobs  
Frank H. Ogawa Plaza; Ste. 10  
Oakland, CA 94612

**Electrical Engineer**

Jacobs  
Frank H. Ogawa Plaza; Ste. 10  
Oakland, CA 94612



**DOCUMENT 00006**

**PROJECT DIRECTORY**

Santa Cruz Metropolitan Transit District  
Metrobase Project, Operations Building

<b>Owner</b>		
Santa Cruz METRO 110 Vernon Street Santa Cruz, CA 95060	Les White <a href="mailto:lwhite@scmttd.com">lwhite@scmttd.com</a> Frank Cheng <a href="mailto:fcheng@scmttd.com">fcheng@scmttd.com</a>	831-426-6080 Fax 831-426-6117
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<b>Landscape Architect</b>		
Joni L. Janecki & Associates 515 Swift Street Santa Cruz, CA 95060	Joni Janecki <a href="mailto:jlj@jlja.com">jlj@jlja.com</a> Nicole Steel <a href="mailto:njs@jlja.com">njs@jlja.com</a>	831-423-6040 Fax 831-423-6054
<b>Structural Engineer</b>		
Mesiti-Miller Engineering 224 Walnut Avenue; Ste.B Santa Cruz, CA 95060	Mark Mesiti-Miller <a href="mailto:mark@mme.com">mark@mme.com</a> Dale Hendsbee <a href="mailto:dale@m-me.com">dale@m-me.com</a>	831-426-3186 Fax 831-426-6607
<b>Security / Data Consultant</b>		
TEECOM 1333 Broadway; Ste. 601 Oakland, CA 94612-1906	Scott Anderson <a href="mailto:scott.anderson@teecom.com">scott.anderson@teecom.com</a>	510-337-2800 Fax 510-337-2804
<b>Mechanical Engineer</b>		
Jacobs Frank H. Ogawa Plaza; Ste. 10 Oakland, CA 94612	Darin Stuart <a href="mailto:darin.stuart@jacobs.com">darin.stuart@jacobs.com</a>	510-457-0027 Fax 510-457-0037
<b>Electrical Engineer</b>		
Jacobs Frank H. Ogawa Plaza; Ste. 10 Oakland, CA 94612	Darin Stuart <a href="mailto:stuarddl@c-b.com">stuarddl@c-b.com</a>	510-457-0027 Fax 510-457-0037
<b>Geotechnical Consultant</b>		
Cotton Shires & Associates 330 Village Lane Los Gatos, CA 95030-7218	Pat Shires David Schrier <a href="mailto:dschrier@conttonshires.com">dschrier@conttonshires.com</a>	408-354-5542 Fax 408-354-1852

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Metrobase Project, Operations Building

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**SECTION 10101**  
**MARKERBOARDS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. This Section includes markerboards.

**1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of marker board surface indicated and as follows:
  - 1. Samples of accessories involving color selection.
- D. Maintenance Data: For marker boards to include in maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

**1.04 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of marker board through one source from a single manufacturer.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory-built marker boards, including factory-applied trim where indicated, completely assembled in one piece.
- B. Store marker board units vertically with packing materials between each unit.

**1.06 WARRANTY**

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.

- b. Surfaces become slick or shiny.
  - c. Surfaces exhibit crazing, cracking, or flaking.
2. Warranty Period: 50 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
  - 1. Color: White.
  - 2. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
- B. Hardboard: AHA A135.4, tempered.
- C. Particleboard: ANSI A208.1, Grade 1-M-1, made with binder containing no urea formaldehyde.
- D. Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.

### 2.02 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboard Assembly: Balanced, high-pressure, factory-laminated markerboard assembly of 3-ply construction consisting of backing sheet, core material, and minimum 0.013 inch thick, porcelain-enamel face sheet with low-gloss finish.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AARCO Products, Inc.
    - b. ADP/Lemco, Inc.
    - c. Best-Rite Manufacturing.
    - d. Claridge Products & Equipment, Inc.
    - e. Ghent Manufacturing Inc.
    - f. Marsh Industries, Inc.
    - g. PolyVision Corporation.
  - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
  - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
  - 4. Width: As indicated on Drawings.
  - 5. Height: As indicated on Drawings.

## 2.03 MARKERBOARD ACCESSORIES

- A. Aluminum Frames: Fabricated from not less than 0.062 inch thick, extruded aluminum; of size and shape indicated.
  - 1. Factory-Applied Trim: Manufacturer's standard baked-enamel or powder-coat finish.
  - 2. Color: As selected by Architect from full range of industry colors and color densities.
- B. Chalktray: Manufacturer's standard, continuous, solid type, extruded aluminum with ribbed section and smoothly curved exposed ends.
- C. Map Rail: Provide the following accessories:
  - 1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
  - 2. End Stops: Located at each end of map rail.
  - 3. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

## 2.04 FABRICATION

- A. Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Factory assemble marker boards. Frames and accessories shall be assembled and attached to marker units at manufacturer's factory before shipment.
- C. Aluminum Frames and Accessories: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to neat, hairline closure.

## 2.05 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
  - 1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils , medium gloss.
- D. Powder-Coat Finish: Apply manufacturer's standard baked finish, complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.
- B. Examine walls and partitions for proper backing for marker boards.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of marker boards.

### 3.03 INSTALLATION

- A. General: Install marker boards on walls in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Attach marker boards using concealed clips, hangers, and grounds to wall surfaces and to marker boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

### 3.04 CLEANING AND PROTECTION

- A. Clean marker boards according to manufacturer's written instructions. Attach one cleaning label to marker board surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect marker boards after installation and cleaning.

END OF SECTION 10101



## SECTION 10160

### METAL TOILET COMPARTMENTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes baked-enamel overhead braced toilet enclosures.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry" for blocking.
  - 2. Division 10 Section "Toilet Accessories - Commercial" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of cutouts for compartment-mounted toilet accessories.
  - 2. Show locations of reinforcements for compartment-mounted grab bars.
- C. Samples for Initial Selection: For each type of unit indicated.
- D. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

##### 1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.01 METAL UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Accurate Partitions Corporation.
  2. All American Metal Corp.
  3. Bradley Corporation; Mills Partitions.
  4. General Partitions Mfg. Corp.
  5. Hadrian Inc.
  6. Knickerbocker Partitions Corp.
- B. Baked-Enamel Units: Facing sheets and closures fabricated from ASTM A 591/A 591M, 80Z (electrolytically zinc-coated), commercial steel sheet for exposed applications, that is mill phosphatized, and selected for smoothness.
1. Facing Sheet Thicknesses: Minimum base-metal (uncoated) thicknesses as follows:
    - a. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.0329 inch.
    - b. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.0438 inch.
    - c. Panels: Manufacturer's standard thickness, but not less than 0.0329 inch.
    - d. Doors: Manufacturer's standard thickness, but not less than 0.0269 inch.
    - e. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.0269 inch.
    - f. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than 0.0329 inch.
  2. Finish: Manufacturer's standard pigmented, organic coating, including thermosetting, electrostatically applied, and powder coatings. Provide coating system that complies with coating manufacturer's written instructions for pretreatment, application, baking, and minimum dry film thickness.
    - a. Color: One color in each room as selected by Architect from manufacturer's full range of colors.
- C. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets are pressure laminated to core material. Units have continuous, interlocking molding strip or lapped and formed edge closures. Exposed surfaces are free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections. Corners are sealed by welding or clips. Exposed welds are ground smooth.
1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.

2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
  3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- D. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304, not less than 0.0312 inch specified thickness and 3 inches high, finished to match hardware.
- E. Stirrup Type Brackets (Fittings): Ear or U-brackets, chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.

## 2.02 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

## 2.03 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be accessible to people with disabilities.
1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
  3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
  4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.

5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  2. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

### 3.02 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10160

## SECTION 10440

### INTERIOR BUILDING SIGNAGE

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Unframed panel signs, with embossed face, for interior applications.
  - 2. Signage accessories.
  - 3. Signage Schedule.
- B. Related Sections include the following:
  - 1. Division 1 Section "Temporary Facilities and Controls" for temporary project identification signs.
  - 2. Division 15 Sections for labels, tags, and nameplates for mechanical equipment.
  - 3. Division 16 Sections including for labels, tags, and nameplates for electrical equipment.
  - 4. Division 16 Section "Interior Lighting" for illuminated exit signs.

##### 1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
  - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
- C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
- D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
  - 1. Panel Signs: Full-size Samples of each type of sign required.
  - 2. Approved samples will not be returned for installation into Project.
- E. Qualification Data: For Installer.
- F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

## 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by signage manufacturer.
- B. Source Limitations: Obtain each sign type through one source from a single manufacturer.
- C. Regulatory Requirements For Accessibility: In addition to requirements of authorities having jurisdiction, provide installed signage that complies with the more restrictive of U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and CalDAG 2000 California Disabled Accessibility Guidebook.
  - 1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to signage indicated on Schedule at end of Part 3.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
- D. Handle products in accordance with manufacturer's instructions.

## 1.06 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS AND PRODUCTS

- A. Basis-of-Design Product: Subject to compliance with the requirements provide ASI Sign Systems; ASI EmBoss ADA Ready Sign System or a comparable product of one of, but not limited to, the following:
  - 1. Innerface Sign Systems, Inc.
  - 2. Mohawk Sign Systems.
  - 3. Signature Signs, Inc.
  - 4. Supersine Company (The).

### 2.02 PANEL SIGN MATERIALS

- A. Mounting Panel: Acrylic.

- B. Face: Vacuum formed 1.5 mil, clear, scratch resistant PVC/vinyl acetate bonded to acrylic mounting panel.

## 2.03 FABRICATION, GENERAL

- A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.
- C. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
- D. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.
- E. Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
- F. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
- G. Graphic Content and Style: Provide sign copy that complies with requirements indicated in the Signage Schedule and on Drawings for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

## 2.04 FABRICATION

- A. Tactile Graphics and Text:
  - 1. Fabrication process: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's vacuum formed embossing process.
  - 2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.
- B. Mounting Panel: 0.080 inch thick minimum, matte finished acrylic.
- C. Background Appearance: Solid colors as select by Architect from manufacturer's standard range.
- D. Tactile Lettering and Graphics Color: As selected by Architect from 3M standard vinyl colors.
- E. Overall Panel Size: See Signage Schedule at end of Section.
- F. Shape: See Signage Schedule at end of Section.

- G. Letter Style, Colors, Letter Sizes and Layout Position: See Signage Schedule at end of Section and ,if not indicated, as selected by Architect from manufacturer's standard letter styles and color charts.
- H. Text schedule: See Signage Schedule at end of Section.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Install product at heights to comply with Part 1 Article "Quality Assurance."
- C. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using one of following methods approved by Architect:
  - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  - 2. Hook-and-Loop Tapes: Use hook-and-loop tapes to mount signs to smooth, nonporous surfaces.
  - 3. Magnetic Tape: Use magnetic tape to mount signs to smooth, nonporous surfaces.
  - 4. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.



5. Shim Plate Mounting:

- a. Application: For mounting to irregular and rough surfaces.
- b. Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.

6. Where panel signs are mounted on glass, provide matching plate on opposite side of glass to conceal mounting materials.

3.03 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

(See Sign Schedule next page)

### 3.04 SIGN SCHEDULE

Sign Type/Location	Location/Mounting	Message	Size	Letters/Braille	Color	Remarks
Building Entrance	Approximately 5 feet above entrance landing immediately adjacent to door on strike side; in a position that is readily visible when the door is in either the open or closed position.	Pictogram [[International Symbol of Accessibility]]	6- by 6-inch minimum	6- by 6-inch Pictogram	Pictogram on contrasting background	Comply with CalDAG Chapter 7, Articles 23 and 58.
Toilet Rooms Doors	On door, centered 60-inch from the floor.	Pictogram [[International Symbol of Accessibility]] with either of the following placed directly below: MEN'S TOILET ROOM or WOMEN'S TOILET ROOM or UNISEX TOILET ROOM	Men's: Equilateral triangle 1/4-inches thick with edges 12-inches long and vertex pointing upward. Women's: 12-inch diameter circle 1/4-inch thick. Unisex: 12-inch diameter circle 1/4-inch thick with 1/4-inch triangle superimposed within circle.	Pictogram and letters sized to fit.	Pictogram and letters on contrasting background	Comply with CalDAG Chapter 7, Articles 42 and 58.

Sign Type/Location	Location/Mounting	Message	Size	Letters/Braille	Color	Remarks
Permanent Rooms and Spaces	Centered 60-inches from the floor, on wall adjacent to door on strike side.	[Sign shall identify room number]	No less than 18 square inches area.	5/8-inch minimum, 2-inches maximum height, Arabic (sans serif block) letters and numerals with corresponding Grade II Braille	Letters on contrasting background	Comply with CalDAG Chapter 7, Article 58.
Exit Doors using key locking hardware in lieu of exit devices.	Mount on locking side of door.	THIS DOOR MUST REMAIN UNLOCKED DURING BUSINESS HOURS		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC
Fire Doors, one-hour fire protection rating or greater	Mount on both sides of door.	FIRE DOOR - KEEP CLOSED - DO NOT OBSTRUCT		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC
Stairway Identification	Approximately 5 feet above floor landing immediately adjacent to door on strike side; in a position that is readily visible when the door is in either the open or closed position.	[signs shall identify the stairway location, indicate whether or not there is roof access, the floor level, and the upper and lower terminus of the stairway]	12- by 12-inches minimum	1-inch high minimum Arabic (sans serif block) letters and numerals with corresponding Grade II Braille	Letters on contrasting background	Comply with CalDAG Chapter 7, Articles 22 and 58; and UBC.
Emergency Shutoff Valves for flammable fuels	Mount at each shutoff valve	[insert type of fuel] SHUTOFF VALVE		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC
No Smoking (See Notes 2 & 3)	Mount at each door into space. Provide one additional sign for each 500 SF of floor area in space.	NO SMOKING		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC

Sign Type/Location	Location/Mounting	Message	Size	Letters/Braille	Color	Remarks
Floor Loading	Mount at each floor level of freight elevator lobby	SQUARE FOOT LIVE LOADS FOR THIS FLOOR OR AREA SHALL NOT EXCEED [insert design live load]		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC
Room Capacity	Locate at any room used for assembly purpose. Mount at each exit doorway.	ROOM CAPACITY - [insert number] OCCUPANTS		1-inch high minimum block letters	Letters on contrasting background	Comply with UBC
<p>Notes:</p> <ol style="list-style-type: none"> <li>1. Final message content, letter height, color and location shall be confirmed by Architect and Authorities having jurisdiction. Table indicates general requirements; see references cited for detailed requirements.</li> <li>2. Caution sign at areas containing or dispensing flammable gasses or liquids.</li> <li>3. Caution sign at storage areas.</li> </ol>						

END OF SECTION 10440

## **SECTION 10505**

### **METAL LOCKERS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SUMMARY**

- A. This Section includes single tier wardrobe lockers.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and base.

##### **1.03 SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
  - 1. Show locker fillers, trim, base, sloping tops, and accessories. Include locker-numbering sequence.
- C. Samples for Verification: For metal lockers, in manufacturer's standard sizes.
- D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 1.

##### **1.04 QUALITY ASSURANCE**

- A. Source Limitations: Obtain locker units and accessories through one source from a single manufacturer.

##### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 366, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- D. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.
  - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on units anchored to concrete floors for corrosion resistance.

### 2.02 WARDROBE LOCKERS

- A. Basis of Design Manufacturer and Product: Subject to compliance with the requirements provide Penco Products, Inc.; Subsidiary of Vesper Corporation; Standard Guardian Lockers or a comparable product by one of the following:
  - 1. Art Metal Products.
  - 2. Debourgh Mfg. Co.
  - 3. List Industries, Inc.
  - 4. Republic Storage Systems Co.
  - 5. Tennsco.
  - 6. Hadrian Locker.
- B. Size: Each single tier locker unit shall measure depth and width indicated on Drawings by 72 inches high, for mounting on base structure.
- C. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners. Comply with the following:
  - 1. Back-Material Sheet Thickness: 0.0239 inch (24 gage).
  - 2. Side-Material Sheet Thickness: 0.0239 inch.
  - 3. Exposed Ends: Form exposed ends of nonrecessed lockers from minimum 0.0598-inch- thick (16 gage) steel sheet.
- D. Frames: Form channel frames from minimum 0.0598-inch- thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.
  - 1. Latch Hooks: Form from minimum 0.1046-inch- thick steel; welded or riveted to door frames.
  - 2. Cross Frames: Form intermediate channel cross frames between tiers from minimum 0.0598-inch- thick steel sheet. Weld to vertical frame members.
- E. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:

1. Sheet Thickness: 0.0598 inch (16 gage) minimum.
  2. Reinforcing and Sound-Dampening Panels: Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.
  3. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
  4. Louvered Vents: Stamped, louvered vents in door face, as follows:
- F. Hinges: Steel, full loop, five or seven knuckle; tight pin; minimum 2 inches high. Weld to inside of door frame and attach to door with at least two factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
1. Provide at least three hinges for each door.
- G. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.
1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic and prelocking.
  2. Latch Hooks: Equip doors with 3 latch hooks; fabricated from minimum 0.0966-inch-thick steel; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
  3. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- H. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
1. Bolt Operation: Automatically locking spring bolt.

## 2.03 LOCKER ACCESSORIES

- A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
1. Hooks and Shelves: Provide not fewer than the following number of single-prong hooks, manufacturer's standard zinc-plated, ball-pointed steel. Attach hooks with at least two fasteners.
    - a. Single-Tier Units: Shelf, one double-prong ceiling hook, and three single-prong wall hooks.
- B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch high. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
1. Number lockers in the following sequence: The first number shall begin on the left-most upper locker in the room, the second number shall be on the locker

beneath it, the third number shall be on the next upper locker to the right, the fourth on the next lower locker on the right and so on. The last number shall be on the lower right locker in the room.

- C. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- thick steel sheet in an unequal leg angle shape, and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- D. Boxed End Panels: Manufacturer's standard; fabricated from minimum 0.0598-inch-thick steel sheet, with 1-inch- wide edge dimension, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers.
- E. Continuous Sloping: Fabricated from cold-rolled steel sheet, manufacturer's standard thickness, but not less than 0.0329 inch thick.
  - 1. Closures: Vertical end type

## 2.04 FABRICATION

- A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.
- B. Knocked-Down Construction: Fabricate lockers for nominal assembly at Project site.
- C. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.
  - 1. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.
- D. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.

## 2.05 FINISHES, GENERAL

- A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.06 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.



- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils on doors, frames, and legs, and 1.1 mils elsewhere.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full line of paint colors:

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.
- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.
- C. Anchor lockers to base and walls at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.
- D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
  - 1. Attach recess trim to recessed lockers with concealed clips.
  - 2. Attach sloping top units to lockers, with closures at exposed ends.
- E. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed lockers.

### 3.02 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Clean interior and exposed exterior surfaces and polish nonferrous-metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10505



## SECTION 10520

### FIRE EXTINGUISHERS AND BRACKETS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following where FEB is designated on the Drawings:
  - 1. Portable fire extinguishers.
  - 2. Mounting brackets for fire extinguishers.
- B. Related Sections:
  - 1. Section 10521 "Portable Fire Extinguisher Cabinets."

##### 1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles.
  - 1. Fire Extinguishers: Include rating and classification.
- B. Maintenance Data: For fire extinguishers to include in maintenance manuals.

##### 1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and brackets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

##### 1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.

- b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 PORTABLE FIRE EXTINGUISHERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. JL Industries, Inc.
  - 2. Larsen's Manufacturing Company.
  - 3. Potter Roemer; Div. of Smith Industries, Inc.
  - 4. Watrous; Div. of American Specialties, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Valves: Manufacturer's standard.
  - 2. Handles and Levers: Manufacturer's standard.
  - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- C. Multipurpose Dry-Chemical Type: UL-rated, 20-A:120-B:C, 20-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

### 2.02 MOUNTING BRACKETS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers and products that may be incorporated into the Work include, but are not limited to the following:
  - 1. JL Industries, Inc.; Bracket.
  - 2. Larsen's Manufacturing Company; Bracket #846.
  - 3. Potter Roemer; Div. of Smith Industries, Inc.; Bracket #3904
- B. Mounting Brackets: Manufacturer's galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 1. Bracket shall have top and bottom spring steel latching straps.
  - 2. Color: Red.

- C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- C. Identification: Apply decals at locations indicated.

END OF SECTION 10520



## SECTION 10521

### PORTABLE FIRE EXTINGUISHER CABINETS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes non-security fire protection cabinets for portable fire extinguishers as follows:

Drawing Designation	Location	Specification Designation
FEC	Back-of-house areas	FEC-1
FEC	Parking Garage	FEC-2
FEC	Mechanical, Electrical, and utility spaces (See Division 10 Section "Fire Extinguishers And Brackets")	FEC-3

- B. Related Sections:

1. Section 10520 "Fire Extinguishers And Brackets" for extinguishers and mounting brackets for FEC-4.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
1. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Selection and Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Size: 6 by 6 inches square.
- C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated in this Section.
- D. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

## 1.04 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
    - a. Schedules and coordination requirements.

## 1.05 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

### 2.02 FIRE PROTECTION CABINET - FEC-1

- A. Cabinet Type: Suitable for 5 lb. fire extinguisher provided under Division 10 Section "Fire Extinguishers."
  - 1. Basis of Design Product: Subject to compliance with requirements, provide
    - a. J. L. Industries, Inc., a division of Activar Construction Products Group; Ambassador Series
    - b. Or comparable product by one of the following manufacturers:
      - 1) Larsen's Manufacturing Company.
      - 2) Potter Roemer LLC.
      - 3) Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated or fire rated to match rating of wall in which installed:
  - 1. FEC-1N: Nonrated.
  - 2. FEC-1FR1: 1-hour fire rated.
  - 3. FEC-1FR2: 2-hour fire rated.
  - 4. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch-



thick, fire-barrier material. Provide factory-drilled mounting holes.

- C. Cabinet Material: Steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  - 1. Rolled-Edge Trim: Minimum 3-inch backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting door pull.
  - 2. Provide cam lock that allows door to be opened during emergency by pulling sharply on door handle.
  - 3. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
  - 1. Location: Applied to cabinet glazing.
  - 2. Application Process: Silk-screened.
  - 3. Lettering Color: Red.
  - 4. Orientation: Vertical.
- K. Finishes: Manufacturer's standard baked-enamel paint or powder coat for the following:
  - 1. Exterior of cabinet door and trim.
    - a. Color: As selected by Architect from manufacturers standard colors.
  - 2. Interior of cabinet.
    - a. Color: White.

## 2.03 FIRE PROTECTION CABINET - FEC-2

- A. Cabinet Type: Suitable for 5 lb. fire extinguisher provided under Division 10 Section "Fire Extinguishers."
  - 1. Basis of Design Product: Subject to compliance with requirements, provide:
    - a. J. L. Industries, Inc., a division of Activar Construction Products Group; Ambassador Series
    - b. Or comparable product by one of the following manufacturers:
      - 1) Larsen's Manufacturing Company.
      - 2) Potter Roemer LLC.
      - 3) Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Steel sheet.
- D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- E. Door Material: Steel sheet.
- F. Door Style: Vertical duo panel with frame.
- G. Door Glazing: Tempered float glass (clear).
- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting door pull.
  - 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
  - 3. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- I. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
  - 1. Location: Applied to cabinet glazing.
  - 2. Application Process: Silk-screened.
  - 3. Lettering Color: Red.
  - 4. Orientation: Vertical.
- J. Finishes: Manufacturer's standard baked-enamel paint or powder coat for the following:
  - 1. Exterior of cabinet, cabinet door, and trim.
    - a. Color and Gloss: As selected by Architect from manufacturer's standard

colors.

2. Interior of cabinet.
  - a. Color: White.

#### 2.04 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  1. Weld joints and grind smooth.
  2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

#### 2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish fire protection cabinets after assembly.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 2.06 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling." After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

### 3.03 INSTALLATION

- A. General: Install fire protection cabinets in locations and at 54 inches above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

### 3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10521

## SECTION 10550

### POSTAL SPECIALTIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes private postal-facility mail receptacles.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of postal specialty.
- B. Shop Drawings: For postal specialties. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include identification sequence for compartments.
  - 2. Include layout of identification text.
  - 3. Include setting drawings, templates, and installation instructions for anchor bolts and other anchorages installed as part of the work of other Sections.
- C. Samples for Verification: For each type of exposed finish required, prepared on 6-by-6-inch square Samples.
- D. Qualification Data: For qualified Installer.
- E. Maintenance Data: For postal specialties and finishes to include in maintenance manuals.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lock keys to Owner by registered mail or overnight package service with a record of each corresponding lock and key number.
- B. Deliver combination-lock combinations to Owner by registered mail or overnight package service with a record of each corresponding lock and combination.

##### 1.05 COORDINATION

- A. Coordinate layout and installation of postal specialties with wall construction.
- B. Templates: Obtain templates for installing postal specialties and distribute to parties involved.

## 1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## 1.07 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Key Blanks: 50 for every 25 locks or fraction thereof, for each type of compartment-door lock installed.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Aluminum: Manufacturer's standard alloy and temper for type of use and finish indicated, and as follows:
  - 1. Sheet and Plate: ASTM B 209.
  - 2. Extruded Shapes: ASTM B 221.
- B. Steel Sheet: Cold rolled, ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, exposed matte finish where exposed.
- C. Metallic-Coated Steel Sheet: Galvanized-steel sheet, ASTM A 653/A 653M, G60 coating designation, extra smooth where exposed; or electrolytic zinc-coated steel sheet, ASTM A 879/A 879M, Coating Designation 08Z.
- D. Die-Cast Aluminum: ASTM B 85, manufacturer's standard aluminum alloy.
- E. Steel Anchor Bolts, Nuts, and Washers: ASTM F 1554, Grade 36 or 55, hot-dip galvanized.

## 2.02 PRIVATE-DELIVERY HORIZONTAL MAIL RECEPTACLES

- A. Front-Loading, Private-Delivery Horizontal Mail Receptacles: Consisting of multiple compartments with fixed, solid compartment backs, enclosed within recessed wall box. Provide access to compartments for distributing incoming mail from front of unit by unlocking master lock and swinging side-hinged master door to provide accessibility to entire group of compartments. Provide access to each compartment for removing mail by swinging compartment door.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Postal Manufacturing Co.; Division of Postal Products Unlimited, Inc.
    - b. Auth-Florence Manufacturing; a Florence company.
    - c. Bommer Industries, Inc.
    - d. Salsbury Industries.
    - e. Security Manufacturing Corporation.
  2. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; with master-door lock and concealed, full-length, stainless-steel piano hinge on one side. Fabricate master door to remain open while mail is deposited.
    - a. Master-Door Lock: Cylinder lock keyed to building keying system; with three keys. Provide cylinders specified in Division 08 Section "Door Hardware."
  3. Compartments and Doors: Manufacturer's standard compartments with extruded aluminum doors. Equip each with lock, identification, and concealed, full-length, flush hinge on one side. Provide one compartment prepared for master-door lock.
    - a. Compartments: As indicated on Drawings.
    - b. Driver Identification: 2-inch-wide by 5/8-inch high, clear-plastic cardholder set in recessed slot in face of compartment door. Provide cardboard strip and self-adhesive numbers.
  4. Compartment-Door Locks: Verify with Owner.
  5. Frames: Fabricated from extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for Driver's identification behind each compartment.
  6. Snap-on Trim: Fabricated from same material and finish as compartment doors.
  7. Concealed Components and Mounting Frames: Aluminum or steel sheet with manufacturer's standard finish.
  8. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
    - a. Anodic Finish: Clear.

## 2.03 ACCESSORIES

- A. Key Cabinet: Wall-mounted, steel cabinet with pivoting, key-holding panels and side-hinged door equipped with five-pin tumbler, cylinder door lock and concealed, full-length flush hinge. Finish cabinet, panels, and door with baked-enamel or powder-coated finish. Provide key control system consisting of key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers.
  - 1. Capacity: Keys for 150 percent of the number of mail-receptacle locks.
  - 2. Cross-Index System: Consisting of index cards for recording key information. Include three receipt forms for each key-holding hook.
  - 3. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

## 2.04 FABRICATION

- A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.
- B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
- C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- D. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
- E. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
- F. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support loads.
- G. Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

## 2.05 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.



- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for roughing-in openings, clearances, and other conditions affecting performance of the Work.
- B. Examine walls and other adjacent construction for suitable conditions where units will be installed.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Install postal specialties level and plumb, according to manufacturer's written instructions and roughing-in drawings.
  - 1. Where dissimilar metals will be in permanent contact with each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer for this purpose.
  - 2. Final acceptance of postal specialties served by USPS depends on compliance with USPS requirements.

### 3.03 FIELD QUALITY CONTROL

- A. Arrange for USPS personnel to examine and test postal specialties served by USPS after they have been installed according to USPS regulations.
- B. Obtain written final approval of postal specialties to be served by USPS. Obtain this approval from USPS postmaster that authorizes mail collection for the served installation.

### 3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as postal specialties are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as

recommended by manufacturer. Verify that integral locking devices operate properly.

- C. Touch up marred finishes or replace postal specialties that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by postal specialty manufacturer.
- D. Replace postal specialties that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- E. On completion of postal specialty installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION 10550

## SECTION 10605

### CHAIN-LINK PARTITIONS AND GATES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following items fabricated from galvanized-steel chain link fencing fabric and framework:
  - 1. Interior partitions.
  - 2. Gates: Swing.
- B. Related Sections include the following:
  - 1. Division 2 Section "Chain Link Fences" for site fencing.
  - 2. Division 5 Section "Metal Fabrications" for overhead bracing assembly.

##### 1.03 DEFINITIONS

- A. Terms below shall be as defined in ASTM E 2016:
  - 1. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
  - 2. Lock Crimp: Deep crimps at points of intersection that lock wires securely in place.

##### 1.04 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link partitions and gates.
  - 1. Partition and gate posts, rails, and fittings.
  - 2. Chain-link fabric, reinforcements, and attachments.
  - 3. Gates and hardware.
- B. Shop Drawings: Show locations of partitions, gates, posts, rails, details of extended posts, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.
- C. Qualification Data: For Installer.

## 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link partitions and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain chain link partition, including accessories, fittings, and fastenings, from a single source.
- C. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver chain link items palleted or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

## 1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of construction contiguous with chain link items by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish location dimensions and proceed with fabricating chain link items without field measurements. Coordinate wall, floor and ceiling construction to ensure that actual location dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.01 CHAIN-LINK PARTITION FABRIC

- A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
  - 1. Steel Wire Fabric: Metallic-coated wire with a diameter of 0.120 inches.
    - a. Mesh Size: 2 inches.
    - b. Coating Weight: Either of following at Contractor's option:
      - 1) Aluminum Coating: ASTM A 491, Type I, minimum 0.30 oz./sq. ft.
      - 2) Metallic (Zinc) Coating: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.
      - 3) Zn-5-Al-MM Aluminum-Mischmetal Alloy Coating: ASTM F 1345, Type III, Class 1, 0.60 oz./sq. ft.

2. Selvage: Twisted top and knuckled bottom.

## 2.02 PARTITION AND GATE FRAMING

- A. Posts and Rails: Round cold-formed, electric-resistance-welded, steel pipe or tubing, with minimum yield strength of 45,000 psi and with outside dimension, minimum wall thickness, and weight complying with ASTM F 761 or ASTM F 654.
  1. Partition Height: As indicated on Drawings.
  2. Tube or Pipe Diameter and Thickness: According to ASTM F 761.
    - a. Top Rail: 1.315 inches
    - b. Line Post: 1.66 inches.
    - c. Terminal Post: 1.90 inches.
    - d. Gate Post: 1.90 inches.
    - e. Tube or Pipe Thickness: 0.065 inch minimum.
- B. Gate: Comply with ASTM F 654 and the following:
  1. Type: I, single swing steel frame tubing.
  2. Fabric Height: 2 inches less than adjacent partition height.
  3. Leaf Width: As indicated on Drawings
- C. Hardware: Latches permitting operation from both sides of gate, hinges. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
- D. Metallic-Coated Steel: Posts, rails, and frames protected with an external coating of not less than 0.6 oz. of zinc/sq. ft., a chromate conversion coating, and a clear, verifiable polymer film; with an internal protective coating of not less than 0.6 oz. of zinc/sq. ft. or 81 percent, not less than 0.3-mil- thick, zinc pigmented coating.

## 2.03 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Post and Line Caps: Provide for each post.
- C. Floor Shoes: Steel or cast iron, 2 inches high sized to suit vertical framing, drilled for attachment to floor, and with set screws for leveling adjustment.
- D. Ceiling Shoes: Steel or cast iron, minimum 4 inches long and sized to suit vertical framing, drilled for attachment to overhead structure, and fabricated to allow 2-inch minimum slip joint for deflection of overhead structure.
- E. Rail and Brace Ends: Steel or cast iron for attaching rails securely to each gate, corner, pull, and end post.
- F. Rail Clamps: Provide line and corner boulevard clamps for connecting top, intermediate and bottom rails in the partition line-to-line posts.

- G. Tension and Brace Bands: Pressed steel.
- H. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- I. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- J. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
  - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
    - a. Hot-Dip Galvanized Steel: 0.106-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link partition fabric.
- K. Finish for Pressed Steel or Cast Iron: Metallic coating not less than 1.2 oz./sq. ft. zinc.

#### 2.04 ANCHORS

- A. Postinstalled Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition (mild).
  - 2. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
  - 3. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.
- B. For Ceiling Shoes: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5.
  - 1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563.
  - 2. Lock Washers: Helical, spring type, carbon steel, The American Society of Mechanical Engineers (ASME) ASME B18.21.1.
- C. For Floor Shoe: Provide expansion anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

## 2.05 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine floors for suitable conditions where chain link items will be installed.
- C. Examine walls and ceilings to which chain link items will be attached for properly located solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
- B. Setting Posts: Anchor partition posts continuous from floor deck to structure above unless indicated otherwise on Drawings. Provide top shoe allowing for a minimum of 2-inches of deflection.
- C. Frame around all abutting structure and finished surfaces to provide no greater than 2 inches clearance.

### 3.03 CHAIN-LINK PARTITION INSTALLATION

- A. Chain link Partitions:
  - 1. Anchor chain link partitions to floor with 3/8 inch diameter, postinstalled expansion anchors through floor shoes located at each post and corner. Adjust chain link partition posts in floor shoes to achieve level and plumb installation.
  - 2. Anchor chain link partitions to structure above with top shoe allowing for a minimum of 2-inches deflection of overhead structure.
  - 3. Anchor chain link partitions to walls at 12 inches o.c. using wall support angle or clip as follows:
    - a. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
    - b. For hollow masonry anchorage, use toggle bolts.
  - 4. Install doors complete with door hardware.
  - 5. Weld metal bases to chain link partitions.

6. Bolt accessories to chain link partition framing.
- B. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- C. Line Posts:
  1. Space line posts between terminal posts uniformly at 4 feet o.c. maximum.
  2. Provide line posts on each side of swinging door openings.
- D. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
  1. Locate horizontal braces at same height as intermediate rails. Install so posts are plumb when diagonal rod is under proper tension.
- E. Top, Intermediate and Bottom Rails: Install, spanning between posts.
  1. Locate horizontal rails at 56 to 60 inches above finished floor.
- F. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch between finish floor surface and bottom selvage. Pull fabric taut and tie to posts and rails. Anchor to framework so fabric remains under tension after pulling force is released.
- G. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.
- H. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- I. Fasteners: Install nuts for tension bands and carriage bolts on the side of the partition opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

### 3.04 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.



### 3.05 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas; repair galvanizing to comply with ASTM A 780.

END OF SECTION 10605



## SECTION 10651

### MANUALLY OPERATED, ACOUSTICAL PANEL PARTITIONS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes manually operated, acoustical panel partitions.
- B. Related Sections:
  - 1. Division 05 Section "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
  - 2. Division 09 Section "Gypsum Board" for sound barrier construction above the ceiling at track.

##### 1.03 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."
- B. STC: Sound Transmission Class.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
  - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

##### 1.05 SUBMITTALS

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

- B. Shop Drawings: Include plans, elevations, sections, details and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data for attachments, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Indicate storage and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing indicated.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing indicated, prepared on Samples of size indicated below:
  - 1. Textile: Full width by not less than 36-inch- long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
  - 2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
  - 3. Panel Edge Material: Not less than 3 inches long.
- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Sprinklers.
    - d. Smoke detectors.
    - e. Access panels.
  - 5. Plenum acoustical barriers.
- F. Setting Drawings: For embedded items and cutouts required in other work[, including support-beam, mounting-hole template].
- G. Qualification Data: For qualified Installer.
- H. Product Certificates: For each type of operable panel partition, from manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each operable panel partition.

- J. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
  - 2. Seals, hardware, track, carriers, and other operating components.
- K. Warranty: Sample of special warranty.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to Division 01 Section "Quality Requirements" for testing indicated.
- D. Forest Certification: Fabricate products with wood, wood veneers, and wood-based panel products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- E. Fire-Test-Response Characteristics: Provide panels with finishes meeting one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
- F. Preinstallation Conference: Conduct conference at Project site.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

#### 1.08 PROJECT CONDITIONS

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

## 1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of operable panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal wear.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## 1.10 EXTRA MATERIALS

- A. Furnish extra materials from the same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel. All panel horizontal and vertical framing members fabricated from minimum 18 GA formed steel with overlapped and welded corners for rigidity.
- B. Gypsum Board: ASTM C 36/C 36M continuously bonded to panel frame.

### 2.02 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Operable acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ModernFold AcoustiSeal 932 or comparable product by one of the following:
    - a. Advanced Equipment Corporation.
    - b. Hufcor.
    - c. Moderco Inc.
    - d. Panelfold Inc.
- B. Panel Operation: Manually operated, paired panels.
- C. Panel Construction: Provide top reinforcement as required to support panel from

suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  - 1. Panel Width: Equal widths.
- E. STC: Not less than 47.
- F. Panel Weight: 8 lb/sq. ft. maximum.
- G. Panel Thickness: Not less than 3 inches.
- H. Panel Closure: Manufacturer's standard.
  - 1. Initial Closure: Fixed jamb.
  - 2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- I. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
  - 1. Hinges: Concealed (invisible).

### 2.03 SEALS

- A. General: Provide types of seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
  - 1. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals:
  - 1. Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
  - 1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range

- not less than 2 inches between retracted seal and floor finish.
2. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 2 inches between retracted seal and floor finish.

## 2.04 FINISH FACING

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
  1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
  2. Color/Pattern: As selected by Architect from manufacturer's full range.
- B. Fabric Wall Covering: Modernfold, Series: Kentucky Derby; Color: 110701-005 over tackable gypsum board from same dye lot, treated to resist stains.
- C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  1. Steel, Painted: Finished with manufacturer's standard as selected by Architect from manufacturer's full range.

## 2.05 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
  2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.



- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

## 2.06 ACCESSORIES

- A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware. Hinges in finish to match other exposed hardware.
  - 1. Manufacturer's standard method to secure storage pocket door in closed position.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

### 3.03 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, without warping or binding. Lubricate hardware and other moving parts.
- B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping. Check and readjust operating hardware. Confirm that latches and locks engage accurately and securely without forcing or binding.

### 3.04 FIELD QUALITY CONTROL

- A. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids; adjust partitions for acceptable fit.
- B. Repair or replace operable panel partitions that do not comply with requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired, replaced, or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.05 CLEANING

- A. Clean soiled surfaces of operable panel partitions to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.

### 3.06 DEMONSTRATION

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

END OF SECTION 10 22 26

## SECTION 10801

### TOILET ROOM ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following toilet and shower accessories:
  - 1. Combination Toilet-Seat-Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser.
  - 2. Combination Toilet-Seat-Cover Dispenser and Toilet Tissue Dispenser.
  - 3. Sanitary napkin vendor.
  - 4. Soap dispensers.
  - 5. Combination Soap Dispenser and Shelf Unit
  - 6. Mirror units.
  - 7. Combination towel dispenser/waste receptacle.
  - 8. Robe hook.
  - 9. Grab bars.
  - 10. Underlavatory guard.
- B. Related Sections include the following:
  - 1. Division 9 Section "Gypsum Board Assemblies" for backing plate for grab bar installations on partition walls.

##### 1.03 REFERENCES

- A. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, provide installed accessories that comply with the more restrictive requirements of both "California Disabled Accessibility Guidebook 2000" (CalDAG 2000) and the Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

##### 1.04 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

#### 1.05 QUALITY ASSURANCE

- A. Conform to requirements of American Disabilities Act Accessibility Guidelines for making facilities and accessories accessible to and usable by the physically handicapped.
- B. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- C. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
- D. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
- E. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.06 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.07 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
  - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: Subject to compliance with requirements, provide accessories indicated in the Toilet and Bath Accessory Schedule at the end of Part 3 by Bobrick Washroom Equipment, Inc. or comparable products by one of the following:
1. A & J Washroom Accessories, Inc.
  2. McKinney/Parker Washroom Accessories Corp.
  3. General Accessory Manufacturing Co. (GAMCO).

### 2.02 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
1. Provide tempered glass where indicated.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

### 2.03 FABRICATION

- A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

- C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless steel hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
  - 1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
  - 1. One-piece, galvanized steel, wall-hanger device with spring- or screw-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### 3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

### 3.03 TOILET AND BATH ACCESSORY SCHEDULE

- A. Recessed Toilet-Seat-Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser; Drawing Ref. No. 1: Where this designation is indicated, provide combination units complying with the following:
1. Basis of Design Product: Bobrick; B-3574.
  2. General: Stainless-steel unit designed for nominal 4-inch wall depth with seamless wall flange; full length stainless steel piano hinged front door secured by tumbler lockset.
  3. Seat-Cover Dispenser: Minimum 500 single- or half-fold paper seat-cover capacity.
  4. Sanitary Napkin Disposal Unit: Removable, reusable, molded, seamless plastic material receptacle, 0.8 gal minimum capacity. Self-closing disposal panel shall be secured to door with a spring-loaded, full-length stainless steel piano hinge and equipped with an international graphic symbol identifying napkin disposal.
  5. Toilet Tissue Dispenser: Double-roll dispenser, noncontrol delivery and manufacturer's standard plastic spindles designed for 4-1/2- or 5-inch- diameter-core tissue rolls. Spindles shall be removable only when door is open.
- B. Recessed Toilet-Seat-Cover Dispenser and Toilet Tissue Dispenser; Drawing Ref. No. 2: Where this designation is indicated, provide combination units complying with the following:
1. Basis of Design Product: Bobrick; B-3474.
  2. General: Stainless-steel unit designed for nominal 4-inch wall depth with seamless wall flange; full length stainless steel piano hinged front door secured by tumbler lockset.
  3. Seat-Cover Dispenser: Minimum 500 single- or half-fold paper seat-cover capacity.
  4. Toilet Tissue Dispenser: Double-roll dispenser, noncontrol delivery and manufacturer's standard plastic spindles designed for 4-1/2- or 5-inch- diameter-core tissue rolls. Spindles shall be removable only when door is open.
- C. Sanitary Napkin Vendor; Drawing Ref. No. 6: Where this designation is indicated, provide stainless-steel sanitary napkin vendor complying with the following:
1. Basis of Design Product: Bobrick B-3500 Series
  2. General: Fabricate cabinet of all-welded construction. Provide seamless door with returned edges and secured by tumbler lockset. Provide identification reading "Napkins" and "Tampons"; brand-name advertising is not allowed. Capacity not less than 30 napkins and 20 tampons.
  3. Mounting: Fully recessed type designed for nominal 4-inch wall depth.
  4. Operation: Single-coin operation, 25 cents.
- D. Soap Dispenser; Drawing Ref. No. 7: Where this designation is indicated, provide soap dispenser complying with the following:
1. Basis of Design Product: Bobrick B-8226.
  2. Liquid Soap Dispenser, Deck Mounted: Piston-and-spout-type unit with minimum 34-oz. capacity, polyethylene reservoir concealed below deck; brightly polished

stainless-steel piston and 6-inch-nominal long spout; and chrome-plated deck escutcheon.

- a. Mounting: Designed for mounting on vanity deck.
  - b. Soap Valve: Designed for dispensing soap in liquid form.
- E. Surface Mounted, Combination Soap Dispenser and Shelf Unit; Drawing Ref. No. 10: Where this designation is indicated, provide combination unit complying with the following:
1. Basis of Design Product: Bobrick B-2014.
  2. General: Stainless-steel unit designed for surface mounting with concealed anchorage. Shelf unit shall unlock from soap dispenser housing with special key (provide) and shall swing up to allow filling of soap vessel without removal from wall; stainless steel spring shall hold shelf up while filling.
  3. Shelf: Nominal 18 inch long by 5 inch deep shelf fabricated of minimum nominal 0.05-inch- thick stainless steel, with exposed edges turned down not less than 1/2 inch.
  4. Liquid Soap Dispenser, Horizontal-Tank Type: Minimum 80 ounce capacity tank with molded internal plastic soap container, with stainless-steel piston, springs, and internal parts designed to dispense soap in measured quantity by pump action; and with unbreakable window-type refill indicator.
    - a. Soap Valve: Designed for dispensing soap in liquid form.
- F. Mirror Units; Drawing Ref. 10: Where this designations is indicated, provide units complying with the following:
1. Basis of Design Product: Bobrick B-165 Series.
  2. Stainless Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.
  3. Size: As indicated on Drawings.
- G. Combination Towel Dispenser/Waste Receptacle; Drawing Ref. No. 4: Where this designation is indicated, provide stainless-steel combination unit complying with the following:
1. Basis of Design Product: Bobrick B-369.
  2. Recessed Type with Flush Receptacle: Designed for nominal 4-inch wall depth with continuous, seamless wall flange; towel dispenser in unit's upper compartment designed to dispense minimum of 350 C-fold or 475 multifold paper towels, in door with continuous hinge and knob latch; waste receptacle in unit's lower portion secured by friction catch and with minimum 2-gal. capacity.
- H. Robe Hook; Drawing Ref. No. 27: Where this designation is indicated, provide robe hook complying with the following:
1. Basis of Design Product: Bobrick B-6727.
  2. Double-Prong Unit: Stainless-steel, double-prong robe hook with rectangular wall bracket and backplate for concealed mounting.



- I. Grab Bars; Drawing Ref. No. 3 and 3A: Where these designations are indicated, provide stainless-steel grab bar complying with the following:
  - 1. Basis of Design Product: Bobrick B-6806 Series.
  - 2. Type: Horizontal units.
  - 3. Size:
    - a. Grab Bar 34: 42-inches.
    - b. Grab Bar 35: 36-inches.
  - 4. Stainless-Steel Nominal Thickness: Minimum 0.05 inch.
  - 5. Mounting: Concealed with manufacturer's standard snap flanges and anchors.
  - 6. Gripping Surfaces: Smooth, satin finish.
  - 7. Outside Diameter: 1-1/2 inches for heavy-duty applications.
  
- J. Underlavatory Guard Ref. No. 21: Where this designation is indicated, provide underlavatory guard complying with the following:
  - 1. Available products include the following: Truebro Inc.; Handi Lav-guard or equal.
  - 2. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

END OF SECTION 10801



## SECTION 11020

### FIRE DEPARTMENT KEY BOX

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes recessed Fire Department key storage boxes (“knox box”).
- B. Products Supplied But Not Installed Under This Section:
  - 1. Install recessed mounting kit under Division 4 Section “Unit Masonry.”
- C. Related Sections: The following Sections contain requirements that may relate to this Section:
  - 1. Division 7 Section “Joint Sealants” for sealant applied to joint between key box and mounting substrate.

##### 1.03 SUBMITTALS

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

##### 1.04 COORDINATION

- A. Coordinate installation of anchorages and recessed mount for key storage box. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Key Storage Box: Locate boxes where indicated on Drawings and position as required by local Fire Department.

#### PART 2 - PRODUCTS

##### 2.01 FIRE DEPARTMENT KEY STORAGE BOX

- A. General: Heavy-duty, UL Rated, high-security, factory finish metal box designed to store keys for Fire Department access.

- B. Basis of Design Product: Subject to compliance with the requirements provide Knox Company; Knox Box 3200 Series or comparable product by another manufacturer acceptable to Authorities Having Jurisdiction.
  - 1. Mounting: Recessed mounted.
  - 2. Size: Approximately 5-inches high by 4-inches wide by 3-1/4-inches deep.
  - 3. Door Type: Hinged.
  - 4. Color. Black.

## 2.02 ACCESSORIES

- A. Recessed Mounting Kit: Steel box assembly with integral box mounting bolts and masonry anchors, designed to recess storage box. Provide only kits supplied by manufacturer of storage box.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Recessed Mounting: Incorporate recessed mounting kit into masonry or concrete wall during wall construction. Install key box in recessed mount after walls are substantially completed and cleaned.
- B. Apply elastomeric sealant to top and side joints between key box and mounting substrate in accordance with requirements of Section 07920 Joint Sealants. Leave bottom joint open for drainage.

### 3.03 ADJUSTING AND CLEANING

- A. Confirm that box doors engage accurately and securely without forcing or binding.
- B. After completing installation of exposed, factory-finished boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 11020

## SECTION 11132

### FIXED PROJECTION SCREENS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes ceiling mounted, automatic, front-projection screens.
- B. Related Sections include the following:
  - 1. Division 5 Section "Metal Fabrications" for steel rod and channel support structure.
  - 2. Division 16 Sections for electrical wiring, connections, and installation of remote-control switches for electrically operated projection screens.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of screen specified.
- B. Shop Drawings: Show layout and types of projection screens. Include the following:
  - 1. Location of screen centerline relative to ends of screen case.
  - 2. Location of wiring connections.
  - 3. Anchorage details.
  - 4. Frame details.
  - 5. Accessories.
- C. Wiring Diagrams: For electrically operated units.

##### 1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

## PART 2 - PRODUCTS

### 2.01 FRONT-PROJECTION SCREENS

A. Material and Viewing Surface of Front-Projection Screens: Provide screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:

1. Matte-white viewing surface with gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.
2. Material: Vinyl-coated glass-fiber fabric.
3. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by FS 191A/5760.
4. Fire-Test-Response Characteristics: Provide projection-screen fabrics identical to materials that have been tested for flame resistance according to both small- and large-scale tests of NFPA 701.
5. Seamless Construction: Provide screens in sizes indicated without seams.
6. Edge Treatment: Without black masking borders.
7. Size of Viewing Surface: As indicated in the following schedule:

Room #	Room Name	Screen (Nominal)	Size
		72 by 72 inches	

B. Electrically Operated Screens, General: Provide manufacturer's standard UL-labeled units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Remotely control operation of each screen to comply with the following:

1. Single-Station Control: 3-position control switch with metal device box and cover plate for flush wall mounting and for connection to 120-V, ac power supply.
2. Motor: Provide motor in roller; instant-reversing motor of size and capacity recommended by screen manufacturer with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.
3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- diameter, metal rod with ends of rod protected by plastic caps.
4. Roller for motor in roller supported by vibration- and noise-absorbing supports.

C. Electrically Operated Screens with Automatic Ceiling Closure: Units designed and fabricated for recessed installation in ceiling with bottom of case composed of 2 panels fully enclosing screen, motor, and wiring; 1 panel hinged and designed to open and close automatically when screen is lowered and fully raised, and the other panel removable or openable for access to interior of case; and complying with the following requirements:

1. Screen Case with Motor in Roller: Wood or medium-density-fiberboard sides and top with metal-lined wiring compartment and aluminum or medium-density-fiberboard bottom panels, factory primed and constructed as follows:

- a. Offset mount bottom panels so their bottom surface will align flush with adjoining ceiling and the bottom edges of case sides and ends will be recessed behind ceiling finish.
  - b. Provide single or double top as standard with manufacturer.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Matte-White Viewing Surfaces:
    - a. Da-Lite Screen Co., Inc.; Matte White.
    - b. Draper Shade & Screen Co., Inc.; Fiberglass Matte White.
  - 2. Electrically Operated Screens with Ceiling Closure, Motor In Roller:
    - a. Da-Lite Screen Co., Inc.; Boardroom Electrol.
    - b. Draper Shade & Screen Co., Inc.; Envoy.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and relationship to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
  - 1. Test electrically operated units to verify that screen, controls, limit switches, closure, and other operating components are in optimum functioning condition.

### 3.02 PROTECTING AND CLEANING

- A. Protect projection screens after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11132





## SECTION 13700

### BASIC SECURITY SYSTEM REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for Sections numbering 137xx , and is intended to supplement, not supersede, the requirements specified in Division 1.
- B. The requirements described herein include the following:
  - 1. References
  - 2. Definitions
  - 3. System Description and Existing Conditions
  - 4. Submittals & Shop Drawings
  - 5. Quality Assurance
  - 6. Permits and Inspections
  - 7. Delivery, Storage and Handling
  - 8. Scheduling
  - 9. Warranty
  - 10. Preventative Maintenance
  - 11. Project Management and Coordination Services
  - 12. Cutting, patching, painting and sealing
  - 13. Field quality control
  - 14. Project Closeout and Record Documents
- C. Products Supplied But Not Installed Under This Section:
  - 1. None.
- D. Products Installed But Not Supplied Under This Section:
  - 1. None.
- E. Products Specified But Not Installed Under This Section:
  - 1. None.

F. Products Furnished and Installed Under Another Section:

1. 120V power
2. Conduit and junction boxes
3. Door hardware
4. Network connections

G. Unit Prices:

1. Submit unit pricing (material, labor, shipping, taxes, and markups) for equipment supplied under this section.

H. Alternates:

1. ALT-13700-01: Renewable Annual Maintenance Agreement
  - a. Submit a renewable annual maintenance agreement proposal for the servicing and adjustment of the existing security system equipment.
  - b. Perform bi-annual examinations by trained personnel including necessary measurements, adjustments, and parts replacement to keep the equipment in efficient and proper operation.
  - c. Perform maintenance work, except emergency repairs, during regular working hours of regular working days.
  - d. Perform emergency repairs on an immediate basis (4 hour response time maximum, 7 days a week, 24 hours a day) when a system or component malfunctions during use.
  - e. Do not subcontract or assign maintenance work unless the Owner has approved such assignment in writing.

I. Related Sections:

1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
2. Section 13710: Access Control and Alarm Monitoring System
3. Section 13720: Video Surveillance System
4. Section 13770: Security System Cabling
5. Section 13780: Security System Labeling
6. Section 13790: Security System Commissioning
7. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices. Refer to Division 5, Miscellaneous Metals.
8. Miscellaneous Lumber and Framing Work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of security materials and equipment. Refer to Division 6, Rough Carpentry.
9. Moisture Protection and Smoke Barrier Penetrations: Include membrane

clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade. Refer to Section 07270 Firestopping, and Section 07900 Sealants.

10. Locking Hardware: Include interface to electronic hardware and door controllers on security related doors. Refer to Section 08710 Door Hardware.
11. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment. Refer to Division 8, Access Doors; also, Division 5, Metals.
12. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9, Painting.

### 1.03 REFERENCES

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.
- B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
  1. National Electric Code (NEC), NFPA 70.
  2. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC).
  3. Uniform Building Code (UBC).
  4. Uniform Fire Code (UFC).
  5. National, State, Local and other binding building and fire codes.
  6. FCC Regulations:
    - a. Part 15 – Radio Frequency Devices & Radiation Limits
- C. Standards: Equipment and materials furnished under this Section shall conform to the following standards where applicable:
  1. Underwriter's Laboratories (UL): Applicable listing and ratings.
    - a. UL 294:Access Control System Units
    - b. UL 1076:Proprietary Burglar Alarm Units and Systems

### 1.04 DEFINITIONS

- A. The following list of terms as used in this Section shall be defined as follows:
  1. "Owner": Santa Cruz Metro Transit District (SCMTD)

2. "Engineer": TEECOM Design Group.
3. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.
4. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Installation shall be complete and ready for regular operation.
5. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.
6. "Connect": To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
7. "As directed": As directed or instructed by the Owner, or their authorized representative.
8. "Cabling": A combination of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling].
9. "Security System": The Access Control, Intrusion Monitoring, CCTV, and Intercom Systems.
10. "SEC": Security Equipment Enclosure.
11. "CEC": CCTV Equipment Enclosure.
12. "ACAMS": Access Control & Alarm Monitoring System

## 1.05 SYSTEM DESCRIPTION

### A. Overview

1. Santa Cruz Metropolitan Transit District is building a new bus operation facility. The new facilities will be located on River Road in Santa Cruz, California.
2. The facility will employ access control and video surveillance security systems. The access control system will be deployed in the Operations Building.
3. Video Surveillance will be deployed in the parking garage and operations building.
4. Phased-in construction required during the project to allow the District to continue operations during construction. The new operations building will be constructed followed by the removal of the existing ops building.

### B. Conduit System

1. Provide conduit, junction boxes, connectors, and J-hanger system to support the security system cabling.

### C. Custom Device Requirements

1. General: Provide a high level of coordination services to ensure the proper installation and functioning of the security system. Coordinate the installation of the security system with other trades. This may include: review of other's

subcontractor's shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.

2. Specific Devices: CCTV video monitors in the dispatch office.

#### D. Role of the Engineer

1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, process and reply to relevant Requests for Information (RFI), and act as an interface between the Contractor and the Owner.
2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents.
3. In summary, the Engineer will perform the following specific services during the design phase:
  - a. Review product submittals and shop drawings for general compliance with the contract drawings and specifications.
  - b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
  - c. Interpret field problems for Owner, and translate into understandable language.
  - d. Review the testing procedures to confirm compliance with industry-accepted practices.

#### E. Drawings

1. Layout: Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.
2. Accuracy: The Drawings show a diagrammatic representation of the system within the constraints of the symbology applied.
3. Detail: The Drawings do not fully represent the entire installation for the Security System. Drawings indicate the layout and location of control console(s) components, as well as location of security devices, i.e. CCTV cameras, card readers, door locks and contacts, and duress stations. The Drawings do not show conduits, wire and cabling between every system component, equipment, or device.

### 1.06 SUBMITTALS

#### A. General

1. Provide required submittals in accordance with Conditions of the Contract, and Division 1 Submittal Procedures Section.
2. Format: Furnish submittal data neatly bound in an 8-1/2" x 11" folder or binder for each specification section with a table of contents listing materials by Section and paragraph number.
3. Submittals shall consist of detailed shop drawings, product specifications, block wiring diagrams, "catalog cuts" and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials

used in fabrication, and material finish. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories which are included and those which are excluded.

4. Label each submittal with the Specification Section Number and provide a cover letter or stamp stating that the submittal has been thoroughly reviewed by the Contractor and complies with the requirements of the Contract Documents. Failure to comply with this requirement shall constitute grounds for rejection of data.
  5. Resubmittals shall include a cover letter, which lists the action taken, and revisions made to each drawing and equipment data sheet in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.
  6. Prepare diagrams using AutoCAD 2000 compatible software. The following are requirements for drawings:
    - a. Drawing Size: Same size as the project contract drawings with the project title block.
    - b. Text Size: Minimum 3/32 inches high when plotted at full size.
    - c. Symbolology: Identical to the symbols used on the Contract Drawings.
    - d. Backgrounds: Screen background information to allow pertinent drawing information to stand out.
    - e. Line Weights: Use appropriate line weights for devices, raceways, and text to stand out against background information.
- B. Contractor Qualifications: Submit the following for review and comment at the beginning of the project.
1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
  2. Certification letters from manufacturers of major system components stating the Contractor is an authorized reseller, installer, and extended warranty provider for the specified security systems.
- C. Product Data: Submit the following for review and comment prior to the purchase and installation of equipment:
1. Product data for products furnished. Include, for each product, the manufacturer, part number, accessories & options selected, color (if applicable), and a brief product description.
  2. Estimated delivery lead times for products.
- D. Shop Drawings
1. Obtain electronic files containing the contract documents drawing files for use in preparing the shop drawings from the Engineer.
  2. Submit the following for review and approval prior to the installation of

equipment:

- a. Floor Plans: 1/8 inch scale floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.

E. Samples

1. Labeling
2. Provide samples as required for proper coordination and installation of custom mounted equipment.

1.07 QUALITY ASSURANCE

A. General

1. Provide new and unused materials, equipment, and parts comprising the units specified herein of current manufacturer and of highest grade.
2. Only use products and applications listed in this Division on the project.

B. Substitutions

1. Where items are noted as "or equivalent", a product of equivalent design, construction and performance will be considered. Submit to the engineer pertinent test data, catalog cuts and product information required to substantiate that the product is in fact equivalent to that specified. Only one substitution will be considered for each product specified.
2. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment, which in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified.
3. Whenever material, process or equipment is specified in accordance with a Federal specification, an ASTM standard, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, support test data to substantiate compliance shall be submitted at no additional cost.
4. Substitutions shall be equivalent, in the opinion of the Engineer, to the specified product. The burden of proof of such shall rest with the Contractor. When the Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted article or material to be equivalent to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the Specifications.
5. Pay for unforeseen increased costs resulting from substituted products at no additional cost to the Owner.

1.08 PERMITS AND INSPECTIONS

- A. Obtain and pay for permits and inspections required for the work.

- B. Furnish materials and workmanship for this work in conformance with applicable legal and code requirements.
- C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.
- D. Obtain review from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

#### 1.09 COORDINATION

##### A. Discrepancies

1. In the event of discrepancies within the Contract Documents, notify the Engineer within 5 days prior to the Bid Opening to allow the issuance of an Addendum.
2. If, in the event that time does not permit notification or clarification of discrepancies prior to the Bid Opening, the following shall apply: The drawings govern in matters of quantity, and the specifications govern in matters of quality. In the event of conflict within the drawings involving quantities, or within the specifications involving quantities, or within the specifications involving quality, the greater quantity and higher quality shall apply. Note such discrepancies and clarify in the Bid. We will make no additional allowances because of errors, ambiguities, or omissions, which reasonably should have been discovered during the preparation of the Bid.

##### B. Job Conditions

1. Protection: Keep conduits, junction boxes, outlet boxes and other openings closed to prevent entry of foreign matter. Cover equipment, devices, apparatus and protect them against dirt, paint, water, chemical or mechanical damage, before and during construction period. Prior to final acceptance, restore to original condition fixture, apparatus or equipment damaged including restoration of damaged factory applied painted finishes. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.
2. Supervision: Personally, or through an authorized and competent representative, supervise the work from beginning to completion and, within reason, keep the same foreman and workmen on the project throughout the project duration.

#### 1.10 PROJECT MANAGEMENT AND COORDINATION SERVICES

- A. Overview: Provide a project manager/engineer for the duration of the project to coordinate the security system work with other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.
  1. Obtain copies of shop drawings for equipment provided by others that require security connections or interface with the security system work.
  2. Prepare and maintain a shop drawing review log indicating the following



information:

- a. Shop drawing number and brief description of the system/material.
- b. Date of your review.
- c. Indication if follow-up coordination is required.

B. Request for Information (RFI)

1. Thoroughly review the contract documents prior to the preparation and submission of an RFI. If an RFI is submitted, attach 8 1/2" x 11" copies of relevant documents to clarify the issue.
2. Submit RFIs with your recommended solution.
3. Prepare and maintain an RFI log using a Microsoft Excel spreadsheet indicating the following information:
  - a. RFI number and brief summary of the issue.
  - b. Date of issuance and receipt of response.

C. Clarification Confirmation Memo (CCM)

1. CCM memos will be prepared by either the Contractor or the Engineer to confirm a decision clarifying the contract documents that does not impact cost or affect other trades.
2. Prepare and maintain a CCM log using a Microsoft Excel spreadsheet indicating the following information:
  - a. CCM number... use CCM-C1, C2, etc. for memos issued by the Contractor and CCM-E1, E2, etc. for memos issued by the engineer.
  - b. Brief summary of issue and date issued.

D. Scheduling of Work

1. Prepare work schedules for each floor indicating the following information:
  - a. Cable Installation
  - b. SEC Build Out
  - c. Device Installation
  - d. Programming
  - e. Testing
  - f. Other tasks included under the alternate work section of these specifications

E. Weekly Status Reports

1. Prepare weekly status reports throughout the entire course of the project containing the following information:
  - a. Updated 2-week look ahead schedule
  - b. Progress during prior week
  - c. Work expected to be completed during the upcoming week.
  - d. Delivery dates for equipment
  - e. Coordination status for each device requiring coordination with other

subcontractors.

- f. Summary of the information owed to the Contractor, who is responsible for providing the information, and due date for the information.

F. Weekly Meetings

1. Conduct or attend weekly coordination meetings with the electrical and other specialty subcontractors to coordinate the installation of the security systems.

1.11 CHANGE ORDER PRICING PROCEDURES

A. Pricing Submission Policy:

1. The unit prices quoted on the Bid Form will be used to adjust the contract amount for the addition or deletion of devices when these modifications are made prior to the start of construction or during the early stages of construction.
2. Change order pricing for: 1) Changes made after the contract work has been completed in an area, 2) Additional conduit and/or cable service lengths in excess of those indicated in the unit price descriptions, or 3) Work not covered by unit price quotes, will be based upon estimated time and materials. The below described estimating guidelines (General Guidelines) may not apply in instances, in which case work may be, at the Owner's option, performed on an actual time and material basis with or without a not to exceed limit. Additionally, these guidelines will be modified, if special circumstances exist such as particularly easy or difficult to access work or an unusually high volume of changes disrupts significantly the flow of the base contract work.
3. Submit copies of take-off sheets and pricing sheets to substantiate the price adjustment request.

1.12 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.
2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage

1. Store materials in a clean, dry, ventilated space free from temperature extremes.
2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle in accordance with manufacturer's written instructions.
2. Prevent internal component damage, breakage, denting and scoring. Do not

install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

### 1.13 WARRANTY

- A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner.
- B. The warranty package shall include but not necessarily be limited to the following:
  - 1. Emergency maintenance service on regular working hour basis
  - 2. Service by factory trained and employed service representatives of system manufacturer.
- C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty-four (24) hours after notification of a malfunction, at no additional cost.
- D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

### 1.14 MAINTENANCE

- A. Extra Materials
  - 1. Deliver extra materials to a secured location determined by the Owner.
  - 2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.
  - 3. Provide new and unused spare parts in their original packing materials upon delivery.
- B. Maintenance Service
  - 1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
    - a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, Access Control System equipment, power supplies, and electrical and mechanical controls.
    - b. Clean system equipment, including interior and exterior surfaces.
    - c. Perform diagnostics on equipment.
    - d. Check and calibrate each ACS device.

- e. Run system software and correct diagnosed problems.
  - f. Resolve previous outstanding problems.
2. Provide software and firmware updates issued free of charge by the manufacturer.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.
- B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Systems and components shall have been thoroughly tested and proven in actual use. Subsystems shall be of one manufacturer.

### 2.02 Equipment Enclosures

- A. Manufacturer: Hoffman, or equivalent.
- B. General: Provide cabinets with:
  1. Hinged and lockable door containing a Hoffman #A-L12AR lock kit (keyed alike with other security enclosures on the project).
  2. Panduit "F" type slotted duct for routing of individual conductors.
  3. One tamper switch for each enclosure.
- C. SECs
  1. Type: Hoffman #A-16N16BLP NEMA type 1 enclosure.
  2. Accessories:
    - a. #A-16N16MP back panel for mounting of the relays, and terminal strips.
    - b. One 5" electric muffin fan for each enclosure housing electrically powered devices.
    - c. One exterior screen for each fan.
- D. Door Equipment Junction Boxes
  1. Type: Hoffman #A-10N10ALP NEMA type 1 enclosure
  2. Accessories:
    - a. #A-10N10MP back panel for mounting of the relays, and terminal strips.

## 2.03 POWER SUPPLIES AND BATTERY CHARGERS

### A. General:

1. Provide power supplies with the following features:
  - a. AC power fail supervision (form "C" contact).
  - b. Low battery supervision (form "C" contact).
  - c. Low battery disconnect feature to prevent battery from deep discharge.
  - d. Built-in charger for sealed lead acid or gel type batteries.
  - e. Automatic switchover to battery when AC power fails.
  - f. Thermal and short circuit protection with automatic rested.
  - g. Fused battery protection.
  - h. AC input and DC output LED indicators.
2. Size power supplies for maximum loading of 75% of rated continuous capacity.
3. Size batteries to provide 2 hours of continuous power backup at the rated continuous current.

### B. Device Power Supplies:

1. Provide a 120 VAC input 12 VDC output, continuous current, fully supervised power supplies for power to motion detectors, and other similarly power security devices.
2. Device Power: AltronixAL600ULX .
3. Device Power: Securitron #BPS-12-6 with 8-output expander card #CCB-8.

### C. Specialty Power Supplies: Refer to the individual system specifications for specialty power supply requirements for access control systems, intercoms, video surveillance, or long range card readers.

## 2.04 MISCELLANEOUS INTERFACE RELAYS

- A. Type: Standard industry control, plug-in type with LED indicator lights to indicate when the relay is energized.
- B. Contacts: Rated for 10 amps at 120VAC.
- C. Coil Operating Voltage: As required, with 24VDC as first choice.
- D. Relays shall incorporate the following features
  1. Snap-on label
  2. Pilot light
  3. 2mm test jacks
  4. Dual contact markings
  5. Snap-on number & letter markers
  6. Solid bus-bar socket construction

- E. Mount relay bases on standard mounting rails.
- F. Use these relays for lock power switching application and. Do not use the output contacts on the access controllers since their rating is not adequate.
- G. Manufacturer: Releco by Turck, Idec or Equal

## 2.05 TAMPER RESISTANT HARDWARE

- A. Provide pinned-allen type hardware for exposed hardware in public spaces.
- B. Hardware used in specialty metal surfaces shall possess a similar finish color.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.
- C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, "True Tape" the conduits to verify cable distances.

### 3.02 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.
- B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

### 3.03 INSTALLATION

- A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.
- B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:

1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures

1. Install boxes, panels, and enclosures square and plumb.
2. Set "flush mounted" units so that the face of the cover, bezel or escutcheon shall be in the same plane as the surrounding finished surface.
3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.
4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting

1. Custom paint devices as indicated on the drawings.

### 3.04 REPAIR AND RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.

B. Punch List:

1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:

1. Make changes to the system such that any defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
2. Repair defects prior to system acceptance.

### 3.05 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

- D. Legally dispose of debris.
- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION 13700



**SECTION 13710**  
**ACCESS CONTROL AND ALARM MONITORING SYSTEM**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section

**1.02 SUMMARY**

- A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control and Alarm Monitoring system installation, as described in these specifications.
- B. Section Includes:
  - 1. Access Control, including access control units, input/output units, and card readers
  - 2. Door contacts and request-to-exit devices
  - 3. Duress buttons and strobe light
  - 4. Interface to electric door hardware
  - 5. Interface to Video Surveillance system
  - 6. Interfaces and connections between security subsystems to allow communication with one another
  - 7. ACAMS Power supplies
- C. Products Supplied But Not Installed Under This Section:
  - 1. None.
- D. Products Installed But Not Supplied Under This Section:
  - 1. None
- E. Products Specified But Not Installed Under This Section:
  - 1. None.
- F. Products Furnished and Installed Under Another Section:
  - 1. Electric feed-through power transfer hinges
  - 2. Life safety system relay
  - 3. Local area network ports
- G. Related Sections:
  - 1. Consult other Divisions, determine the extent and character of related work and

properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

2. Section 13700 Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.
3. Section 13720 Video Surveillance System: includes product information for video integration with the ACAMS.
4. Section 13770 Security System Cabling: includes product information for wire and cable needed to support the ACAMS.
5. Section 13780 Security System Labeling: includes label types and formats for security devices.
6. Section 13790 Testing/Commissioning: includes the integrating testing/commissioning requirements for the ACAMS.

### 1.03 DEFINITIONS

A. The following list of terms as used in this Section shall be defined as follows:

1. "REX": Request-to-exit
2. "ACU": Access Control Unit

### 1.04 SYSTEM DESCRIPTION

A. Overview

1. The project requires controlled entry and exit to the Operations building.
2. Electronic access control required for the Operations Building.
3. The ACAMS system to be computer based with remote ACUs and proximity base card readers.
4. SCMTD desires ACAMS containing badging capabilities.
5. Software integrations capabilities with video surveillance system

B. Access Control & Alarm Monitoring System

1. Utilize SCMTD TCP/IP based network for connectivity between the access control panels and the host (server) computer.
2. Provide proximity card readers.
3. Card readers required to control access to Operations Building main lobby entrance, and Stair No 1 access to floors 1 and 2, and elevator.
4. Provide door contacts for access controlled and perimeter doors.
5. Provide REX devices for access controlled doors.
6. The ACAMS system monitors perimeter doors. Activation of any perimeter door sends an alarm directly to the Access Control System.

C. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following:

- a. Tamper switches located within each security equipment enclosure and wireway (use unsupervised inputs for this purpose).
- b. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).
- c. Tamper switches located within each door junction box.

#### 1.05 SUBMITTALS

- A. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.
- B. Product Data: Submit product information for components specified herein.
- C. Shop Drawings:
  - 1. Device placement on floor plans.
  - 2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
    - a. Central Controller
    - b. Printers
    - c. Card Reader Controllers
    - d. Card Readers
    - e. Door position monitoring contacts
    - f. Alarm point monitoring modules
    - g. Electric door locks & hardware
    - h. Miscellaneous control relays
    - i. Fire Alarm interface wiring
    - j. Devices connected to the system
    - k. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
  - 3. Schedules: Provide schedules for access control units that show each point ID with a description of the connected devices.
  - 4. Block Diagram/Riser Diagram: Show the access control system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
  - 5. User interface graphics with icons and control buttons displayed.
  - 6. Custom mounting details

#### 1.06 EXTRA MATERIALS

- A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)
  - 1. Access Control and Alarm Monitoring System
    - a. Access Controller Boards
    - b. Reader Interface Modules

2. Card Readers
3. Fuses (Place five (5) of each type of fuse inside each SEC and power supply housing).
4. Relays

## PART 2 - Products

### 2.01 MANUFACTURERS

- A. Access Control and Alarm Monitoring System
  1. GE/Casi Rusco to match existing system
- B. Card Readers
  1. HID
  2. Motorola/Indala
  3. Or Equal

### 2.02 HOST COMPUTER & SOFTWARE

- A. System Hardware: Document the cost of this hardware at time of bid due to price reductions and advancements in technology. Prior to placement of order, provide upgrades to the most current model as requested by the Owner up to the cost of the specified system.
  1. Processor: Pentium III 2.1 GHz, rack mountable.
  2. Random Access Memory: 512 MB minimum.
  3. Monitor: Viewsonic VG180 18.1" LCD flat screen, 1280 x 1024, 32-bit color, Super Video Graphics Array (SVGA) standard with 32MB VRAM video card.
  4. Mass Storage: 100 GB (10,000 RPM, 8 ms avg. seek) RAID-5 SCSI fixed hot-pluggable disk drive array (requires three 9.1 GB drives).
  5. Backup Media: HP 24x6e DAT Tape Drive Array.
  6. I/O Ports
    - a. Mouse port.
    - b. 2-parallel ports.
    - c. 2-USB ports
    - d. 8-RS232 serial ports.
    - e. Two 10/100BASE-TX NICs (redundant fail-over configured)
  7. Input media
    - a. 1.44 MB 3.5" diskette drive.
    - b. 48x CD-R/W drive.
  8. Keyboard: Enhanced 101-key with tactical feedback, rack mounted on a slide out tray.
  9. Mouse: Logitech 3-button trackball (using marble optical tracking).

10. Modem: US Robotics 56k internal.
  11. Operating System: Most current version of Windows XP supported by the ACAMS manufacturer.
  12. Additional Software
    - a. Veritas Back-up Exec with open file add-on (most current version).
- B. Software Package:
1. GE Topaz Server Software
  2. GE Workstation Software
- C. UPS:
1. APC #SU1400RMNET by BEST or equivalent for backup of one CPU, one printer, and one monitor. Connect UPS alarm condition output relay to security system. Provide smart software interface with UPS and operating system to facilitate automatic shut-down.

### 2.03 ACCESS CONTROLLERS

- A. General: RS-485, RS422, or 20mA based 8-door controller with battery backup, database, user defined reports, and several communication ports. Controller shall have multiple communication channels to which a variety of devices can connect. Controller shall support at least one hardware module daughterboard for additional memory and/or for future feature enhancements. Functions provided include:
1. Central control for devices attached.
  2. Makes decisions for access.
  3. Responds to monitor activity.
  4. Receives input to control its decision making.
  5. Reports activity to other devices.
- B. Capacities:
1. Addressable Devices: Proximity sensors, up to 8.
  2. Monitor Inputs: Station switch, tamper, power fail, and alarm.
  3. Relay outputs: Building Mode and Alarm.
  4. I/O module: System shall connect with monitor input/output module via RS-485, RS422, or 20mA.
- C. Mounting: Provide in its own enclosure as a complete UL assembly.
- D. Power:
1. Source: Power is provided via unshielded twisted pair wiring from a Power Supply unit.
  2. Battery: A low voltage battery (such as a lithium cell) shall maintain the internally stored database setup when no power is available to the controller.

- E. Wiring:
  - 1. Cable limitations
    - a. Communications data channel shall not exceed 4,000 feet.
    - b. Every RS-485 device requires 16 VDC minimum for power.
    - c. Limit communications power cable length by the cable losses, the length of the cable, and the devices to which it is connected.
- F. Communications
  - 1. RS-485, RS422, or 20mA devices: through the system's shielded twisted pair wiring.
  - 2. Host or printer: TCP/IP via 10Base-T/100Base-TX/RS-485 Terminal Server interface.
  - 3. Terminal: ASCII through Terminal Port.
- G. Self-protection: The Controller shall have inputs to detect:
  - 1. Power input failures.
  - 2. Controller tampering.
- H. Manufacturer:
  - 1. GE to match existing system

#### 2.04 MONITOR INPUT/RELAY OUTPUT BOARDS

- A. General
  - 1. Monitor Input: Module that monitors inputs that occur over network and sends them via RS-485 protocol to the Controller.
  - 2. Relay Output: Executes relay commands received from the Controller via RS-485 protocol.
- B. Capacities:
  - 1. Monitor Inputs: 8 four-state monitor points.
  - 2. Relay Outputs: 8 Normally opened (NO) or Normally Closed (NC) via strap position.
- C. Mounting: Standalone in the SEC.

#### 2.05 NETWORK/COMMUNICATION INTERFACE DEVICES

- A. TCP/IP 10/100BASE-TX Connection
  - 1. Access control system standard
- B. RS-232 to RS-485
  - 1. Capable of transmitting data up to 4,000 ft at 64 kbps.
  - 2. Manufacturer: Access control system standard or Black Box RS-232 to RS422/485, IC107A.

C. RS-232 to Fiber

1. Manufacturer: Access control system standard or Black Box Async Fiber Driver, MD940A.

2.06 PROXIMITY CARD READERS

A. General

1. Wire readers back to the SEC directly using S-485 Multiplexers. Do not daisy chain readers together.
2. Provide a single unit with properly sized mounting holes that allow it to be attached directly to a single gang electrical box, unless otherwise noted.
3. Presenting a card to the reader shall initiate a single read. Thereafter the card must be removed from the reader's field and re-presented before it is again read by the system.
4. Provide a multi-color LED to indicate the status of the door and an audible indicator. Provide separate terminal control points for the green, red, and amber LED, and the audible indicator.
5. Provide with an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.
6. Provide units sealed to a NEMA rating of 4X, and internal electronics will have conformal coating to provide a high degree of environmental protection.
7. Provide units capable of communicating in a Wiegand protocol interface, and compatible with standard access control systems.
8. Exterior Locations: Provide fully weatherized units with an operating temperature of -22 to 150 degrees Fahrenheit (-30 to 65 degrees Celsius), and an operating humidity of 5-95% non-condensing.
9. Provide reader personality modules as required.
10. Provide card readers to match their current system standards.

B. Standard Range Readers (ProxPro)

1. Read Range: 4 inches (minimum)
2. Operating Voltage: 10-28.5 VDC.
3. Manufacturer: HID ProxPro 5355, Gray.

C. Standard Range Reader (ThinLine II)

1. Read Range: 4 inches (minimum)
2. Operating Voltage: 4.7-16 VDC.
3. Manufacturer: HID ThinLine II 5395, Gray.

D. Standard Range Reader (MiniProx)

1. Read Range: 4 inches (minimum)
2. Mounting: Single piece unit narrow enough to be mounted onto a 1.75" (4.45

- cm) metal doorframe or mullion.
- 3. Operating Voltage: 4.7-16 VDC.
- 4. Manufacturer: HID MiniProx 5365, Gray.

## 2.07 ACCESS CARDS

### A. Cards

- 1. Provide 200 proximity cards.
- 2. Format: Wiegand 26-Bit
- 3. Manufacturer: HID ISOProx II

## 2.08 POWER SUPPLIES/BATTERY CHARGERS

### A. Access Control & Alarm Monitoring System

- 1. Provide a 120 VAC input to 24 & 12 VDC output, continuous current, fully supervised power supplies for power to door locks, motion detectors, indicator lamps, etc.
- 2. Provide separate power supplies for lock power. Other devices such as REX's and alarm horns may be combined on common power supplies.
  - a. Manufacturer:
    - 1) Securitron: #BPS-24-6 UL listed power supply / battery charger,
    - 2) Altronix,
    - 3) Or Equivalent
- 3. Provide a separate low voltage power supply for each access control panel.
  - a. Manufacture:
    - 1) AMAG: Acme #Buckboost transformer
    - 2) GE/CASI-Rusco
    - 3) Lenel
    - 4) Software House: #apS

## 2.09 NETWORK SWITCH

- A. Provided by Owner's IT department.

## 2.10 DOOR POSITION CONTACTS

- A. Steel Doors: Sentrol 1078 closed-loop, 1/2" gap, Ademco, or equivalent.
- B. Roll-Up Doors: Sentrol 2205A closed-loop, 3" gap, Ademco, or equivalent.

## 2.11 REQUEST-TO-EXIT MOTION SENSORS

### A. Manufacturer:

- 1. Door Frame Mounted:
  - a. Detection Systems, DS160i,



- b. T-REX.
- 2. Ceiling Mounted:
  - a. Visonic, SPY-3.

## 2.12 STROBE

- A. Operating Voltage: 12/24 VDC.
- B. Color: Blue
- C. Mounting: Surface mounted.
- D. Manufacturer:
  - 1. ATW Security #Doberman
  - 2. Amseco #SL-5 series, or
  - 3. Or Equal

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Host CPU and Workstations
  - 1. Rack mount Head End equipment, CPUs, monitors, keyboards and UPS units located in the Equipment Cabinets.
  - 2. Rack mount CPU's in security console.
  - 3. Provide extension cords, and line extenders if required, for keyboards, monitors, mice, etc. for equipment mounted in consoles.
- B. Access Controllers
  - 1. Place power supply and associated hardware in same location.
  - 2. Install supervisory and end of line resistors as required.
- C. Proximity Readers
  - 1. Cable Requirements: Minimum five conductor, 22 AWG, stranded cable with overall shield. A six-conductor cable is required when controlling the red and green LED individually. A seven-conductor cable is required when both the red and green LED's are controlled by the Host. A 22AWG twisted pair shielded, stranded cable is required for use of the tamper switch.
  - 2. Wire the card reader 's multi-color LED to indicate the following status of the door.
    - a. Red status shall indicate that the door is secure (locked).
    - b. Green status shall indicate that the door is unsecured (unlocked).
    - c. Yellow status shall indicate the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.

3. The card reader shall produce an audible beep tone to indicate to the user:
  - a. The card was read and/or access was denied.
  - b. Door is being held open and needs to be closed.

D. Door Position Contacts

1. Install on protected (secured) side of door.
2. Install 6" from leading edge at top of door.

E. Request-To Exit Motion Detectors

1. Mount motion detector on the secured (protected side) of door.
2. Install motion detector so that detection pattern is not obstructed by Exit Signs, light fixtures and other objects that would interfere with proper operation.
3. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
4. Adjust detection sensitivity to pulse.
5. Mask detector lens to provide a confined detection area limited to the door handle or pushbar.
6. Run wire inside structural tube steel frame into back of conduit for cage locations.

F. Strobe

1. Mount strobe to standard 4" square back box with extension ring.

G. Door Hardware

1. Route power to electrically controlled locks on life-safety doors through fire alarm interface relays to allow the door to be unlocked in the event of a fire alarm.
2. Setup and conduct a door hardware coordination meeting.
3. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

### 3.02 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner and the Engineer to determine the programming criteria. Discuss the following:

1. Access card levels and door groupings.
2. Alarm priority levels.
3. Schedules and time codes.
4. Holidays and holiday types (priorities).
5. Action/responses from individual input points.

6. Standard and custom (expanded) reports.
  7. System data base backup to DAT
- B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.
  - C. Program and setup the system such that no additional programming other than entering new access cards is required. Programming shall include the setup of available features of the software.
  - D. Use the point names provided on the system point schedule.
  - E. Perform 2 full system back-ups at completion of initial programming and deliver one copy to owner with letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second DAT and store onsite. Perform back-ups on a regular bases through the remainder of the project.
  - F. Customize menus with the assistance of the factory to "gray-out" features not used on project (such as elevator control).
  - G. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

END OF SECTION 13710



**SECTION 13720**  
**VIDEO SURVEILLANCE**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system installation, as described in this specification.
- B. Section Includes:
  - 1. CCTV Monitoring and Recording System
  - 2. CCTV cameras, mounts, and housings
  - 3. CCTV Power supplies
  - 4. Interfaces and connections between CCTV subsystems to allow communication with one another
- C. Products Supplied But Not Installed Under This Section:
  - 1. None
- D. Products Installed But Not Supplied Under This Section:
  - 1. None
- E. Products Specified But Not Installed Under This Section:
  - 1. None
- F. Products Furnished and Installed Under Another Section:
  - 1. 120V power.
  - 2. Network ports in the IDF for CCTV connectivity via WAN
- G. Related Sections:
  - 1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
  - 2. Section 13700 Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
  - 3. Section 13710 Access Control & Alarm Monitoring System: includes product information for video integration with the ACAMS.

4. Section 13770 Security System Cabling: includes product information for wire and cable needed to support the video surveillance system.
5. Section 13780 Security System Labeling: includes label types and formats for security devices.
6. Section 13790 Testing/Commissioning: includes the integrating testing/commissioning requirements for the video surveillance system.

### 1.03 DEFINITIONS

A. The following list of terms as used in this Section shall be defined as follows:

1. "DVR": Digital Video Recorder

### 1.04 SYSTEM DESCRIPTION

A. Overview

1. The project requires video surveillance of the Operations surface and deck parking lots. View of existing cameras on the Maintenance and Fueling building is made capable over the network so all cameras can be view in the Operations building.

B. CCTV Camera System

1. Provide two flat screen video monitors in the Operations Building Dispatch Office.
2. Provide 16-channel DVRs in the Operations Building Dispatch Office to record fixed cameras.
3. Provide coax to twisted pair converters for video signal transfer from Service Facility to Operations Center. Utilize twisted pair cable provide by Owner.
4. Utilize SCMTD TCP/IP based network for connectivity between DVRs.

C. Custom Device Requirements

1. Coordinate installation of wall mounted flat screen video monitors in the dispatch area with the Architect and owner. Provide detailed shop drawings showing planned installation method and requirements.

### 1.05 SUBMITTALS

A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:

1. Device placement on floor plans
2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
  - a. Video surveillance system, monitors, and recording equipment

- b. Devices connected to the system
  - c. Miscellaneous control relays
  - d. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
3. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
  4. User interface graphics with icons and control buttons displayed.
  5. Custom mounting details

#### 1.06 EXTRA MATERIALS

- A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)
  1. Cameras (fixed)
  2. Power Supplies (CCTV)
  3. Fuses (Place five (5) of each type of fuse inside each SEC and power supply housing).
  4. Relays

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Video Surveillance System
  1. Pelco
  2. BOSCH
  3. Dedicated Micro

#### 2.02 CCTV CAMERA SYSTEM

- A. General
  1. Type: Color, solid-state CCD with DSP technology and wide dynamic range, unless otherwise noted.
  2. Power: 24 VAC, 60Hz.
  3. Imager: 1/3 inch format, unless otherwise noted.
  4. Synch: Adjustable line lock for synchronizing camera to power line. No auxiliary sync cable required.
  5. Lens: integrated adjustable 3 - 8mm
  6. Housing: integrated dome housing
  7. Resolution: 650 TV minimum resolution (EIA RS-170), unless otherwise noted.
  8. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise

noted.

B. Standard Fixed Camera

1. Manufacturer:
  - a. Pelco #IS50-DWSV8S
  - b. Or equivalent
2. Accessories:
  - a. Pedant Mount: Pelco #IS150-P
  - b. Pole Adapter Kit: Pelco #SWM-PA-GY
  - c. Or equal

2.03 CCTV VIDEO MONITORS

A. 15" LCD

1. Type: Color
2. Size: 15 inch, flat panel
2. Manufacturer:
  - a. Viewsonic #VPA150
  - b. Sharp
  - c. Tatung
3. Accessories
  - a. Black Box AC211A Video-to-VGA Converter

2.04 CCTV MONITORS DESK MOUNT EQUIPMENT

- A. Manufacturer: APW-Wrightline: Desk top monitor organizer #TF16601 or equivalent
- B. Accessories
1. Articulating Arm: #FPDARM1, fully articulating arm with 20" fore and art adjustment, 6" veridical adjustment
  2. Articulating Arm: #PFPDARM2, double mount arm with over/under positioning of two monitors.

2.05 CCTV DIGITAL VIDEO RECORDER

A. General

1. Complete Digital Video Management System (DVMS) that encompasses recording video, viewing video, reviewing recorded video, and storing video for indefinite periods of time. System components are linked together via a computer network.
2. The system simultaneously records, displays live video, and plays back video. None of the video operations interfere with each other. Recording does not stop for playback, live video view, or video storage.
3. Recorders are provided for capturing, digitizing, and storing video. Recorders



may be configured to record full-time, to record in response to an alarm, or to record based on a user-defined schedule. Full-time recording refers to 24 hours per day, 7 days per week, 365 days per year.

4. Live view and video playback does not interrupt the recording process.
5. A reporting utility provides tracking of alarms, incidents, operator logs, Point of Sale (POS) transactions, and service requests. Video and images may be stored with reports for documenting events.
6. Video authentication provides confidence the video has not been altered. It uses mathematical “fingerprints” to verify the authenticity of the video. Video encryption is not used.

## B. Recorders

1. Use TCP/IP network protocol to communicate to server.
2. Built in, internal Ethernet card for connection to a 10Base T or 100Base T LAN.
3. Captures camera signals from fixed cameras, PTZ cameras, infrared cameras, x-ray cameras, and low light cameras. Camera signals may be color, black and white, or both.
4. Video Information
  - a. The recorder shall store the time, date, and source of the video and is to be available during playback.
  - b. The video source, capture date, start time, and stop time are stored for each clip. The source is identified as either a monitor or a camera.
  - c. The alarm information is stored in the database on the main server when the video is in response to an alarm condition.
5. Recording Configuration
  - a. Shall use TCP/IP network protocol to communicate to head end.
  - b. Captures camera signals from fixed cameras, PTZ cameras, infrared cameras, x-ray cameras, and low light cameras. Camera signals may be color, black and white, or both.
  - c. Recorders shall be capable of recording video with or without sending the video to tape.
6. Video Storage
  - a. Video is stored in clips on the recorder’s internal hard drive. As the hard drive becomes full, the oldest clips are groomed to make room for new video.
  - b. After a video file is saved to the internal hard drive, it can be sent to tape.
  - c. The length of time video is to be stored on tape is specified per camera with respect to recorder and server configurations.
7. Video Authentication
  - a. Each video clip is fingerprinted through a mathematical algorithm during the video capture process. The fingerprint shall become part of the clip and used by the playback software to verify the video has not been altered.

8. Alarm recording
  - a. Recording Options
    - 1) Alarm condition via activation of an external alarm contact.
    - 2) Video motion detection.
  - b. Recording programmable by camera and by time and date schedule.
  - c. Allow a mix and match of continuous recording and alarm recording, based on camera input and capture card connection.
9. Video Motion Detection
  - a. Each video input capable of detecting activity from camera input and to initiate an alarm condition.
  - b. The area of video motion detection shall be operator selectable for each camera input. If the scene changes within the alarm area, an alarm condition is initiated.
10. Manufacturer:
  - a. Pelco: #DX4816HD-2000
  - b. Or Equal
  - c. Provide maximum drive capacity at time of purchase.
11. Workstation (Provide Monitor, Keyboard, and Software Only)
  - a. Monitor:
    - 1) Viewsonic VA926G LCD flat screen, 1280 x 1024, 32-bit color, Super Video Graphics Array (SVGA) standard with 16MB VRAM video card, Dell, or equal.

C. UPS:

1. APC #BP650S by BEST or equal for backup of one CPU and one monitor. Connect UPS alarm condition output relay to security system. Provide smart software interface with UPS and NT operating system to facilitate automatic shut-down. Provide a separate UPS for each required workstation.

2.06 CCTV LIGHTNING PROTECTORS

B. Video Line Coaxial Cable Protectors

1. Provide on coaxial cables serving exterior cameras.
2. Manufacturer: PolyPhaser Corp #IS-75BB/1.5, or equivalent.

C. Power Line Protectors

1. Provide on power lines serving exterior cameras.
2. Manufacturer: PolyPhaser Corp #IS-SPTV, or equivalent.

2.07 COAX TO TWISTED PAIR ADAPTERS

- A. Capable of transmitting or receiving baseband color video signals over unshielded twisted-pair telephone wire up to a distance of 500 feet without external power at either end.

B. Support "Up the coax" Pan/Tilt/Zoom controls up to 500 feet.

C. Connectors:

1. User interface Connector: female BNC
2. Screw terminals for connection to telephone wire

D. Manufacturer: NVT #1662R video transceiver

## 2.08 POWER SUPPLIES/BATTERY CHARGERS

A. CCTV System Power Supplies

1. 120 VAC input to 24 VAC output, continuous current, fully supervised power supplies for power to cameras.
2. Manufacturer:
  - a. Pelco #MSC-16-10SB UL listed power supply/batter charger, Kalatel, Altronix, or equivalent.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. CCTV Cameras

1. Provide outdoor housing and mounts for exterior cameras.
2. Exact placement of cameras shall be field determined to ensure complete coverage.
3. Fixed camera lenses shall be field determined to ensure complete.
4. Route watertight flex from junction box to camera housing from below on exterior cameras.

B. CCTV Digital Recording System

1. Rack mount CCTV equipment located in the Main Equipment Room.

### 3.02 PROGRAMMING

A. Prior to the completion of construction schedule a meeting with the Owner and the Engineer to determine the programming criteria. Discuss the following:

1. Camera naming
2. CCTV camera call-up & recording features (including video motion detection)
3. System data base backup to DAT

A. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.

B. Setup and program the system such that no additional programming required.

C. Use the camera naming convention agreed upon at in the programming meeting

when programming point names into the system.

- D. Perform 2 full system back-ups at completion of initial programming and deliver one copy to the Owner with a Letter of Transmittal explaining information included in back-up and brief description of recovery procedures. Label the second DAT and store onsite. Perform back-ups on a regular bases through the remainder of the project.
- E. Customize menus with the assistance of the factory to “gray-out” features not used on project.
- F. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

END OF SECTION 13720

**SECTION 13770**  
**SECURITY SYSTEM CABLING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.
- B. Section Includes:
  - 1. Wire and cable.
- C. Related Sections:
  - 1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
  - 2. Section 13700 Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
  - 3. Section 13780 Labeling: includes label types and formats.
  - 4. Section 16111 Conduit: includes pathway types in different areas of the project.

**1.03 SUBMITTALS**

- A. Product Data: Submit product information, including:
  - 1. Cable Description and Use
  - 2. Jacket Rating
  - 3. Outside Diameter (of the overall wire or cable)
  - 4. Manufacturer
  - 5. Part Number

**PART 2 - PRODUCTS**

**2.01 WIRE AND CABLE**

- A. General
  - 1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and

- video signal cable in the same conduit without interference or signal noise.
2. Cable installed outdoors shall contain a PVC or Polyethylene jacket, flooded to prevent water intrusion.
  3. Cables installed indoors shall contain a plenum rated jacket (type CMP).
- B. Manufacturers
1. Provide cable by Westpenn, Belden, Commscope, or equivalent.
- C. Access Control & Alarm Monitoring System Cable
1. Plenum Jacketed Cable
    - a. #22/2 AWG unshielded: Westpenn #25221B.
    - b. #22/4 AWG unshielded: Westpenn #25241.
    - c. #22/2 PR AWG individually shielded: Westpenn #D25510.
    - d. #22/4 AWG shielded (overall): Westpenn #D253651.
    - e. #22/6 AWG shielded (overall): Westpenn #253270B.
    - f. #18/2 AWG unshielded: Westpenn #25224B.
    - g. #18/4 AWG unshielded: Westpenn #25244B.
    - h. #18/4 AWG shielded (overall): Westpenn #253244B.
    - i. #14/2 AWG unshielded: Westpenn #25226B.
- D. CCTV Coaxial Cable
1. Provide minimum RG-59/U CCTV video coaxial cable between the camera and the monitoring equipment. Coaxial cable shall have the following features:
    - a. 95% percent copper braid.
    - b. Foam dielectric.
    - c. Solid copper core.
    - d. 75 ohm characteristic impedance.
    - e. Plenum jacket.
  2. Manufacturer: West Penn #25815.
  3. Provide West Penn #825 with a black jacket for CCTV video cross-connect/patch cabling under 15' in length.
  4. BNC Connectors
    - a. Provide 3 piece BNC connectors designed for the specific coaxial cable used.
    - b. Use cable manufactures recommended BNC connector for type and size of coaxial cable.
    - c. Use correct full cycle ratcheting crimper manufactured for the specific BNC connector.

## 2.02 CABLE HANGERS ("J-HOOKS")

- A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.

B. Manufacturer:

1. B-Line #BCH21 (or variation per installation method); hanger for up to 40 cables
2. B-Line #BCH32 (or variation per installation method); hanger for up to 90 cables
3. Erico
4. Panduit
5. Or Equal

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Label cables in accordance with Section 13780 – Security Labeling.
- B. Secure wire and cable run vertically in conduit for continuous distances greater than thirty (30) feet at the vertical run terminations. Secure non-coaxial cables using screw-flange nylon cable ties or similar approved devices, Thomas and Betts or equivalent. Provide symmetrical clamping devices with split, circular or other wire conforming, nonmetallic bushings for coaxial cables.
- C. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations.
- D. Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.
- E. Lace, tie or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace or harness wire and cable to prevent mechanical stress on electrical connections; do not support wire or cable from a connection point.
- F. Dress and secure coaxial cables to preclude stress and/or deformation.
- G. Wiring for shielding certain conductors from others or routing in separate raceways, shall be as recommended by the manufacturer's current requirements.
- H. Provide necessary tie wires.
- I. Do not run signal wire and cable in parallel to power (120VAC).
- J. Follow manufacturers recommended guidelines for installation.

### 3.02 SIGNAL GROUNDING

- A. Ground SEC enclosures to nearest Telecommunications Grounding Busbar using an insulated #6 AWG (colored green) copper conductor.
- B. Provide termination busbar for shielded cables in SEC enclosure.
- C. Terminate shield drain wire at source end only (i.e., at SEC enclosure, not at the device)

- D. Provide continuous circuit above ground along entire circuit from load end (reader) to source end (ACU).
- E. Tape-off at drain wire a device, do not terminate.
- F. Comply with manufacturers recommended grounding requirements.

### 3.03 CABLE SUPPORT

#### A. Horizontal Support

- 1. Concrete and Metal construction (Above Ceiling)
  - a. Provide separate and dedicated cable support system for security cable runs. Anchor cable support system to structural ceiling. Support and tie cables at a maximum of 5 foot intervals.
- 2. Wood Construction (above ceiling and no ceiling)
  - a. Support cable utilizing appropriately sized drive rings or "D" rings.
  - b. Fasten rings to structural ceiling.
  - c. Install drive rings at approximately 5 foot intervals.
  - d. Route cable through drive rings and cable tie at 10 foot intervals, or every other drive.

#### B. Vertical Support

- 1. Riser Systems
  - a. Route cable through conduit in vertical riser systems.
  - b. Terminate conduit at each stacked closet in a junction box. Use 12"x10"x8" junction box as a minimum.
  - c. Fastened entire cable group to the inside of junction box at every other floor or approximately every 24 feet.
  - d. Fasten cable in Junction box utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method.
- 2. Vertical cable on floor space not in riser system
  - a. Route cable from below suspended ceiling devices to above ceiling when possible.
    - 1) Provide conduit and firestopping for cable routed in fire rated wall assemblies.
    - 2) Provide conduit for cable routed from below ceiling devices to above ceiling on concrete tilt up style walls.
  - b. Cable routed vertically from devices with no suspended ceiling.
    - 1) Provide conduit stub from device junction box to 14 feet A.F.F minimum.

END OF SECTION 13770



**SECTION 13780**  
**SECURITY SYSTEM LABELING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.
- B. Section Includes:
  - 1. Labeling of wire, cable, security devices, enclosures, and raceways.
- C. Related Sections:
  - 1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
  - 2. Section 13700 Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

**1.03 SUBMITTALS**

- A. Product Data: Submit the following:
  - 1. Product information for components specified herein.
  - 2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.
- B. Labeling Sample:
  - 1. Submit two sets of physical product samples for review and comment by Engineer and Owner prior to the installation of equipment:

**PART 2 - PRODUCTS**

**2.01 NAMEPLATES**

- A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved nameplates shall have white letters and be punched for mechanical fasteners.

## 2.02 LABELS

- A. Manufacturer: Brady, or Thomas and Betts.
- B. Wire and Cable Labels:
  - 1. Self-laminating adhesive laser labels.
  - 2. Machine printable with a laser printer.
  - 3. Printable area: X inches by X inches.
  - 4. Cable size: 0.16 – 0.32” OD
  - 5. Color: white with black lettering
  - 6. Manufacturer: Brady wire marking labels WML–211-295 and WML-311-292.
- C. Device Labels:
  - 1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General Requirements
  - 1. Label the security system components. The components shall include, but are not limited to, the following:
    - a. Equipment Enclosures
    - b. Conduits
    - c. Security Devices
    - d. Batteries
    - e. Wires and Cables
    - f. Equipment Racks
    - g. Terminal Blocks
    - h. Relays
    - i. Patch panels, and the termination positions within the patch panels.
  - 2. Labels shall coincide with device IDs used on the record drawings.
  - 3. Degrease and clean surfaces to receive nameplates and labels
  - 4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.
- B. Equipment Enclosures
  - 1. Label SEC and CEC enclosures associated with the security system with a nameplate.
  - 2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
  - 3. Color: Green background with White lettering.

4. Example:

- a. Line 1: "SEC-01" (1/2 inch high letters)
- b. Line 2: "Security Equipment Enclosure" (1/4 inch high letters)

C. Conduits

1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
2. Example: "To SEC-01"

D. Security Devices

1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
2. Label each device in a concealed location with the system point number and address.

E. Batteries

1. Label power supply batteries with the month and year they were installed.
2. Example: "April 2004"

F. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
5. Positional labels so they are clearly visible without the need to remove wire management or any other obstructions.
6. Label cables at both ends of a run and within all pull and junction boxes using machine generated wrap-around labels.
7. See Item 3.02 for examples.

G. Terminal Blocks.

H. Relays.

- I. Patch Panels:
  - 1. Label individual ports on the patch panels.
  - 2. Example: "V01 V02 V03 ..."

### 3.02 CABLE LABEL FORMAT

#### A. From Panel to Field Device:

- 1. Line 1: Device Type and Device Number.
- 2. Line 2: Panel ID – Port Number.
- 3. Example:

CR 001  
PANEL 2 – CR5

#### 4. Standard Device Types:

- a. CR = Card Reader.
- b. K = Camera.
- c. IC = Intercom Reader.
- d. R = Relay Output.
- e. A = Alarm Point.

#### 5. Standard Port #s:

- a. CR = Reader.
- b. M = Monitored Input.
- c. R = Relay Output.

#### B. From Door Junction Box to Card Reader:

- 1. Line 1: Device Type and Device Number.
- 2. Line 2: Panel ID – Port Number.
- 3. Example:

CR 001  
PANEL 4 – CR3

#### C. Miscellaneous Examples:

- 1. From Door Junction Box to Door Contact:

CR001  
D.C.

- 2. From Door Junction Box to Rex Alarm:

CR001  
REX ALM

3. From Panel to Rex:

CR001  
REX PWR  
VDC

4. From Panel to Lock:

CR001  
LCK PWR  
24 VDC

D. Communications Cable:

1. Line 1: Communication Type and Direction.
2. Line 2: Panel ID.
3. Example:

RS485 TO  
PANEL 2

4. Typical Communication Types:

- a. 100BASE-T
- b. RS 485
- c. RS 232
- d. RS 422
- e. SNET
- f. 20mA

END OF SECTION 13780



**SECTION 13790**  
**SECURITY SYSTEM COMMISSIONING**

PART 1 - General

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

1.02 SCOPE OF WORK

- A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to test a completed security system installation as described in these specifications.
- B. Base Bid Work
  - 1. Full testing of a completed security system which includes:
    - a. A complete pretest of the security system.
    - b. A final walk test with the Engineer and/or Owner.
    - c. Test Results Record Documentation.
- C. Related Sections:
  - 1. Section 13700 Basic Security Requirements: for submittal format.

1.03 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

- A. Overview
  - 1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.
  - 2. Perform testing activities after-hours or on weekends when the system is “quiet” and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.
- B. Pre-Test
  - 1. Perform a 100% pre-test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system’s operation to the Owner and Engineer.
  - 2. Document the results of the pre-test using the approved test forms and shall submit a copy to the Engineer along with the system activity reports

C. Final Test

1. Perform a final test of the system in the presence of the Engineer and/or Owner to demonstrate correct operation of the security system.

1.04 SUBMITTALS

A. Operation and Maintenance Manuals: Submit the following for review and comment at the completion of the project:

1. Functional Design Manual: Includes a detailed explanation of the operation of the system.
2. Hardware Manual which includes:
  - a. Pictorial parts list and part numbers.
  - b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators.
  - c. Telephone numbers for the authorized parts and service distributors.
  - d. Include service bulletins.
3. Software Manual which includes:
  - a. Use of system and applications software.
  - b. Initialization, start-up, and shut down procedures.
  - c. Alarm Reports
4. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:
  - a. Computers and peripherals.
  - b. System start up and shut down procedures.
  - c. Use of system, command, and applications software.
  - d. Recovery and restart procedures.
  - e. Graphic alarm presentation.
  - f. Use of report generator and generation of reports.
  - g. Data entry operator commands.
  - h. Alarm messages and reprinting formats.
  - i. System access requirements.
5. Maintenance Manual which includes:
  - a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.
  - b. Detailed instructions for repair of the security system.
  - c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.
  - d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.
6. Test Results Manual, which includes the document results of tests, required



under this Specification, organized by System, Floor, and Door.

7. Record Drawings Manual which includes 11"x17" prints of record drawings as described below.
- B. Record Drawings: Submit the following for review and comment at the completion of the project:
1. Drawings shall fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints.
  2. Record drawings shall include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.
  3. Record drawings shall include the following additional information:
    - a. Device addresses & IP address information.
    - b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)
  4. Final acceptance will not be made until the Engineer approves the record drawings.

#### 1.05 QUALITY ASSURANCE

- A. Provide a project manager to coordinate the security system commissioning work with other trades.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.01 SCHEDULING

- A. Coordinate security commissioning with the General Contractor, and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

##### 3.02 TESTING REQUIREMENTS

A. Site Tests

1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.
2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.
3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.
4. At the completion of the work, test the entire system to verify proper operation.

These tests shall include:

- a. Building Perimeter Test: Test doors, cameras, and devices related to securing the perimeter of the operations building.
- b. Equipment Room Test: Inspect system panels, power supplies, and other related security equipment located in these areas.
- c. Access Control System Test: Test the software for correct programming and setup.
- d. Other Readers/Door Test: Test remaining card readers and doors not included in the above tests.
- e. CCTV Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the ACAMS system for alarm call-up. Test and verify CCTV system viewable from Dispatch monitors.
- f. CCTV Camera Test: Review cameras for proper coverage, quality of video, etc.

#### B. Test Preparation

1. Provide device identification numbers that differ from or were not included on the original contract drawing set.
2. Provide a complete systems point list.
3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.
4. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
5. Provide radios for use by the Engineer and Owner during testing.
6. Provide pre-programmed access cards for use during testing. Provide one card for each access level.

### 3.03 TEST PROCEDURES

- A. Refer to the test forms for testing procedures for each type of device/system.

### 3.04 DOCUMENTATION

- A. Provide a full-sized blueline drawing containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each ACU & I/O Board) for each SEC. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.
- B. Provide a service log on the inside door of each SEC. Service log shall include columns for the following information: date of service, description of work performed, service technician(s), service company. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

### 3.05 DEMONSTRATION

- A. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system.
- B. Utilize the database for the project during training to give the users a project specific example to learn from.
- C. Provide a minimum of 10 hours of on-site training for the ACAMS by a factory-trained representative. Conduct separate training sessions for system administrator, system supervisor, and operator level users
- D. Provide a minimum of 6 hours of on-site training for the Surveillance system by a factory-trained representative. Conduct separate training sessions for system administrator, system supervisor, and operator level users.
- E. Maintain a sign in sheet with names and dates of all persons trained and forward to University's Representative upon completion of training.
- F. Provide for two Owner's representatives to attend factory certification training (off-site) for the Access Control System

END OF SECTION 13790



## SECTION 13930

### FIRE PROTECTION SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SECTION INCLUDES

- A. Furnish and install Automatic wet pipe sprinkler system; include:
  - 1. Design and install wet-pipe sprinkler systems for the Administration Building. Design shall include all required Hydraulic calculations.

##### 1.03 RELATED SECTIONS

- A. Section 01330 - Submittal Procedures

##### 1.04 REFERENCES

- A. NFPA 13 - (2002) Installation of Sprinkler Systems.
- B. NFPA 25 - (2002) Inspection, Maintenance and Testing of Water-Based Fire Protection Systems.
- C. NFPA 14 - (2003) Standpipe and Hose Systems
- D. Uniform Building Code - (2001 Edition with latest California (CA) amendments)
- E. Uniform Fire Code - (2001 Edition with latest CA amendments)

##### 1.05 SYSTEM DESCRIPTION

- A. System to provide complete sprinkler and standpipe coverage per codes listed above. If a conflict exists the most restrictive requirement(s) shall be used in the design.
- B. Provide system in accordance with occupancy classification and general layout as shown on drawings.

##### 1.06 SUBMITTALS

- A. Submit complete shop drawings, product data, design and hydraulic calculations to authority having jurisdiction (AHJ) and Engineer for approval. Shop drawings shall contain all items required by NFPA 13 and NFPA 14. Incomplete drawings will be rejected. Obtaining the approval of the AHJ shall be included in the scope of work. Submit review set to the Engineer concurrent with the submittal to the AHJ. Submit proof of AHJ approval to the Engineer.

- B. Shop drawings shall include detailed pipe layout, hangers, supports, components, and accessories. Shop drawings shall also include the coordinated locations of all lights and HVAC diffusers. The Contractor shall verify, in writing, at the time of submittal that the information shown has been reviewed and approved by the mechanical and electrical sub-contractors. All shop drawings submitted without this certification will be rejected without a review.
- C. Provide operation and maintenance manuals in quantities and format as specified in Section 01330 - Submittal Procedures. Maintenance Manuals shall include the applicable forms from NFPA 25 along with a recommended maintenance schedule as well as written maintenance procedures for recommended maintenance. Operation manuals shall include reduced size drawings of system, copies of the hydraulic calculations and hydraulic name plate, UL listing information for all components of the system, catalog cut sheets for all system components, a written sequence of operations for the system, copies of the systems acceptance forms from NFPA 13 and 14, copies of all warranties and guarantees, copies of the completed and signed off City sprinkler inspection card and copies of the final certificate of occupancy. All copies of documents shall be legible. Provide typed instructions relative to the operation of the sprinkler controls. Encase instructions in metal frame with Lucite cover and mount at the riser location.

#### 1.07 QUALITY ASSURANCE

- A. Design and installation shall conform to the requirements of NFPA 13 and 14 and the Uniform Building Code and Fire Code. See section 1.3, References, for code edition.
- B. Equipment and Components: Shall Be UL listed or FM approved for fire protection service.
- C. Specialist Firm: The automatic wet pipe sprinkler contractor shall be a California State licensed (C-16) company specializing in the design and installation of sprinkler systems.

#### 1.08 REGULATORY REQUIREMENTS

- A. All "For construction" drawings, hydraulic calculations and product data shall include the stamp of approval of the authority having jurisdiction.

#### 1.09 EXTRA STOCK

- A. Provide extra sprinkler heads per the provisions of NFPA 13.
- B. Provide suitable wrenches for each head type.
- C. Provide and install metal storage cabinet in location designated by the Engineer.

## PART 2 - PRODUCTS

### 2.01 PIPING MATERIALS

- A. Provide pipe material per NFPA 13 and 14.

### 2.02 SPRINKLER HEADS

- A. Office areas: (Areas with hard or drop ceilings): Semi-Recessed Pendant Sprinkler Heads. Sprinkler and Escutcheon finish color to be white.
- B. Non-Office areas (Areas without hard or drop ceilings): Pendant, Upright or Sidewall Sprinkler Head (with BRZ or CHRM finish) and head guard if sprinkler deflector is within 15 feet of the floor.
- C. Manufacturers
  - 1. Reliable
  - 2. GEM
  - 3. Viking
  - 4. Or equal.

### 2.03 ACCESSORIES

- A. Provide all accessories to achieve a complete working system, including, but not limited to, flow switches and tamper switches. Electrical connection to fire alarm systems by Fire Alarm Contractor.
- B. Provide and install an engraved hydraulic nameplate with the information required by NFPA 13. Plate shall have minimum 1/8 inch white letters on red background.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Coordinate work of this section with other affected work. Use reflected ceiling plans; mechanical plans, structural plans and electrical lighting plan to avoid conflicts with lights, ducts, piping or structure.

### 3.02 INSTALLATION

- A. Piping system shall include flexible couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints and other features in accordance with NFPA 13 and 14 for protection of piping against damage from earthquakes.
- B. Place exposed piping above bottom cord of bar joists, unless shown otherwise on Drawings.
- C. Place pipe runs to minimize obstruction to other work.

- D. Place piping in concealed spaces above finished ceilings.
- E. Apply strippable tape or paper cover to ensure sprinkler heads do not receive field paint finish.
- F. Provide drain valves at system low points.
- G. The locations of the sprinkler heads shall be coordinated with the mechanical and electrical sub-contractors so as to avoid conflicts among sprinkler heads, lights, and diffusers.
- H. Coordinate locations of piping and sprinkler heads in covered parking areas to maintain clearances required for passage of vehicles. For minimum clearances see architectural drawings.

### 3.03 FIELD QUALITY CONTROL

- A. Hydrostatically test sprinkler systems in accordance with NFPA 13 and 14. Check system for leakage at joints. Measure hydrostatic pressure at low point of each system or zone being tested.

### 3.04 CLEANING

- A. Flush entire piping system of foreign matter in accordance with NFPA 13. Flushing shall continue until water is clear.

END OF SECTION 13930



## SECTION 14240

### HYDRAULIC ELEVATORS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes hydraulic, holeless passenger Elevator #1.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Division 4 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry.
  - 3. Division 5 Section "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Divider beams.
    - c. Structural-steel shapes for subsills.
    - d. Pit ladders.
  - 4. Division 9 Section "Linoleum Floor Coverings" for finish flooring in elevator cars.
  - 5. Division 13 Section "Fire Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.
  - 6. Division 13 Section "Basic Security System Requirements" for security card access equipment used to restrict elevator use.
  - 7. Division 16 Section "Premises Telephone Wiring" for telephone service to elevators.
  - 8. Division 16 Sections for electrical service for elevators to and including disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.

##### 1.03 DEFINITIONS

- A. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

##### 1.04 SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features,

finishes, and similar information.

- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- square samples of sheet materials; and 4-inch lengths of running trim members.
- D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- E. Maintenance Manuals: Include operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at Project closeout as specified in Division 1.
- F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an experienced installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in ASME A17.1, "Safety Code for Elevators and Escalators."
  - 1. Seismic Risk Zone: Project is located in Zone 3 or greater.
- C. Accessibility Requirements: In addition to requirements of authorities having jurisdiction, comply with the more restrictive requirements of both "California Disabled Accessibility Guidebook 2000" (CalDAG 2000) and the Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)"

#### 1.06 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.

- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

## 1.07 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by manufacturer agreeing to repair, restore, or replace defective elevator work within specified warranty period.
  - 1. Warranty Period: 12 months from date of Substantial Completion.

## 1.08 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service.
    - a. Response Time: Two hours or less.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hydraulic elevators that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Dover Elevator Systems.
  - 2. Fujitec America, Inc.
  - 3. Montgomery KONE Inc.
  - 4. Otis Elevator Co.
  - 5. Schindler Elevator Corp.
  - 6. Thyssen Elevator Group North America.

## 2.02 MATERIALS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.
- B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:
  - 1. Pump, with fan-cooled squirrel-cage induction motor, mounted on top of oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch-thick, glass-fiber insulation board.
  - 2. Submersible pump, with submersible squirrel-cage induction motor, suspended inside tank from vibration isolation mounts.
  - 3. Provide motor with wye-delta or solid-state starting.
  - 4. Provide variable-voltage variable-frequency motor control.
- C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.
- D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.
  - 1. Provide dielectric couplings at plunger/cylinder units.
  - 2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785 joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.
- F. Protective Cylinder Casings: PVC pipe casings complying with ASME A17.1, of sufficient size to provide not less than 1-inch clearance from cylinder, and extending above pit floor.
- G. Corrosion Protective Filler: A solventless, petroleum-based gel formulated for filling the space between hydraulic cylinders and protective casings. Filler is heavier than water, electrically nonconductive, and liquefies at approximately 150 deg F.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Diversified Enterprises; No-Ox-Id R-R #6110A.
    - b. Pacific Standard Chemical Co.; Union-Gard 160.
- H. Car Frame and Platform: Welded steel units.

- I. Finish Materials: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated:
  1. Satin Stainless Steel: ASTM A 666, Type 304, with No. 6, nondirectional satin finish.
  2. Enameled-Steel Sheet: Cold-rolled steel sheet complying with ASTM A 366/A 366M, matte finish, stretcher-leveled standard of flatness; hot-rolled steel sheet complying with ASTM A 569/A 569M may be used for door frames. Provide with factory-applied enamel finish; colors as selected by Architect.
  3. Prime-Painted Steel Sheet: Cold-rolled steel sheet, ASTM A 366/A 366M, or hot-rolled steel sheet, ASTM A 569/A 569M, with factory-applied rust-inhibitive primer.
  4. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications; color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range of products.

## 2.03 OPERATION SYSTEMS

- A. Passenger Elevators: Provide manufacturer's standard microprocessor operation system for each elevator or group of elevators as required to provide type of operation system indicated.
  1. Single Elevator: Provide "selective collective automatic operation" as defined in ASME A17.1.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated.
  1. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car may be moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, each of a preselected length of time, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at fire command station. Manual operation causes automatic operation to cease.
  2. Standby Powered Lowering: On activation of standby power, cars are lowered to the lowest floor, open their doors, and shut down.
  3. Automatic Dispatching of Loaded Car: When car load exceeds a predetermined weight, doors will begin closing.
- C. Security Features: In addition to above operational features, provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
  1. Keyswitch Feature: Car and hall push buttons are activated and deactivated by security keyswitches. Key is removable only in deactivated position.
  2. Secured Landing Feature: Allows each landing to be secured or cleared. If landing is secured, car buttons for that landing do not register a call unless

landing access code is entered within a predetermined time period after landing button is pressed. When a secured landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered or predetermined time period has elapsed.

- a. Access codes are programmed at each car operating panel using a security keyswitch. Secured landing feature is activated and deactivated by a security keyswitch at the main landing.
3. Car-to-Lobby Feature: Feature, activated by a keyswitch at main lobby, that causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, cars complete calls registered before keyswitch activation and resume normal operation.
  4. Card-Reader Operation: For access to restricted landings. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space in car as indicated for card reader.
    - a. When system is activated, car calls to restricted landings do not register until card is accepted by security access system. Security access system determines which landings are restricted and which of those are accessible to cardholder.
    - b. Card readers and other security access system equipment are specified in Division 13 Section "Basic Security System Requirements."

## 2.04 SIGNAL EQUIPMENT

- A. General: Provide signal equipment for each elevator or group of elevators with hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.
- B. Car Control Stations: Provide manufacturer's standard semirecessed car control stations. Mount in return panel adjacent to car door, if not otherwise indicated.
- C. Car Control Stations: Provide fully recessed car control stations with applied metal faceplates. Mount in return panel adjacent to car door, if not otherwise indicated.
- D. Swing-Return Car Control Stations: Provide car control stations fully recessed in hinged return panel adjacent to car door.
  1. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation.
  2. Mark buttons and switches with manufacturer's standard identification for required use or function that complies with ASME A17.1.
  3. Mount controls at heights complying with with the more restrictive requirements of both "California Disabled Accessibility Guidebook 2000" (CaIDAG 2000) and the Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

- E. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- F. Fire Department Communication System: Provide flush-mounted cabinet in each car and required conductors in traveling cable for fire department communication system specified in Division 16 Sections.
- G. Car Position Indicator: For passenger elevator cars, provide illuminated-signal type, digital-display type, or segmented type, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
  - 1. Include travel direction arrows if not provided in car control station.
- H. Hall Push-Button Stations: Provide hall push-button stations at each landing for each elevator or group of elevators as indicated.
  - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  - 2. Provide units with direction-indicating buttons; two buttons at intermediate landings; one button at terminal landings.
- I. Hall Lanterns: Provide units with illuminated arrows, but provide single arrow at terminal landings.
  - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
  - 2. Place lanterns either above or beside each hoistway entrance, unless otherwise indicated. Mount at a minimum of 72 inches above finished floor.
  - 3. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
    - a. At manufacturer's option, audible signals may be placed on each car.
- J. Hall Position Indicators: Provide illuminated-signal type or digital-display type, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- K. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations with text and graphics according to ASME A17.1, Appendix H.

## 2.05 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with a uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

## 2.06 PASSENGER ELEVATOR CAR ENCLOSURES

- A. General: Provide manufacturer's standard enameled-steel car enclosures with removable wall panels, suspended ceiling, trim, accessories, access doors, doors, power door operators, sills (thresholds), lighting, and ventilation.
  - 1. Floor finish is specified in another Section.
  - 2. Metal Wall Panels: Flush hollow-metal construction, fabricated from metal indicated.
  - 3. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch fire-retardant-treated particleboard with plastic-laminate panel backing complying with NEMA LD 3, Type BKV and manufacturer's standard protective edge trim. Panels have a flame-spread rating of 25 or less, when tested according to ASTM E 84.
  - 4. Fabricate car with recesses and cutouts for signal equipment.
  - 5. Fabricate car door frame integrally with front wall of car.
  - 6. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
  - 7. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
  - 8. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic complying with flammability requirements.
  - 9. Handrails: Manufacturer's standard handrails, of metal indicated.

## 2.07 PASSENGER HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
  - 1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- B. Materials and Fabrication: Provide manufacturer's standards but not less than the following:
  - 1. Stainless-Steel Frames: Formed stainless-steel sheet.
  - 2. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
  - 3. Sills: Extruded metal, with grooved surface, 1/4 inch thick..
  - 4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.



## 2.08 PASSENGER ELEVATOR

### A. Elevator No. #1:

1. Type: Holeless, telescoping, beside-the-car, dual cylinder.
2. Stops: See Drawings.
3. Rated Load: 3500 lb.
4. Rated Speed: 100 fpm.
5. Operation System: Selective collective automatic operation.
6. Auxiliary Operations:
  - a. Standby power operation.
  - b. Standby powered lowering.
  - c. Battery-powered lowering.
  - d. Independent service.
  - e. Loaded-car bypass.
  - f. Automatic dispatching of loaded car.
  - g. Nuisance call cancel.
7. Security Features: Card-reader operation.
8. Car Enclosures: As follows:
  - a. Inside Width: 80 inches.
  - b. Inside Depth: 51 inches.
  - c. Inside Height: 94 inches minimum.
  - d. Front Walls: Satin stainless steel with integral car door frames.
  - e. Car Fixtures: Satin stainless steel.
  - f. Side and Rear Wall Panels: Plastic laminate.
  - g. Reveals: Enameled steel.
  - h. Door Faces (Interior): Satin stainless steel.
  - i. Door Sills: Aluminum.
  - j. Ceiling: Luminous ceiling.
  - k. Handrails: Satin stainless steel, at side and rear walls.
  - l. Floor prepared to receive sheet linoleum (specified in Division 9 Section "Linoleum Floor Coverings").
9. Hoistway Entrances: As follows:
  - a. Width: 42 inches.
  - b. Height: 84 inches.
  - c. Type: Single-speed side sliding.
  - d. Frames: Satin stainless steel.
  - e. Doors: Satin stainless steel.
  - f. Sills: Aluminum.
10. Hall Fixtures: Satin stainless steel.
11. Additional Requirements: As follows:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
  - b. Provide protective blanket hooks in car and one complete set of full-height

blankets.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions, and examine supporting structure and other conditions under which elevator work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance.

### 3.02 INSTALLATION

- A. Install cylinders plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.
- D. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cement fittings.
- E. Lubricate operating parts of systems as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

### 3.03 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

### 3.04 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program.
- B. Make a final check of each elevator operation with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

### 3.05 PROTECTION

- A. Temporary Use: Do not use elevators for construction purposes unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage.
  - 1. Provide full maintenance service by skilled, competent employees of elevator Installer for elevators used for construction purposes. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use same parts and supplies as used in the manufacture and installation of original equipment.
  - 2. Provide protective coverings, barriers, devices, signs, and other procedures to protect elevators. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

END OF SECTION 14240



## SECTION 15050

### MECHANICAL GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 15.
- B. Each section included in Division 15 - Mechanical is incomplete without the provisions stated herein.

##### 1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Access doors.

##### 1.4 RELATED SECTIONS

- A. Section 02324 – Trenching.
- B. Section 09910 - Paints.
- C. Section 15950 - Testing, Adjusting and Balancing.

##### 1.5 REFERENCES

- A. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600kN-m/cu. m.)).
- B. ASTM E 814 - Fire Tests of Through-Penetration Fire Stops.
- C. IEEE C2 - National Electrical Safety Code.
- D. UL 1479 - Fire Tests of Through-Penetration Firestops.

##### 1.6 DEFINITIONS

- A. Provide: Where the word "provide" is used, the word shall be understood to mean "the Contractor shall furnish and install" the equipment, tests, inspections, etc. referenced.
- B. Related Work: The sections referenced under RELATED SECTIONS shall be

understood to include provisions which directly affect the work being specified in the section where RELATED SECTIONS occurs.

- C. Concealed: Where the word "concealed" is used in conjunction with piping, equipment, and the like, the word shall be understood to mean hidden from sight as in chases, furred spaces, or suspended ceilings.
- D. Exposed: Where the word "exposed" is used, the word shall be understood to mean open to view.

#### 1.7 SUBMITTALS

- A. Access Doors: Furnish product data and shop drawings. Indicate detailed dimension.

#### 1.8 REGULATORY REQUIREMENTS

- A. Perform work in accordance with the editions, revisions, amendments, or supplements of applicable statutes, ordinances, codes, or regulations of Federal, State, and Local Authorities having jurisdiction in effect on the date bids are received.
- B. Where approval standards have been established by OSHA, UL, ASME, AGA, AMCA, ANSI, ASHRAE, ARI, NFPA, State Fire Insurance Regulatory Body, follow these standards whether or not indicated on the Drawings and Specifications. Include cost of work required to comply with requirements of these authorities in the original proposal.
- C. Requirements in reference specifications and standards are minimum for equipment, material, and work. In instances where capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet listed or shown capacities.
- D. Resolve code violations discovered in Contract Documents with A/E prior to Contract award. After Contract award, make corrections or additions necessary for compliance with applicable codes.
- E. Arrange with local and state authorities and utility companies for permits, fees, and service connections for temporary and permanent water, sanitary sewer, storm and industrial waste services, verifying locations and arrangement, and pay charges including inspections.

#### 1.9 CONTRACT DRAWINGS

- A. Drawings are generally diagrammatic and are intended to encompass a system that will not interfere with the structural and architectural design of the building. Coordinate work to avoid interferences between piping, equipment, architectural, and structural work.
- B. Coordinate with architectural features, trim and millwork details, and install equipment in cabinets or other special areas as directed by A/E.

- C. Horsepower ratings on motors are based on scheduled equipment and design conditions. Actual field condition or substitutions from scheduled equipment may require different horsepower. If larger motor sizes are required, coordinate electrical service to ensure proper wire sizes and devices.
- D. Provide valves, stopcocks, waste cocks, strainers, and connections where shown on Drawings and where required for controlling the various pieces of equipment. Install valves where branches take off from mains for domestic water, hot water, chilled water, compressed air and natural gas.
- E. Drawings are based on equipment specified. Make adjustments, modifications, or changes required, due to use of other equipment.

#### 1.10 PROJECT/SITE CONDITIONS

- A. Site Visitation: Visit the site of the proposed construction to become thoroughly familiar with details of work and working conditions, verify dimensions in the field, and advise A/E of discrepancies before performing Work.
- B. Space Requirements:
  1. Consider space limitations imposed by contiguous work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
- C. Conceal piping and ductwork in finished areas, except in mechanical rooms, and where noted otherwise on the drawings. Route pipes and ducts through the building without interfering with other contractors' equipment or construction.
  1. Provide maximum possible clear height underneath piping and ductwork.
  2. Install equipment requiring service so that it is easily accessible.
  3. Compare the equipment sizes with the space allotted for installation before installation and make written notice of possible conflict. Disassemble large equipment to permit installation through normal room openings when required. Should written notice not be made in a timely manner, make adjustments and modifications necessary without additional compensation.
  4. Timely place equipment too large to fit through finished openings and stairways.
- D. Site Obstructions:
  1. Drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed as to accuracy of location or completeness of information.
  2. Verify with A/E, utility companies, municipalities, and other interested parties that available information has been provided before cutting or trenching operations are begun. Verify locations given.
  3. Alter routing of new work should obstruction be encountered, whether or not shown on Drawings. Reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and

- structures in a satisfactory and serviceable condition.
4. Assume total responsibility for and repair damage to existing utilities caused by construction, whether or not such existing facilities are shown. Repair the lines, if damaged.
- E. Cutting and Patching:
1. Submit written request to A/E in advance of cutting or alterations.
  2. Execute cutting and demolition by methods which will prevent damages to other work and will provide proper surfaces to receive installation of repairs.
  3. Restore work which has been cut or removed; install new products complying with specified products, functions, tolerances, and finishes specified.
  4. Escutcheon Plates.
  5. Heavy chrome-plated or nickel-plated escutcheon plates for penetrations of finished surface.
  6. Product: B&C No. 10 with concealed hinges.
  7. Fit work airtight to pipes, sleeves, ducts, and other penetrations through surfaces. For fire-rated penetrations, provide assemblies in accordance with UL 1479 and ASTM E 814 utilizing products and materials equal to rating of surfaces penetrated.

#### 1.11 MATERIALS AND WORKMANSHIP

- A. Provide new materials and equipment by those regularly engaged in the production and manufacture of specified materials and equipment. Where UL or other agency has established standards for materials, provide materials which are listed and labeled accordingly. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.
- B. Work shall be performed by workmen skilled in the trade required for the work. Install materials and equipment to present a neat appearance when completed in accordance with the approved recommendations of the manufacturer and in accordance with Contract Documents.
- C. Provide labor, materials, apparatus, and appliances essential to the complete functioning of the systems described or indicated herein, or which may be reasonably implied as essential whether mentioned in the Contract Documents or not.
- D. Make written request for supplementary instructions to A/E in cases of doubt as to Work intended or in the event of need for explanation thereof.
- E. Performance and material requirements scheduled or specified are minimum standards acceptable. The right to judge the quality of equipment that deviates from the Contract Documents remains solely with A/E.
- F. Prior to the purchase of materials manufactured outside the United States, submit complete certifications and typical mill reports for review. Provide mill heat



markings on foreign pipe delivered to job site; make available corresponding mill test reports.

#### 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Follow the manufacturer's directions completely in the delivery, storage, and handling of equipment and materials.
- B. Store equipment in a clean, dry place protected from other construction. While stored maintain factory wrapping or tightly cover and protect equipment against dirt, water, construction debris, chemical, physical or weather damage, traffic and theft.
- C. Adequately brace and package equipment to prevent breakage and distortion while in transit.

#### 1.13 YEAR 2007 COMPLIANCE WARRANTY

- A. If the Contract requires that specific listed products must perform as a system in accordance with this warranty, then extend that warranty to those listed products as a system.
- B. If the Contract requires verification through testing that Products provided are Year 2007 compliant, provide, upon request, a copy of testing results which verify that Products are Year 2007 compliant.
- C. The duration of this warranty and the remedies available to the Owner for breach of this warranty are as defined in and subject to, the terms and limitations of the standard commercial warranty or warranties under this Contract, the remedies available to the Owner under this warranty are limited to repair or replacement of any listed product whose noncompliance is discovered and made known in writing within 360 days after acceptance.
- D. Do not construe anything in this warranty to limit any rights or remedies the Owner may otherwise have under this Contract with respect to defects other than Year 2007 performance.
- E. The warranty period for Contractor workmanship and operation shall be for 360 days after final completion of project and acceptance by Owner.
- F. Extended Manufacturer's Warranties shall be provided in addition to Contractor's Warranty for a minimum period of five years.

#### 1.14 EXCAVATION

- A. Trenching and backfilling shall comply with Section 02324 – Trenching as well as provisions specified herein.
- B. Trenching:
  - 1. Provide minimum 12 inches between outer surfaces and embankment or shoring which may be used, when excavating for manholes and similar

- structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.
2. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines constructed during excavating and trenching operations, from damage during excavating, trenching, and backfilling; if damaged, repair lines as directed by utilities, Owner, and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.
  3. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finish grades, whichever is lower:
    - a. 1-Foot Minimum Cover: Sanitary sewer, storm drainage, industrial waste, acid waste.
    - b. 2-Foot Minimum Cover: Domestic water, fire line.
- C. Backfilling:
1. Backfill trenches after piping, fittings, and joints have been tested and approved.
  2. Backfill trenches with sand to provide 6 inches sand below piping and 12 inches sand cover.
  3. Backfill remainder of trenches with satisfactory materials. Backfill shall be material specified as "Fill" in Section 02055 – Soils or on-site soil conforming to the referenced geotechnical investigation. Place and compact fill as specified in Section 02324 – Trenching. Take care not to damage utility lines.
  4. Backfill trench utility line with sand backfill material in 6-inch layers, where trenches cross streets, driveways, building slabs, or other pavements. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.

## 1.15 WELDING

- A. Weld piping and above grade steel tanks in accordance with qualified procedures using performance qualified welders and welding operators. Qualified procedures and welders in accordance with ASME Section IX. Welding procedures qualified by others and welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. Notify the A/E 24 hours in advance of tests, and perform the tests at the work site if practicable. Furnish A/E with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. Apply welders or welding operators assigned symbols near each weld they make as permanent record.

## 1.16 PAINTING

- A. Refer to Section 09910.
- B. Properly prepare surfaces to receive paint. Prime prepared surfaces and finish with two coats of exterior oil base paint. Verify primer and paint are rated for application.
- C. Repair damage to factory painted finishes.
- D. Remove splattered and incidental paint from mechanical equipment.

## 1.17 PILOT INSTALLATION

- A. Provide a pilot installation of items of equipment which are concealed and require service, such as variable air volume boxes, fan coil units, and hot water coils. Have pilot installation approved before further installation work is performed for the particular items of equipment.

## 1.18 ACCESS DOORS

- A. Provide access doors in walls, floors, and ceilings to permit access to equipment and piping requiring service or adjustment:
  - 1. Valves.
  - 2. Manual balance dampers and automatic control dampers.
  - 3. Fire dampers, smoke dampers and smoke/fire dampers.
  - 4. Air terminal units.
  - 5. Duct mounted filters and coils.
  - 6. Plumbing drainage cleanouts.
  - 7. Kitchen hood exhaust ductwork, in accordance with NFPA requirements.
  - 8. Other mechanical equipment indicated in mechanical equipment schedules requiring maintenance, adjustment, or operation.
- B. Provide hinged access doors and frames as follows:
  - 1. Drywall Construction:
    - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel. Factory prime paint surfaces not galvanized.
    - b. Product: Milcor, □□Style DW.
  - 2. Visible Masonry and Ceramic Tile: Milcor, □□Style M.
  - 3. Gypsum and Cement Plaster: Milcor, □□Style K.
  - 4. Acoustic Plaster:
    - a. Reinforce panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sleeved and grommeted screwdriver operated cam locks in sufficient number for the size of the panel. Factory prime paint surfaces not galvanized.
    - b. Product: Milcor, □□Style AP.
    - c. Acoustic Tile: Milcor, □□Style AT.
- C. Provide continuous concealed hinges and cam locks.

- D. Provide UL listed 1-1/2 hour Label "B" access doors with automatic self-closing latching mechanism where required.
- E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.
- F. Coordinate approval and location of access doors with A/E.

#### 1.19 NOISE AND VIBRATION

- A. Provide the entire operating system and its component items of equipment free of objectionable vibration or noises. Refer to ASHRAE handbook for recommended noise criteria (NC) unless otherwise noted. Statically and dynamically balance rotating equipment, and mount or fasten so that no equipment vibration will be transmitted to the building. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts, or other parts of work, rectify such conditions at no additional compensation.

#### 1.20 OPERATING INSTRUCTIONS

- A. Provide services of authorized representatives of manufacturer to ensure that the equipment is installed according to the manufacturer's recommendations, is operating properly, and to instruct Owner's operating personnel during start-up and operating tests of complete mechanical systems. Prove operation of equipment to A/E. Notify A/E seven days prior to beginning equipment start-up.
- B. Certify in writing that these services have been performed.
- C. Perform tests as specified in Section 15950.

#### 1.21 SERVICE

- A. Inspect, clean, and service air filters and strainers immediately prior to final acceptance of project. Replace disposable type air filters.
- B. Provide lubrication for operation of equipment until final acceptance of the equipment by A/E. Protect bearings during installation and thoroughly grease steel shafts to prevent corrosion. Provide extended lubrication lines for parts requiring lubrication which are concealed or inaccessible.
- C. Provide complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify it for proper operation as required.
- D. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys, and other rotating parts which are located so a person might come in close proximity with. Construct protective guard around angle iron frame,

securely bolted to apparatus; comply with safety requirements. Install guard to completely enclose drives and pulleys, and not interfere with lubrication of equipment. Provide 2-inch minimum diameter opening in fan belt guards housing for tachometer.

- E. Place mechanical systems in complete working order, and clean and polish fixtures, equipment, and materials thoroughly returning to "as new" condition prior to request for final review.
- F. Remove excess material and debris. Clean out lines and fittings and adjust valves. Broom clean areas. Thoroughly clean ductwork inside and out before grilles are installed.

#### 1.22 PROJECT RECORD DOCUMENTS

- A. Maintain a set of Contract Documents at the job site for the purpose of recording final size, location, and interrelation of work under this Division. Mark this set of drawings as the job progresses to indicate "as-built" location of equipment, including concealed piping, valves, and ductwork.
- B. Obtain Drawings from A/E, at Contractor's expense, and record as-built conditions.
- C. Clearly and accurately delineate the work by dimensions on the record drawings as installed, with equipment locations identified by at least two dimensions to permanent structures.
- D. Final record drawings shall be marked "AS-BUILT," and signed and dated by Contractor.
- E. Provide certified "AS-BUILT" drawings at the conclusion of project.

#### 1.23 FINAL REVIEW

- A. Obtain necessary Certificates of Occupancy from local authorities.
- B. Submit final approved operation and maintenance manuals including approved submittals, test reports, and "AS-BUILT" drawings prior to requesting final payment. Delivery of operation and maintenance manuals is a condition of final acceptance.

#### 1.24 GUARANTEE

- A. Guarantee materials, parts, and labor for Work for one year from the date of issuance of occupancy permit. During that period, make good faults or imperfections that may arise due to defects or omissions in materials or workmanship with no additional compensation and as directed by A/E.
- B. Certain items of equipment, such as small sealed refrigeration units, are covered by the manufacturer's warranty of longer durations.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 15050

## **SECTION 15051**

### **SUBMITTALS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Preparation and submission of shop drawings and catalog data.
- B. Each section included in Division 15 - Mechanical incorporates this section by reference and is incomplete without the provisions stated herein.

##### **1.3 RELATED SECTIONS**

- A. Section 15052 - Operation and Maintenance Manuals.

##### **1.4 MANUFACTURERS**

- A. Listed manufacturers will be acceptable as long as specified requirements are met.
- B. Manufacturers who are not listed as "acceptable manufacturers" bear the burden of proof to A/E that their products comply with specified requirements. Those manufacturers shall agree in writing to bear the cost of A/E time to review compliance with Specifications whether their products are approved or not.

##### **1.5 CONTRACTOR'S CERTIFICATION**

- A. Submittals will be submitted only by Contractor. Indicate by signed stamp that Contract Documents have been checked, that the work shown in the submittals is in accordance with contract requirements and that dimensions and relationship with work of other trades have been checked. Submittals submitted for review that have not been checked and signed by Contractor, will be returned for checking before being considered by the A/E.

##### **1.6 PREPARATION**

- A. Include information relevant to particular equipment or materials to be furnished, where product data published by manufacturer is part of submittal.
- B. Provide documentation of compliance with manufacturer's published literature or drawings or letter signed by officer of manufacturer in cases where compliance with UL, FM, ARI, IRI, or other similar organization standards are required.
- C. Furnish all underground piping submittals within 15 days after receiving a signed

contract and prior to the start of installation. Furnish all other HVAC and Plumbing submittals in one package at one time within 45 days after receiving a signed contract. No piece meal submittals will be accepted.

- D. Include identifying symbols and equipment numbers used in Contract Documents for all equipment and material submitted.
- E. Cross reference sheet numbers on Drawings for shop drawings. Provide shop drawings consisting of plans drawn to scale, with elevations and sections, to show clearly the location of major items of equipment and clearances for maintenance and code requirements.
- F. Submit only requested submittals complete by types of equipment (i.e., pumps, air handling equipment, etc.) labelled with applicable specification section(s) included. Each submittal will be handled separately. Should any item not be acceptable, the entire submittal will be returned to Contractor for correction and resubmittal. Partial submittals will not be acceptable. The intent of this requirement is that all approved bound sets of data will be identical and will contain only acceptable information.
- G. Submit a compliance sheet for each submittal indicating the submittal is in full compliance with the drawings and specifications. Indicate by drawing number or specification section number and paragraph numbers all exceptions taken and include an explanation.
- H. The review of submittals does not relieve or modify Contractor's responsibility for compliance with Contract Documents or dimensions or errors contained in the submittal or quantity count. It is clearly understood that, in the review process, noting of some discrepancies but overlooking others does not grant Contractor permission to proceed in error. Regardless of any information contained in the submittals, Contract Documents govern the work, and are neither waived nor suspended in any way by the review of the submittals.
- I. A minimum review period of two weeks, exclusive of transmittal time, will be required in A/E office for each submittal. Take this time period into consideration when scheduling construction.
- J. Include in submittals sufficient plans, elevations, sections, performance data, dimensions, bolt locations, ratings, sound data, weights and schematics to clearly describe the equipment and to show compliance with these specifications. Provide a cover or title sheet for the submittal containing the following:
  - 1. Name of Contractor originating the submittal.
  - 2. Name of project for which the submittal is made.
  - 3. An index of all items submitted including:
    - a. Mark of equipment on drawings.
    - b. Manufacturer.
    - c. Catalog number.
    - d. Specification section number.
  - 4. Date of submittal and date of each revision.
  - 5. Contractor's certification of review.
  - 6. Contractor's certification of compliance.



- K. Shop drawings and product data which do not comply with specified requirements will be returned for resubmittal. Submit two paper sepias for shop drawings.
- L. A/E will retain one copy and the Owner will retain one copy of the submittal. Remaining copies will be returned to Contractor marked FURNISH AS SUBMITTED, FURNISH AS CORRECTED, REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM. If it is marked FURNISH AS SUBMITTED or FURNISH AS CORRECTED, no additional submittal is required. If it is marked REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, repeat the submittal in accordance with this section. It is intended that Contractor submit complete and accurate shop drawings and product data at the first submittal. If the submittals are returned to Contractor marked REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, only one additional submission is permitted.
- M. If the reproducible sepia or product data marked FURNISH AS SUBMITTED or FURNISH AS CORRECTED is altered for any reason after it has been stamped, the REVIEWED stamp shall automatically be voided.
- N. Provide all work in accordance with the submittals stamped FURNISH AS SUBMITTED or FURNISH AS CORRECTED inasmuch as they are in agreement with Contract Documents. Where differences occur between the submittals and Contract Documents, Contract Documents shall govern the work.
- O. Provide one copy of all approved shop drawings and product data to the testing, adjusting and balancing contractor prior to project completion.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REQUIRED SUBMITTALS

- A. Furnish product data for devices, equipment, or systems specified. All other submittals will be returned to Contractor without review. Furnish shop drawings as indicated.

### 3.2 FINAL SUBMITTAL

- A. In addition to the number of copies of shop drawings and product data required to review submittals, maintain separate file of final reviewed copies of such material. Deliver approved submittals in hardback binder for Owner's use. Incorporate changes and revisions made throughout construction period. Refer to Section 15052.

END OF SECTION 15051



## SECTION 15052

### OPERATION AND MAINTENANCE MANUALS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Preparation and submission of operation and maintenance manuals.
- B. Each section included in Division 15 - Mechanical incorporates this section by reference and is incomplete without the provisions stated herein.

##### 1.3 RELATED SECTIONS

- A. Section 15050 - Mechanical General Provisions.
- B. Section 15051 - Submittals.
- C. Section 15950 - Testing, Adjusting and Balancing

##### 1.4 PREPARATION

- A. Furnish four copies of complete operation and maintenance instructions, service manuals and parts list applicable to each manufactured item of equipment furnished. Bind operation and maintenance information in four separate loose leaf binders and deliver to the A/E at least four weeks prior to final review of the project.
- B. Organize binders to contain like equipment such as pumps, piping, valves or air handlers, terminal boxes, condensers, etc., in separate divisions. Provide a complete double index for each binder to include:
  - 1. An alphabetized list of the products by name.
  - 2. An alphabetized list of manufacturers whose products have been incorporated in the work, together with their addresses and the name, addresses and telephone numbers of the local sales representative or supplier.
- C. For each section of product, equipment or system, organize the data as follows:
  - 1. Furnish a general description of the equipment or system listing the major components, intended service and other general data.
  - 2. Furnish technical data including nameplate data, design parameters, ratings, capacity, performance data, operating curves, characteristics and the like. Clearly distinguish between information which does and does not apply.
  - 3. List warnings and cautions to be observed during both installation and

- operations.
4. Fully detailed installation and operation instructions including special tools required, alignment instructions, start-up, and shut-down sequences.
  5. Furnish maintenance, service and repair instructions including maintenance and service schedules, materials, and methods for performing routine and annual service.
  6. Furnish a troubleshooting guide and check list indicating common failures, test methods and procedures for determining component fault or failure.
  7. Furnish a spare parts list indicating part and order number with name, address, and telephone number of supplier. Include current prices of replacement parts and supplies.
  8. Furnish diagrams including controls, wiring, installation or operation of the equipment or system.
  9. Furnish copies of all approved submittals. Refer to Section 15051.
  10. Furnish copies of all test reports. Refer to Section 15950.
  11. Print copies of the "AS-BUILT" drawings. Refer to Section 15050.
  12. Furnish all warranties and guarantees.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 15052

## SECTION 15060

### HANGERS AND SUPPORTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Supports, anchors and sleeves applicable to mechanical, plumbing, and fire protection systems, including:
  - 1. Pipe, duct, and equipment hangers, supports, and associated anchors.
  - 2. Equipment bases and supports.
  - 3. Sleeves and seals.
  - 4. Flashing and sealing equipment and pipe stacks.

##### 1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Provide hanger and support inserts and sleeves and coordinate placement into formwork.

##### 1.4 RELATED SECTIONS

- A. Section 15083 - Piping Insulation.

##### 1.5 REFERENCES

- A. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- B. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

##### 1.6 QUALITY ASSURANCE

- A. Supports for Sprinkler Piping: NFPA 13.
- B. Supports for Standpipes: NFPA 14.

#### PART 2 - PRODUCTS

##### 2.1 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Provide malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over:

Carbon steel, adjustable, clevis.

- C. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.
- E. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- I. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- J. Design hangers without disengagement of supported pipe.
- K. Copper Pipe Support and Hangers: Carbon steel ring, adjustable, copper plated.
- L. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180-degree segments, minimum 12 inches long at pipe support.
- M. Shield for Insulated Piping 2-1/2 Inch and Larger (Except Cold Water Piping): Use pipe covering protective saddles.
- N. Shields for Insulated Cold Water Piping 2-1/2 Inch and Larger: Galvanized steel shields in 180-degree segments in accordance with following table:

Pipe	Metal Gage	Shield Length
2 1/2" to 5"	16	12"
6" to 12"	14	24"
Over 12"	12	24"

- O. Shields for Vertical Copper Pipe Risers: Sheet lead.

## 2.2 HANGER RODS

- A. Steel, threaded both ends, threaded one end or continuous threaded.

## 2.3 INSERTS

- A. Provide malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Lead Flashing: 5 pounds per square foot sheet lead for waterproofing; 1 pound per square foot sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; use 16 gage at fire resistant elements.

## 2.5 EQUIPMENT BASES AND SUPPORTS

- A. Provide concrete pads and equipment bases for all outdoor equipment on grade, floor mounted equipment in main central plant area, areas with floors below grade, penthouse equipment rooms, floor mounted air handling units and where shown on Drawings.
- B. Provide prefabricated curbs for roof mounted equipment with the equipment.

## 2.6 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 16 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Above Grade: Form with 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Provide prefabricated fire rated sleeves including seals, UL listed; or provide Schedule 40 galvanized steel, sized for minimum 1 inch space between sleeve and carrier pipe.
- D. Sleeves for Pipes Through Floor Supporting Riser Piping: Standard weight galvanized steel pipe.
- E. Sleeves for Pipes Through Roof: Standard weight galvanized steel pipe.
- F. Sleeves for Round Ductwork: Form with galvanized steel.
- G. Sleeves for Rectangular Ductwork: Form with galvanized steel or wood.
- H. Provide fire-stop compound at all penetrations of floor slabs or firewalls such that fire rating integrity of barrier is not lessened.

- I. Caulk: Caulk all sleeves water and airtight.
- J. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping. Provide pipe sleeves one size larger than the pipe it serves, including insulation, except where "Link Seal" casing seals are used.
- K. Sleeves Penetrating Walls Below Grade: Provide "Link-Seal" casing seal and sleeve as manufactured by Thunderline Corporation, Wayne, Michigan, for all pipes passing through walls below grade.

2.7 FINISHES

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- B. Provide corrosion resistant hangers and supports for all piping and ductwork in corrosive atmosphere.

2.8 ANCHOR BOLTS

- A. Provide galvanized anchor bolts for all equipment placed on concrete pads or on concrete slabs of the size and number recommended by the manufacturer of the equipment.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

Pipe Size	Max. Hanger Spacing	Hanger Diameter
1/2" to 1-1/4"	6'-6"	3/8"
1-1/2" to 2"	10'-0"	3/8"
2-1/2" to 3"	10'-0"	1/2"
4" to 6"	10'-0"	5/8"
8" to 12"	14'-0"	7/8"
14" and Over	14'-0"	1"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at Joints	

- B. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.



- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with five feet maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide corrosion resistant hangers by Corr-Tech for all piping hangers in corrosive areas. Provide hanger rods, bolts, nuts and all metal parts coated with the same material as hangers.

### 3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, provide inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### 3.3 FLASHING

- A. Provide flexible flashing and metal counterflashing where sleeves, piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24-inch by 24-inch sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36-inch by 36-inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor drains watertight to adjacent materials.
- E. Provide acoustical lead flashing around ducts and pipes penetrating equipment

rooms, installed in accordance with manufacturer's instructions for sound control.

- F. Flexible sheet metal flashing and counterflashing on all roof curbs for mechanical equipment on roof; seal watertight.

### 3.4 EQUIPMENT BASES AND SUPPORTS

- A. Coordinate installation of equipment bases of concrete type specified under Division 3 for all outdoor equipment on grade and floor mounted equipment in main central plant area, areas with floors below grade, penthouse equipment rooms, floor mounted air handling units and where shown on Drawings.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. Provide base of a minimum height of 4 inches above finished grade and a width that projects a minimum of 3 inches beyond equipment on all sides. Bevel edges of base.
- F. Prepare surface under bases by cleaning, clearing, chipping and roughing.
- G. Provide curbs of 14 inches minimum height above roofing surface for installation of mechanical equipment on roof.

### 3.5 SLEEVES

- A. Provide sleeves for all pipe penetrations through walls, roof or slab above grade.
- B. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- C. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves full depth and provide floor plate.
- D. Where piping or ductwork penetrates floor, ceiling or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and seal air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration. When penetration is through a fire rated floor or wall, provide fire safing insulation so that the assembly when complete is UL listed and equals the fire rating of construction penetrated by the sleeve.
- E. Install chrome plated steel escutcheons at finished surfaces.
- F. Provide three 6 inch long reinforcing rods welded at 120-degree spacing to the sleeve on all sleeves supporting riser piping 4 inches and larger. Embed reinforcing rods in concrete or grout to existing concrete.

- G. Install sleeve assembly for walls below grade with 1/4-inch thick plate located in the middle of the wall.
- H. Neatly cut holes in existing walls, floors and roofs for placement of sleeves. Place sleeve and grout, and caulk annular space to provide finished appearance.
- I. Install pipe in sleeve so that neither the pipe nor its insulation touches the sleeve at any point.
- J. Seal space between pipe and sleeve watertight for all sleeves penetrating the roof.

### 3.6 ANCHOR BOLTS

- A. Locate position of anchor bolts by means of suitable templates.
- B. When equipment is placed on vibration isolators, secure equipment to the isolator and the isolator to the floor, pad or support as recommended by the vibration isolator manufacturer.

### 3.7 INSULATION SHIELDS

- A. Provide insulation shields at every hanger support.
- B. Provide shields of the proper length to distribute weight evenly and to prevent sagging or indentation of insulation at hanger.
- C. Install shield so that hanger is placed at the center of the shield.
- D. Attach shield to insulation with adhesive to prevent slippage or movement; refer to Section 15083.

END OF SECTION 15060



## SECTION 15070

### VIBRATION ISOLATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Vibration isolators for rotary, dynamic, or reciprocating equipment or components; include:
  - 1. Vibration isolation.

##### 1.3 REFERENCES

- A. ASHRAE - Guide to Average Noise Criteria Curves.

##### 1.4 SUBMITTALS

- A. Indicate isolation base dimensions.
- B. Indicate vibration isolator locations, with static and dynamic load.
- C. Include calculations required to certify compliance with specified requirements.
- D. Submit manufacturer's certificate that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

##### 1.5 QUALITY ASSURANCE

- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.
- B. Provide vibration isolation devices, including auxiliary steel bases and pouring forms, from a single manufacturer or supplier who will be responsible for complete coordination of all phases of this work.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Amber-Booth Company.
- B. Korfund Dynamics Corporation.

- C. Mason Industries.

## 2.2 ISOLATION BASES

- A. Type A: Integral structural steel fan and motor base with motor slide rails.
- B. Type B: Slung structural steel base with gusseted brackets.

## 2.3 VIBRATION ISOLATORS

- A. Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- B. Type 2: Open spring mount with stiff springs (horizontal stiffness equal to vertical stiffness).
- C. Type 3: Open spring mount with stiff springs, heavy mounting frame, and limit stop.
- D. Type 4: Closed spring hanger with acoustic washer.
- E. Type 5: Closed spring hanger with 1 inch thick acoustic isolator.
- F. Type 6: Rubber waffle pads, 30 durometer, minimum 1/2-inch thick, maximum loading 40 pounds per square inch. Use neoprene in oily or exterior locations.
- G. Type 7: 1/2-inch thick rubber waffle pads bonded each side of 1/4-inch thick steel plate.
- H. Type 8: Type BRD-1 rubber-in-shear isolators. Size isolator for 0.35-inch deflection.

## 2.4 FABRICATION

- A. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- B. Color code spring mounts.
- C. Select springs to operate at two-thirds maximum compression strain, with 1/4-inch ribbed neoprene pads.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install vibration isolators for motor driven equipment.
- B. Set steel bases for 1-inch clearance between housekeeping pad and base.

Adjust equipment level.

- C. Provide spring isolators on piping connected to isolated equipment as follows: up to 4-inch diameter, first three points of support; five to 8-inch diameter, first four points of support; 10-inch diameter and over, first six points of support. Static deflection of first point to be twice deflection of isolated equipment.
- D. Provide minimum of four hangers for each fan coil unit and water source heat pump. Provide isolators for each hanger.

### 3.2 SCHEDULE

Isolated Equipment	Base Type	Isolator Type
Water Source Heat Pumps		
Suspended	B	5
Centrifugal Fans Class I & II to 54 Inches	A	1
Boiler	B	6 or 7
Lakos System	B	6 or 7
Cooling Tower		
Other than Slab on Grade	B	1
Pumps		
3 horsepower & Smaller	B	6 or 7
5 horsepower & Over	B	2
Piping		4
Ductwork		N/A
Engine Driven Generator	Field Verify	3
Fan Coil Units		8

END OF SECTION 15070





## SECTION 15075

### MECHANICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.3 SECTION INCLUDES

- A. Furnish and install materials for identification of mechanical products installed under Division 15.

##### 1.4 RELATED SECTIONS

- A. Section 09900 - Paints and Coatings.

##### 1.5 REFERENCES

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems.
- B. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

##### 1.6 SUBMITTALS

- A. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. W. H. Brady Company.
- B. Craftsmark.
- C. Markem Corporation.
- D. Seton Name Plate Company.

## 2.2 MATERIALS

- A. Color: Meet requirements of ANSI A13.1, unless specified otherwise.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved white letters on a black background; minimum size 3 inches long and 1 inch high. Minimum lettering height for numbers and names is 1/4-inch and other data is 1/8-inch.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- D. Stencils: With clean cut symbols and letters 2-1/2 inch high for ductwork and equipment.
- E. Stencil Paint: Semi-gloss, high build epoxy esther or alkyd paint.
- F. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
- G. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- H. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mils thick, manufactured for direct burial service.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Plastic Nameplates: Secure nameplates to equipment fronts using corrosive resistant screws and rivets. Install nameplates parallel to equipment lines.
- B. Metal Tags: Install with corrosive-resistant chain and "j-hook."
- C. Stencil Painting: Apply single coat sufficient to cover background completely with minimum 4 mils dry film thickness.
- D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.
- E. Plastic Tape Pipe Markers: Install completely around pipe in accordance with manufacturer's instructions.
- F. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

- G. Equipment
  - 1. Identify mechanical equipment scheduled on Drawings with nameplates, except for air devices, sprinkler heads, plumbing fixtures, and plumbing shock absorbers.
  - 2. Identify name, number, function, capacity, and other pertinent information of air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.
- H. Controls: Identify control panels and major control components outside panels with plastic nameplates.
- I. Valves: Identify valves in main and branch piping with metal tags.
- J. Fire Dampers: Label with plastic nameplates in accordance with NFPA 90A.
- K. Piping: Paint exposed piping in colors to meet ANSI standards. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs, including risers and drops, adjacent to each valve and tee at each side of penetration of structure or enclosure and at each obstruction. Provide a flow arrow at each identification marker.
- L. Ductwork: Identify ductwork with stenciled painting. Identify as to air handling unit number, and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure and at each obstruction.
- M. Use identification of equipment on the "Record Drawings" for nameplate designations.
- N. Attach identification for items such as special switches, etc., located in finished areas, on or in the immediate vicinity of the item.

### 3.3 VALVE CHART AND SCHEDULE

- A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed.

### 3.4 COLOR CODE FOR MARKING PIPE

MATERIAL	BAND	LETTERS AND ARROW	LEGEND
Cold water (potable) WATER	Green	White	POTABLE
Fire protection water WATER	Red	White	FIRE PR.
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.

MATERIAL	BAND	LETTERS AND ARROW	LEGEND
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Yellow	Black	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Yellow	Black	COMP. AIR
Natural gas	Blue	White	NAT. GAS
Freon	Blue	White	FREON
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STM.
Condensate	Yellow	Black	COND.

### 3.5 COLOR CODE MARKING SIZES

OUTSIDE DIAMETER OF PIPE COVERING (INCHES)	LENGTH OF COLOR BAND (INCHES)	ARROW LENGTH BY WIDTH (INCHES)	SIZE OF LEGEND LETTERS AND NUMERALS (INCHES)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

END OF SECTION 15075

**SECTION 15081**  
**DUCT INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Thermal and acoustical insulation applied externally or internally to ductwork and air handling devices; including:
  - 1. Duct insulation.
  - 2. Insulation jackets.
  - 3. Duct liner.

**1.3 RELATED SECTIONS**

- A. Section 09910 - Paints.
- B. Section 15810 - Ducts.

**1.4 REFERENCES**

- A. ASTM C 553 - Mineral Fiber Blanket and Felt Insulation.
- B. ASTM C 612 - Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM E 84 - Surface Burning Characteristics of Building Materials.

**1.5 SUBMITTALS**

- A. Include product description, list of materials, and thickness for each service and location.

**1.6 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in duct insulation application with three years minimum experience.
- B. Materials: UL listed; flame spread/fuel contributed/smoke developed rating of 25/25/50 in accordance with ASTM E 84.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Certaineed Corporation.
- B. Knauf Fiber Glass.
- C. Manville Corporation.
- D. Owens-Corning Fiberglass Corporation.

### 2.2 MATERIALS

- A. Type A: Flexible glass fiber; ASTM C 553; commercial grade; 'k' value of 0.29 at 75 degrees F; 1 pound per cubic foot minimum density; 0.002-inch foil scrim kraft facing for air ducts.
- B. Type B: Rigid glass fiber; ASTM C 612, Class 1; 'k' value of 0.24 at 75 degrees F; 0.002-inch foil scrim kraft facing for air ducts.
- C. Type C: Ductliner, flexible glass fiber; ASTM C 553; 'k' value of 0.28 at 75 degrees F; 1-1/2 pounds per cubic foot minimum density; coated air side for maximum 4,000 feet per minute air velocity.
- D. Adhesives: Waterproof vapor barrier type, Childers CP-82.
- E. Finish: Vapor barrier finish coating, Childers CP-33.
- F. Jacket: Presized glass cloth, minimum 7.8 ounces per square yard.
- G. Lagging Adhesive: Fire resistive to ASTM E 84, Childers CP-82.
- H. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.
- I. Lagging: 2 inch high density fiberglass, 6 pounds per cubic foot, covered with a 0.016 acoustically treated stucco embossed with 1-1/4 pounds per square foot aluminum cladding, Childers Muffl-Jac.
- J. Joint Tape: Glass fiber cloth, open mesh.
- K. Tie Wire: Annealed steel, 16 gage.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Install exterior materials after duct has been tested and approved.
- B. Clean surfaces for adhesives.

## 3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Provide insulation on exterior of all round duct.
- C. Insulation (Types A and B) Application for exterior of duct in Interior of Building:
  - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
  - 2. Install without sag on underside of ductwork. Use 4 inch wide strips of adhesive on 8 inch centers or mechanical fasteners where necessary to prevent sagging. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
  - 3. Insulate standing seams and stiffeners which protrude through the insulation with 1-1/2 inch thick, unfaced, flexible blanket insulation. Cover with glass cloth and coat with vapor barrier finish coating.
  - 4. On circumferential joints, the 2-inch flange on the facing shall be secured with 9/16-inch outward clinch steel staples on 2-inch centers, and taped with a minimum 3 inch wide strip of glass fabric and finish coating.
  - 5. Cover seams, joints, pin penetrations and other breaks finish coating reinforced with glass cloth.
- D. Liner (Type C) Application:
  - 1. Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 15-inch centers maximum on top and side of ductwork with dimension exceeding 20 inches. Seal and smooth joints. Do not use nail-type fasteners. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  - 2. Ductwork dimensions indicated are net outside dimensions required for air flow. Insulation thickness already incorporated in duct size.
  - 3. Omit lining as necessary to permit satisfactory operation of dampers and air control devices. Provide 1-1/2 inch external insulation 6 inches beyond the liner termination.
  - 4. Coat all exposed edges and leading edges of cross joints with adhesive.
- E. Noise Control and Sound Traps:
  - 1. For noise control and sound traps, use lagging. Secure insulation with 100 percent coverage of lagging adhesive, pins and clips not more than 18 inches on center.
  - 2. Secure bottom of duct insulation using alternate single and double clips. The first pin will secure the insulation and the second clip will be used to secure the cladding. Isolate the exterior clip from the cladding by using two 1/8-inch closed cell neoprene (Armaflex) washers on either side of the cladding. Predrill holes in cladding and avoid contact with pin during installation.
  - 3. For round duct, secure insulation with 100 percent coverage of lagging adhesive. Secure cladding with 3/4-inch, 0.020-inch stainless steel bands on 12 inch centers.

- 4. For joints and overlaps, fold cladding to form a double thickness hem 2 inches minimum. Seal with a non-shrink, non-hardening sealing compound.
- F. Walk-in Plenum Application: Adhere insulation on interior surface of plenum with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners. Seal and smooth joints. Do not use nail-type fasteners.
- G. Continue insulation with vapor barrier through penetrations.

3.3 SCHEDULE

- A. Provide insulation or liner for duct in accordance with the following schedule:

Duct	Type	Insulation Thickness
Combustion Air Duct	A or B	1"
Exhaust Ducts within 10 feet of Exterior Openings and Exhaust Ducts Exposed to Outdoor Air	A or B	1"
Outside Air Intake Ducts	C	2"
Plenums	A or B	1"
Ventilation Equipment Casings	A or B	2"
Concealed Round, Rectangular, Supply, Exhaust or Return Duct	A or B	2"
Exposed Round Supply, Exhaust or Return Duct	C	1"
Rectangular Supply, Exhaust or Return within 10 feet of the Mechanical Room or Air Handler	C	2"

END OF SECTION 15081



**SECTION 15083**  
**PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Thermal insulation for mechanical and plumbing piping systems including jackets and accessories.
- B. Mechanical system includes horizontal roof drains and waste lines which receive condensate from air handling units or evaporators as well as thermal system piping.

**1.3 RELATED SECTIONS**

- A. Section 09910 - Paints.
- B. Section 15060 - Hangers and Supports.
- C. Section 15160 - Storm Drainage Piping.

**1.4 REFERENCES**

- A. ASTM B 209 - Aluminum and Aluminum-alloy Sheet and Plate.
- B. ASTM C 177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- C. ASTM C 195 - Mineral Fiber Thermal Insulation Cement.
- D. ASTM C 533 - Calcium Silicate Block and Pipe Thermal Insulation.
- E. ASTM C 547 - Mineral Fiber Preformed Pipe Insulation.
- F. ASTM C 552 - Cellular Glass Block and Pipe Thermal Insulation.
- G. ASTM E 84 - Surface Burning Characteristics of Building Materials.
- H. ASTM E 96 - Water Vapor Transmission of Materials.

**1.5 SUBMITTALS**

- A. Include product description, list of materials, and thickness for each service and locations.

- B. Include detail drawings of insulation dams.

## 1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in piping insulation application with three years' minimum experience.
- B. Materials: Composite flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84; includes jackets, adhesives, facing, coatings, and mastics.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Insulation:
  - 1. Armstrong.
  - 2. Knauf Fiber Glass.
  - 3. Johns Manville Corporation.
  - 4. Owens-Corning Fiberglass Corporation.
- B. Jackets:
  - 1. Childers.
  - 2. Johns Manville Corporation.
  - 3. Pabco

### 2.2 INSULATION

- A. Type A: Mineral fiber or fiberglass preformed insulation; ASTM C 547; 'k' value of 0.23 at 75 degrees F; noncombustible.
- B. Type B: Molded cellular glass insulation; ASTM C 552; maximum water vapor transmission rating of 0.005 perm-in; 'k' value of 0.45 at 400 degrees F.
- C. Type C: Elastomer, closed cell, flexible, insulation; ASTM E 96; maximum vapor transmission rating of 0.20 perms; ASTM C 177; 'k' value of 0.27 at 75 degrees F.

### 2.3 JACKETS

- A. Interior, Concealed Applications:
  - 1. Type A Insulation: Zeston 2000 PVC with longitudinal and end laps.
  - 2. Type B Insulation: Cover with a fiberglass cloth jacket and finish coat.
  - 3. Type C Insulation: Two (2) coats of SB Armaflex Finish.
  - 4. Insulate fittings, joints and valves with molded insulation of like material

and thickness as adjoining pipe. Use insulating cement to fill voids and cracks. Finish with glass or canvas cloth and finish coat. PVC jackets may be used with glass cloth and finish coat.

B. Interior, Exposed Applications:

1. Type A Insulation: Provide factory applied white kraft foil vapor barrier. Also finish with canvas jacket or fiberglass cloth with Childers CP-52 finish. Size for finish painting. Do not use PVC jackets. Verify jacket is suitable for applications.
2. Type B Insulation: Cover with a fiberglass cloth jacket and finish coat.
3. Type C Insulation: Two (2) coats of SB Armaflex Finish.
4. Insulate fittings, joints and valves with molded insulation of like material and thickness as adjoining pipe. Use insulating cement to fill voids and cracks. Finish with glass or canvas cloth and finish coat. PVC jackets may be used with glass cloth and finish coat.

C. Exterior Applications:

1. Insulate piping system as indicated under interior, concealed applications.

D. Jacket Materials:

1. Factory Applied Jackets: White kraft bonded to reinforced foil vapor barrier with self-sealing adhesive joints.
2. PVC Jackets: One piece, premolded type, to meet flame spread and smoke developed rating of 25/50 in accordance with ASTM E 84.
3. Canvas Jackets: UL listed treated cotton fabric, 6 ounces per square yard.
4. Fiberglass Cloth Jackets: 9 ounces per square yard glass cloth.
5. Aluminum Jackets: ASTM B 209; 0.020-inch thick; smooth finish with factory applied moisture barrier.
6. Stainless Steel Jackets: Type 304 stainless steel; 0.010-inch thick; smooth finish.

## 2.4 ACCESSORIES

- A. Insulation Bands: 3/4-inch wide; 0.015-inch thick galvanized steel, stainless steel or 0.007-inch thick aluminum.
- B. Metal Jacket Bands: 3/8-inch wide; 0.015-inch thick aluminum or 0.010-inch thick stainless steel to match jacket.
- C. Insulating Cement: ASTM C 195; hydraulic setting mineral wool; Ryder One-Coat.
- D. Sealants: Used at valves, fittings and where insulation is terminated. Sealant is brush applied to end of insulation and continued along pipe surface. Provide Childers CP-76.
- E. Adhesives: Used to adhere the longitudinal lap seam of vapor barrier jackets and at butt joints between insulation or fitting covers. Provide Childers CP-82 as general purpose adhesive. Use Childers CP-97 fibrous adhesive for calcium silicate or when adhering pipe saddles and shields to the insulation.

- F. Primers: Provide Childers CP-53 primer to cover insulating cements prior to finishing coating.
- G. Finish: Provide Childers CP-33 as a general purpose finish to coat the longitudinal seams and butt joints of vapor barrier jackets or glass cloth jackets. Use Childers CP-52 AHV2 reinforced with glass cloth as an adhesive and sizing for canvas and in other locations as indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean surfaces to be insulated and install insulation material after performance tests for piping have been completed and approved.

### 3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Continue insulation with vapor barrier through penetrations.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. Insulate fittings, valves, flanges and strainers. On flexible connections, expansion joints and unions, bevel and seal ends of insulation and continue sealant a minimum of 4 inches along the piping.
- E. On insulated piping conveying fluids between 100 degrees F and 140 degrees F, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations. Continue sealant a minimum of 4 inches along the piping.
- F. Provide dams in insulation at intervals not to exceed 20 feet to prevent migration of condensation or leakage.
- G. Provide an insert, except where pipe covering protection saddles are specified, not less than 12 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2-1/2 inch diameter or larger, to prevent insulation from sagging at support points. Provide inserts for 180-degree arc and not less than the length of the pipe shield manufactured of cork, cellular glass or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used. Adhere pipe shield to insulation with adhesive.
- H. Neatly finish and seal all insulation at supports, protrusions and interruptions. Maintain water vapor retarder with mastic.

3.3 BURIED PIPING

- A. Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

3.4 SCHEDULE

Piping	Type	Pipe Size	Insulation Thickness	
Domestic Hot Water, Heating Hot Water	A	1-1/2" & Smaller	1"	
		2" to 4"	1-1/2"	
		5" & Larger	2"	
Engine Exhaust	D	1-1/2" to 2"	1-1/2"	
		2-1/2" to 6"	2"	
		8" to 14"	2-1/2"	
		16" & Larger	3"	
Condenser Water	A	2" & Smaller	3/4"	
		2-1/2" & Larger	1"	
Refrigerant Suction and Liquid	C	3" & Smaller	3/4"	

END OF SECTION 15083



**SECTION 15120**  
**PIPING SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Pressure gages and pressure gage taps, thermometers and thermometer wells. Section also includes, expansion tanks, air vents, air separators, pressure relief valve, strainers, pump suction fittings, combination fittings, and flexible pipe connections.

**1.3 RELATED SECTIONS**

- A. Section 15950- Testing Adjusting, And Balancing

**1.4 REFERENCES**

- A. ASME - Boiler and Pressure Vessel Codes, SEC VIII-D - Rules for Construction of Pressure Vessels.
- B. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- C. ASTM A 105 - Forgings, Carbon Steel, for Piping Components.
- D. ASTM A 126 - Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ASTM A 216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- F. ASTM A 395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- G. ASTM E 1 - Standard Specification for ASTM Thermometers.
- H. ASTM E 77 - Standard Test Method for Inspection and Verification of Thermometers.

**1.5 SUBMITTALS**

- A. Product Data: Submit for manufactured products and assemblies required for this Project.
  - 1. Manufacturer's data indicating use, operating range, total range, accuracy, and location for manufactured components.
  - 2. Submit product description, model, dimensions, component sizes,

- rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
  4. Submit electrical characteristics and connection requirements.

- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Project Record Documents: Record actual locations of actual locations of components and instrumentation. Submit inspection certificates for pressure vessels.
- E. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years experience, and with service facilities within 100 miles of Project.
- B. Installer Qualifications: Company specializing in performing Work of this Section with minimum three years experience.

#### 1.7 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing Work of this section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except for required rough in, taps, supports and test plugs.



## 1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.11 WARRANTY

- A. Provide five-year manufacturer warranty for piping specialties.

## 1.12 MAINTENANCE SERVICE

- A. Provide monthly visit for one year starting from Date of Substantial Completion to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

## 1.13 MAINTENANCE MATERIALS

- A. Provide two bottles of red gage oil for static pressure gages.

## 1.14 EXTRA MATERIALS

- A. Supply one extra 10gallon drum of ethylene glycol.

## PART 2 - PRODUCTS

### 2.1 PRESSURE GAGES

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. Provide materials in accordance with State Municipality standards.
- C. Gage: ASME B40.1, UL 393 UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
  - 1. Case: Steel.
  - 2. Bourdon Tube: Brass.
  - 3. Dial Size: 2-1/2 inch diameter.
  - 4. Mid-Scale Accuracy: One percent.
  - 5. Scale: Pounds per square inch.

### 2.2 PRESSURE GAGE TAPS

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. Needle Valve: Stainless Steel, 1/4-inch NPT for minimum 300 pounds per square inch.
- C. Ball Valve: Brass 1/4-inch NPT for 250 pounds per square inch.

## 2.3 STEM TYPE THERMOMETERS

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. Thermometer: ASTM E 1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.
  - 1. Size: 9-inch scale.
  - 2. Window: Clear glass.
  - 3. Stem: Brass, 3/4 inch NPT, 3-1/2 inches long.
  - 4. Accuracy: ASTM E 77, 2 percent.
  - 5. Calibration: Both degrees F and degrees C.

## 2.4 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required.

## 2.5 TEST PLUGS

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. 1/4-inch NPT or 1/2-inch NPT stainless steel fitting and cap for receiving 1/8-inch outside diameter pressure or temperature probe with:
  - 1. Neoprene core for temperatures up to 200 degrees F.
  - 2. Nardel core for temperatures up to 350 degrees F.
  - 3. Viton core for temperatures up to 400 degrees F.

## 2.6 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Wessels, Amtrol Inc. or Young Engineering Mfg. Inc. or equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME SEC VIII-D; supplied with National Board Form U-1, rated for working pressure of 125 pounds per square inch-gage, with flexible butyl diaphragm sealed into tank, and steel support stand.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 25 pounds per square inch-gage.
- D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- E. Condenser Water System:
  - 1. Select expansion tank pressure relief valve at 80 pounds per square inch maximum.
  - 2. Set pressure reduction valve at select 25 pounds per square inch.

## 2.7 AIR VENTS

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.

## 2.8 AIR SEPARATORS

- A. Manufacturers: Wessels, Bell & Gossett or Young Engineering Mfg. Inc. or equal.
- B. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with ASME SEC VIII-D; for 125 pounds per square inch-gage operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

## 2.9 STRAINERS

- A. Manufacturers: ASHCROFT, WEKSLER, PALMER, AND AMETEK or equal.
- B. Size 2 inch and Under: Screwed brass or iron body for 175 pounds per square inch-gage working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- C. Size 2-1/2-inch to 4 inch: Flanged iron body for 175 pounds per square inch-gage working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- D. Size 5 inch and Larger: Flanged iron body for 175 pounds per square inch-gage working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

## 2.10 PUMP SUCTION FITTINGS

- A. Manufacturers: Wessels, Bell & Gossett or Young Engineering Mfg. Inc. or equal.
- B. Fitting: Angle pattern, cast-iron body. Threaded for 2 inches and smaller, flanged for 2-1/2 inches and larger. Rated for 175 pounds per square inch-gage working pressure, with inlet vanes, cylinder strainer with 3/16-inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- C. Accessories: Adjustable foot support, blow-down tapping in bottom, gage tapping in side.

## 2.11 COMBINATION PUMP DISCHARGE VALVES

- A. Manufacturers: Wessels, Bell & Gossett or Young Engineering Mfg. Inc. or equal.

- B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 pounds per square inch-gage operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

#### 2.12 BALANCING VALVES

- A. Manufacturers: ARMSTRONG, NIBCO, AND APOLLO or equal.
- B. Construction: Brass or bronze body with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 pounds per square inch-gage.
- D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

#### 2.13 RELIEF VALVES

- A. Manufacturers: ARMSTRONG, NIBCO, AND APOLLO or equal.
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

#### 2.14 PRESSURE REDUCING VALVES

- A. Manufacturers: ARMSTRONG, NIBCO, AND APOLLO or equal.
- B. Bronze or cast iron body, stainless or chrome steel valve spring, stem, and trim, phosphor bronze diaphragm, pilot operated, threaded up to 2 inches, flanged over 2 inches.

#### 2.15 SAFETY RELIEF VALVES

- A. Manufacturers: ARMSTRONG, NIBCO, AND APOLLO or equal.
- B. Valve: Bronze body, stainless steel valve spring, stem, and trim, direct pressure actuated, capacities ASME certified and labeled.
- C. Accessories: Drip-pan elbow.

#### 2.16 FLEXIBLE PIPE CONNECTION

- A. Metraloop™ - UL Listed Flexible Seismic Loop:
- B. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be located at the building exterior wall. Seismic bracing shall

not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of movement in the +X, +Y, +Z planes. All flexible loop connections below grade shall be inside a concrete vault with heavy duty truck rated steel grate for access to flexible loop. Flexible loops shall be recognized as having a limited cycle life. Therefore, after a seismic occurrence and as part of general service usage, flexible loops shall require periodic inspection and testing.

- C. When the flexible loop is installed above or below the horizontal center of the piping run, the flexible loop shall include a drain plug to which a valve can be added. Flexible loops, installed in any orientation other than hanging straight down shall require the installation of a support at the 180 degree return to prevent the flexible loop from sagging. This additional support shall not inhibit, restrict or prevent the flexible loops movement.
- D. Flexible loops shall consist of two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return. Loops shall include a factory supplied, center support nut located at the bottom of the 180 degree return, and a drain/air release plug. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.
- E. Flexible loops attached to fuel gas lines, shall be specifically manufactured for fuel gas applications and certified by the American Gas Association.
- F. Flexible loops attached to cast iron soil piping or storm drain piping, shall be installed using the appropriate Metraflex listed no-hub or bell and spigot joint connector. Soil and drain loops require a cleanout port in the 180 degree return. The cleanout port must be positioned for access. Detail of cleanout port must be referenced prior to ordering.
- G. Provide flexible piping connection per table:

PIPE SIZE	MOVEMENT	END TO END	LENGTH	PSI	*SPRING FORCE LBS.	WEIGHTLBS
2"	±8"	23"	30"	300	78	19
2-1/2"	±8"	25"	34"	300	83	31
3"	±8"	27"	37"	300	90	45
4"	±8"	31 1/2"	43"	175	120	64
5"	±8"	26"	48"	175	202	105
6"	±8"	42"	55"	175	202	160
8"	±8"	56"	70"	175	260	297

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install Work in accordance with State Municipality standards.

- B. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.
- C. Install gage taps in piping
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- H. Locate test plugs adjacent thermometers and pressure gages.
- I. Provide air vents at system high points and as indicated.
- J. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- K. Provide drain and hose connection with valve on strainer blow down connection.
- L. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- M. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- N. Support pump fittings with floor mounted pipe and flange supports.
- O. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- P. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- Q. Pipe relief valve outlet to nearest floor drain.
- R. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- S. Install flexible piping connections per manufactures instructions.

### 3.2 FIELD QUALITY CONTROL

- A. Test for strength of glycol and water solution and submit written test results.

### 3.3 CLEANING

- A. Clean and flush glycol system before adding glycol solution.

### 3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- B. Do not install hydronic pressure gauges until after systems are pressure treated.

END OF SECTION 15120





## SECTION 15130

### PUMPS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Pumps for mechanical systems except where integral with manufactured piece of equipment, including: Pumps and pump controls where self-contained.

##### 1.3 RELATED SECTIONS

- A. Section 15070 - Vibration Isolation.
- B. Section 15083 - Piping Insulation.
- C. Section 15950 - Testing, Adjusting and Balancing.
- D. Section 16220 - Motors and Controllers.

##### 1.4 SUBMITTALS

- A. Include certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. For each pump with a motor horsepower greater than 10, submit a certified shop performance test curve indicating capacity, head, horsepower and flow rates from shutoff to 125 percent of design flow.
- B. For centrifugal pumps, include certification that pump impeller diameter is less than 85 percent of the diameter of the maximum impeller possible for the pump casing, and that fabricated structural steel base is of sufficient strength to prevent vibration, warping or misalignment of the pump.
- C. Provide operation and maintenance manual.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. General Pumps:
  - 1. Allis-Chalmers.
  - 2. Aurora.
  - 3. Bell and Gossett.

4. Ingersoll-Rand.
5. PACO.
6. Peerless.
7. Taco.

## 2.2 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Capacity test for design flow after final assembly.
- C. Construction to permit complete servicing without breaking piping or motor connections.
- D. Pumps to operate at 1,750 rotations per minute unless specified otherwise.
- E. Complete pump assembly, including casing, flanges and seals, suitable for the service intended and the working pressure and temperatures scheduled for the system. Scheduled working pressure applies to the entire pump assembly including the suction and discharge flanges.
- F. Pumps to be complete with grease lubricated ball bearings, grease fittings and relief plugs, unless stated otherwise hereinafter.
- G. Free of flashing and cavitation at all flow rates from 25 to 125 percent of design flow under the suction conditions of the actual pump installation.
- H. Critical speed at least 115 percent of the running speed listed in the schedule.
- I. Pump connections to be flanged, except that on end suction, base mounted pumps connection sizes 2-1/2 inch and less may be threaded.
- J. Heating pumps to be suitable for handling water at 230 degrees F.
- K. Select motors to drive the pump through its characteristics curve from zero flow to 25 percent above the design flow without exceeding rated full load nameplate horsepower. Provide a non-overloading motor, such that the rated horsepower will not be exceeded at any point on the pump curve. Do not use the motor service factor.
- L. Motor Starters:
  1. Multiple Pump Systems: Furnish motor starter with pump to be installed under Division 16.
- M. Paint pumps.

## 2.3 END SUCTION BASE MOUNTED PUMPS

- A. Type: Centrifugal, end suction, single stage, direct connected.

- B. Casing: Cast iron, split volute, single suction, rated for greater of 150 pounds per square inch or 1.25 times actual working discharge pressure, renewable bronze wearing rings, flanged suction and discharge.
  - 1. Select casing to accommodate an impeller 15 percent greater in diameter than the diameter of the impeller actually selected to meet the specified conditions.
  - 2. Equip casing with tapped openings for vent drain and seal flush. Fit tops with petcocks and pipe for seal flush.
  - 3. Provide suction and discharge tapped for gage connection.
- C. Impeller: Bronze, fully enclosed, dynamically balanced keyed to shaft. Diameter less than 85 percent of the diameter of the maximum impeller possible for the pump casing.
- D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.
- E. Bearings: Grease lubricated type ball bearings. Provide seal and integral dirt and water seal.
- F. Drive: Flexible coupling with coupling guard.
- G. Seals: John Crane Company, Type 1 or 2, mechanical seals suitable for the intended application.
- H. Motor: Provide ODP motors for indoor service.
- I. Baseplate: High grade heat treated cast iron or reinforced heavy steel with integral drain rim grout base.

#### 2.4 IN-LINE DOMESTIC WATER CIRCULATORS

- A. Pump: All bronze, centrifugal circulator, single stage, direct connected with a resiliently mounted motor for in-line mounting, oil lubricated, 125 pounds per square inch maximum working pressure.
- B. Impeller: Bronze, keyed to shaft.
- C. Bearings: Bronze, sleeve bearings.
- D. Shafts: Stainless steel with integral thrust collar.
- E. Seals: Mechanical seals.
- F. Couplings: Flexible, spring type coupling.

#### 2.5 SEWAGE EJECTORS AND SUMP PUMPS

- A. Type: Vertical submersible, centrifugal, direct connected, duplex, complete with pumps, controls, alternator, fiberglass sump and internal piping.

- B. Casing: All iron construction on volute with radial clearance around impeller.
- C. Impeller: Stainless steel, non-clogging semi-open, keyed to corrosion resistant alloy steel shaft.
- D. Support: Mount pumps on cast iron or steel cover with pedestal registered and dowelled with manway inspection openings bolted to steel coverplate with gas tight gaskets. Provide with pipe penetration and float control sleeves where appropriate.
- E. Bearings: Permanently lubricated ball-type, double seal, single row. Rate bearings for 17,500 hours.
- F. Mechanical Seal: Double seal, carbon Ni-Resist type.
- G. Shaft: 300 series stainless steel with stainless steel impeller lock nut.
- H. Drive: Flexible coupling.
- I. Temperature: Provide 140 degrees F temperature rating.
- J. Sump Cover: Steel coverplate with inspection opening and cover, and alarm and control fittings.
- K. Motor Control: Across-the-line electric starters with ambient compensated quick-trip overloads for each phase with manual trip and reset button, circuit breaker, control transformer alternator, H-O-A selector switch, pilot lights and high level alarm light and horn.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide air cock and drain connection on horizontal pump casings.
- B. Provide line sized gate valve and strainer on suction side and line sized soft seated check valve and globe valve on discharge side of all pumps except sump pumps.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inch and over.
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Level and align pump baseplate, pump and driver. Provide metal supporting blocks, wedges and shims as required. Rigidly bolt pump base plate to the concrete base. After final alignment of centrifugal pumps, 25 horsepower and

larger, dowel the pump and motor to the base.

- F. Provide one set of replacement seals for each size pump.

END OF SECTION 15130



## SECTION 15140

### DOMESTIC WATER AND SANITARY DRAINAGE PIPING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Sanitary drainage and vent piping systems and domestic water piping, including valves and fittings.
- B. Miscellaneous apparatus attached to plumbing piping systems.

##### 1.3 RELATED SECTIONS

- A. Section 15050 - Excavation.
- B. Section 15050 - Backfill.
- C. Section 02516 - Disinfection of Water Distribution.
- D. Section 15060 - Hangers and Supports.
- E. Section 15070 - Vibration Isolation.
- F. Section 15083 - Piping Insulation.
- G. Section 15410 - Plumbing Fixtures.
- H. Section 15480 - Domestic Water Heaters.
- I. Section 15950 - Testing, Adjusting and Balancing.

##### 1.4 REFERENCES

- A. ASME A112.26.1M - Water Hammer Arresters.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DMV.
- E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

- F. ASSE 1011 - Hose Connection Vacuum Breakers.
- G. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- H. ASSE 1019 - Wall Hydrants, Frost-Proof Automatic Draining Anti-Backflow Types.
- I. ASTM A 47 - Ferritic Malleable Iron Castings.
- J. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- K. ASTM A 74 - Cast Iron Soil Pipe and Fittings.
- L. ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- M. ASTM B 32 - Solder Metal.
- N. ASTM B 88 - Seamless Copper Water Tube.
- O. ASTM B 306 - Copper Drainage Tube (DWV).
- P. ASTM C 425 - Compression Joints for Vitrified Clay Pipe and Fittings.
- Q. ASTM C 564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- R. ASTM C 700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
- S. ASTM D 3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings (4 inches to 15 inches).
- T. ASTM F 477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- U. ASTM F 679 - Standard Specifications for Poly (Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings (18 inches to 27 inches).
- V. AWS A5.8 - Brazing Filler Metal.
- W. AWWA C111 - Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- X. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- Y. AWWA C606 - Grooved and Shouldered Joints.
- Z. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- AA. CISPI 310 - Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and



Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

BB. MSS SP-110 - Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

CC. PDI WH-201 - Water Hammer Arresters.

## 1.5 SUBMITTALS

A. Include data on pipe materials, pipe fittings, and special fabricated items.

B. Include component sizes, rough-in requirements, service sizes and finishes for specialties.

C. Provide operation and maintenance manual.

## 1.6 QUALITY ASSURANCE

A. For each product specified, provide components by same manufacturer throughout project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Valves:

1. Apollo.
2. Crane.
3. De Zurik.
4. Nibco.
5. Stockham.
6. Wilkins.

B. Floor Drains:

1. Jay R. Smith.
2. Josam.
3. Tyler/Wade.
4. Zurn.

C. Cleanouts:

1. Jay R. Smith.
2. Josam.
3. Tyler/Wade.
4. Zurn.

D. Backflow Preventers:

1. FEBCO.
2. Rockwell.
3. Watts.
4. Wilkins

- 5. Jay R. Smith
- E. Water Hammer Arresters:
  - 1. Precision Plumbing Products.
  - 2. Sioux Chief.
  - 3. Watts.
- F. Hose Bibbs/Hydrants:
  - 1. Chicago.
  - 2. Jay R. Smith.
  - 3. Josam.
  - 4. Woodford.
  - 5. Zurn.
- G. Trap Primers:
  - 1. Jay R. Smith.
  - 2. Precision Plumbing Products.
  - 3. Watts.

## 2.2 SANITARY SEWER AND VENT PIPING

- A. Below Grade Within 5 Feet of Building:
  - 1. Cast Iron Piping and Fittings: ASTM A 74, service weight, hub and plain end with CISPI 301 or ASTM C 564 neoprene elastomeric compression type gaskets.
  - 2. Cast Iron Pipe and Fittings: CISPI 301, service weight hubless, with ASTM C 564, neoprene elastomeric compression type gasket system.
- B. Above Grade:
  - 1. Cast Iron Piping and Fittings: ASTM A 74, service weight, hub and plain end with ASTM C 564, neoprene elastomeric compression type gaskets.
  - 2. Cast Iron Piping and Fittings: CISPI 301, service weight, hubless with CISPI 310 neoprene elastomeric gaskets and stainless steel clamp-and-shield assemblies.
  - 3. Copper Tubing and Fittings: ASTM B 306, Type DWV with ASME B16.23 cast bronze or ASME B16.29 wrought copper fittings and ASTM B 32, grade 50B solder joints.

## 2.3 SANITARY PRESSURIZED PIPING (FROM SEWAGE EJECTOR)

- A. Below Grade:
  - 1. Piping: Ductile iron, AWWA C151.
  - 2. Fittings: Ductile or gray iron, standard thickness with flanged or grooved ends.
  - 3. Joints: AWWA C111, rubber gasket with 3/4-inch diameter rods or mechanical grooved couplings with a synthetic rubber gasket for AWWA pipe, AWWA C606.
- B. Above Grade
  - 1. Piping: Galvanized steel ASTM A 53, Schedule 40.
  - 2. Fittings: ASME B16.3, galvanized malleable iron, ASTM A 234 forged

- steel welding type, or pregrooved cast iron fittings.
3. Joints: Screwed up to 2 inches in size. Over 2 inches welded or mechanical joint coupling with zero flex for grooved piping.

## 2.4 WATER PIPING

- A. Below Grade Within 5 Feet of Building:
  1. Pipe 2 Inches and Smaller; Copper Tubing: ASTM B 88, Type K, annealed.
    - a. Fittings: None.
    - b. Joints: AWS A5.8 BCuP silver braze (lead free).
  2. Pipe Over 2 Inches; Copper Tubing: ASTM B 88, Type K, hard drawn.
    - a. Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.
    - b. Joints: AWS A5.8 BCuP silver braze (lead free).
- B. Above Grade:
  1. Pipe 2-1/2 Inches and Smaller; Copper Tubing: ASTM B 88, Type L, hard drawn. (compression fittings not allowed).
    - a. Fittings: ASME B16.18, cast bronze, or ASME B16.22 wrought copper and bronze.
    - b. Joints: ASTM B 32, solder, Grade 95TA (lead free).
  2. Pipe Over 2-1/2 Inches
    - a. Galvanized Steel Pipe: ASTM A 53, Schedule 40.
      - 1) Fittings: Cast iron.
      - 2) Joints: Grooved mechanical couplings.
    - b. Copper Tubing: ASTM B 88, Type K, hard drawn.
      - 1) Fittings: ASME B16.18, cast bronze or ASME B16.22, wrought copper and bronze.
      - 2) Joints: AWS A5.8 BCuP silver braze (lead free).

## 2.5 UNIONS, FLANGES AND COUPLINGS

- A. Pipe 2 Inches and Smaller: (compression fittings not allowed).
  1. Ferrous Piping: 150 pounds per square inch-gage malleable iron threaded unions.
  2. Copper Tubing: 150 pounds per square inch-gage bronze unions with soldered joints.
- B. Pipe Over 2 Inches:
  1. Ferrous Piping: 150 pounds per square inch-gage forged steel slip-on flanges; 1/16-inch thick preformed neoprene gaskets.
  2. Copper Tubing: 150 pounds per square inch-gage slip-on bronze flanges; 1/16-inch thick preformed neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings:
  1. Housing: ASTM A 47, malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; steel bolts, nuts and washers; galvanized for galvanized pipe.
  2. Sealing gasket: "C" shape composition sealing gasket.

- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.6 VALVES

### A. Gate Valves:

1. 2 Inches and Smaller: Bronze body, 125 pounds per square inch steam, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.
2. Over 2 Inches: Iron body, 125 pounds per square inch steam, bronze trim, OS&Y rising stem, handwheel, wedge, flanged or grooved ends.

### B. Globe Valves:

1. 2 Inches and Smaller: Bronze body, 125 pounds per square inch steam, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity (repackable under pressure).
2. Over 2 Inches: Iron body, 125 pounds per square inch steam, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

### C. Ball Valves:

1. 2 Inches and Smaller: Bronze body, full port, chrome plated brass/bronze ball, teflon seats, separate packnut with adjustable stem packing, rated 150 pounds per square inch steam and 600 WOG, solder or threaded ends. Valve ends shall have full depth ANSI threads or extended solder connections and be comply with MSS SP-110. Provide with balancing stops on hot water return line.
2. Over 2 Inches: Cast steel body, Class 150 stainless steel ball and stem, teflon seat and stuffing box seals, lever handle, flanged ends.

- D. Butterfly Valves: Iron body, aluminum bronze disc, 400 series stainless steel shaft, resilient liner seat, full lug body, shaft integral with disc. Provide valves absolute tight with 150 pounds per square inch pressure drop imposed across seat. Valves shall be capable for use as isolation valves and recommended by manufacturer for dead end service at full pressure without need for downstream flange. Provide gear operator for valves 8 feet and larger. Provide lever lock handle with toothed plate for shutoff service and infinitely adjustable handle with locknut and memory stop for throttling service for smaller sizes.

### E. Swing Check Valves:

1. 2 Inches and Smaller: Rate 200 pounds per square inch WOG minimum water pressure, brass or bronze construction, bronze disc, threaded or soldered connections.
2. Over 2 Inches: Rated 200 pounds per square inch WOG minimum water pressure, iron body, brass mounted, flanged connections.

## 2.7 DRAINS

- A. Floor and Shower Drain, Toilets and Finished Areas: Coated cast iron body floor drain, two-piece body with double drainage flange, invertible nonpuncturing

flashing collar, weepholes, bottom outlet, and adjustable satin nickel-bronze round strainer; Josam 30000-A Series. Provide 1/2-inch primer tap in P-trap and connect to trap primer.

- B. Floor Sink: 15-inch by 15-inch square cast iron, 8-3/8 inch deep floor sink with acid-resisting interior, double drainage flange with weepholes, aluminum internal dome strainer, nickel-bronze sanitary sloped rim and nickel-bronze anti-tilting grate. Provide, aluminum sediment bucket and clamping device. Provide 1/2-inch primer tap in P-trap and connect to trap primer.

## 2.8 CLEANOUTS

- A. Interior Service Floor Areas and Exterior Areas: Round coated cast iron floor cleanout with internal gasketed ABS cleanout plug and adjustable ABS housing with scoriated secured round satin nickel-bronze top; Josam 56010 Series.
- B. Interior Finishes Floor Areas: Square coated cast iron floor cleanout with internal gasketed ABS cleanout plug and adjustable ABS housing with secured scoriated square satin nickel-bronze top; Josam 56030 Series.
- C. Interior Finished Wall Areas: Round stainless steel wall access cover with center screw, coated cast iron cleanout tee with hub and spigot connection and recessed bronze tapped plug; Josam 58790 Series. Provide secured cover vandalproof screw.

## 2.9 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventer Assembly : ASSE 1013, USC FCCC HR, and CSA B64.5.
  - 1. 3/4-inch to 2-inch: Bronze body, modular design with replaceable seats, two independent check valves with intermediate relief valve, ball valve test cocks, 1/4-turn full port resilient seated bronze ball valves, bronze strainer, soft seated check valve; Watts No. 909QT with 601 check. Or Wilkins equal.
  - 2. 2-1/2 inch to 10-inch: Iron body, removable bronze seats, two independent check valves with intermediate relief valve, external sensing line, stainless steel internal parts, cast iron check valve bodies, 125 lb. cast iron strainer, and nonrising stem gate valve shutoffs; Watts No. 909S. Or Wilkins equal.

## 2.10 ESCUTCHEONS

- A. Provide escutcheons at finished surfaces where bare or insulated piping exposed to view passes through floors, walls or ceilings, except in boiler, utility or equipment rooms. Fasten securely to pipe or pipe covering. Provide satin finish, corrosion resisting steel, polished chromium-plated zinc alloy or polished chromium-plated copper alloy of the one-piece or split-pattern held in place by internal spring tension or setscrew.

## 2.11 PIPE DRAINS

- A. Provide 3/4-inch hose bibb with renewable seat and gate valve or full port ball valve ahead of hose bibb. Provide 3/4-inch brass plugs or caps at other low points. Disconnection of supply piping at fixture will be acceptable.

## 2.12 WATER HAMMER ARRESTERS

- A. ASME A112.26.1M; sized in accordance with PDI WH-201, factory precharged suitable for operation in temperature range of minus 33 to 300 degrees F and maximum 250 pounds per square inch-gage working pressure; Watts No. 15.

## 2.13 HOSE BIBBS/HYDRANTS

- A. Hose Bibb: Chrome plated brass construction with hose thread spout, adjustable packing nut with deep stem guard, with vacuum breaker in accordance with ASSE 1011; Woodford Model No. 24P-3/4.
- B. Wall Hydrants (WH-A): ASSE 1019; concealed type, non-freeze, self-draining type with chrome plated brass casting, lockable recessed box, hose thread spout, stainless steel operating stem, removable key and vacuum breaker; Woodford Model No. B65.

## 2.14 TRAP PRIMERS

- A. 1 to 2 Floor Drains: Precision Plumbing Products P-2.
- B. 3 to 8 Floor Drains: Precision Plumbing Products P-1.
- C. Provide trap primer distribution unit for more than one drain trap.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Coordinate forming of floor construction to receive drains to required invert elevations.

## 3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.

- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves and fittings are not exposed.
- H. Establish elevations of buried piping outside the building to be below "frost line," but not less than 18 inches.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- K. Establish invert elevations, slopes for drainage to 2% and the main building sewer line shall slope at 2%.
- L. Excavate and backfill in accordance with the mechanical general provisions.
- M. Install hub and plain end pipe with hub end upstream.
- N. Install valves with stems upright or horizontal, not inverted.
- O. Use grooved mechanical couplings and fasteners only in accessible locations.
- P. Install unions downstream of valves and at equipment or apparatus connections.
- Q. Install brass male adapters each side of valves in copper pipe system. Sweat solder adapters to pipe.
- R. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- S. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- T. Provide spring loaded check valves on discharge of water pumps.
- U. Slope water piping and arrange to drain at all low points.
- V. Install piping parallel with or at right angles to walls unless otherwise shown on drawings.
- W. Conceal piping above ceiling, in walls or chases, etc., unless otherwise noted on

the drawings.

- X. Bending of rigid piping is not permitted, only ells shall be utilized for a change in direction.
- Y. Temporarily plug or cap open ends of pipe at the end of each work day.
- Z. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- AA. Install roof drains and overflow drains using lead flashing, 4 pounds per square foot or heavier.
- BB. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- CC. Encase exterior cleanouts in concrete flush with grade.
- DD. Install water hammer arresters complete with accessible isolation valve.
- EE. Install water hammer arresters on hot and cold water lines at the end of each battery of plumbing fixtures and at each plumbing fixture which is located remote from a battery of fixtures.
- FF. Provide trap primers in cold water lines for traps. Tap trap primers off the top of the domestic water supply line.
- GG. Seismically brace new domestic water, gas, domestic hot water, waste, and storm drain piping per the SMACNA Seismic Restraint Manual Guidelines For Mechanical Systems.

### 3.3 SERVICE CONNECTIONS

- A. Connect to sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with backflow preventer, water meter with by-pass valves and pressure reducing valve, as indicated.

END OF SECTION 15140



## **SECTION 15160**

### **STORM DRAINAGE PIPING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Roof drains and storm piping within building and underground laterals within 5 feet of building.

##### **1.3 RELATED SECTIONS**

- A. Section 15050 – Electrical General Provisions, including trenching.
- B. Section 15060 - Hangers and Supports.
- C. Section 15083 - Piping Insulation.
- D. Section 15950 - Testing, Adjusting and Balancing.

##### **1.4 REFERENCES**

- A. ASME B16.3 - Malleable Iron Threaded Fittings, Classes 150 and 300.
- B. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- C. ASTM A 74 - Cast Iron Soil Pipe and Fittings.
- D. ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- E. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- F. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- G. AWWA C606 - Grooved and Shouldered Joints.
- H. CISPI 301 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
- I. CISPI 310 - Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.

## 1.5 SUBMITTALS

- A. Include data on pipe materials and pipe fittings.

## PART 2 - PRODUCTS

### 2.1 STORM PIPING

- A. Below Grade:
  - 1. Cast Iron Piping and Fittings: ASTM A 74 service weight.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with CISPI 310 couplings, neoprene gaskets, or lead and oakum.
- B. Above Grade:
  - 1. Cast Iron Piping and Fittings: CISPI 301, service weight hubless.
  - 2. Joints: CISPI 310, neoprene elastomeric compression type gaskets and stainless steel clamp-and-shield assemblies.
  - 3. Contractor's Option:
    - a. Schedule 40 galvanized steel pipe with galvanized Victaulic Style 77 couplings.
    - b. Product: "No. 100", Gustin-Bacon.

### 2.2 STORM PRESSURIZED PIPING (FROM SUMP PUMP)

- A. Below Grade:
  - 1. Piping: Cast iron, AWWA C151.
  - 2. Fittings: Ductile or gray iron, standard thickness with flanged or grooved ends.
  - 3. Joints: AWWA C111, rubber gasket with 3/4 inch diameter rods or mechanical grooved couplings with a synthetic rubber gasket for pipe, AWWA C606.
- B. Above Grade:
  - 1. Piping: Black steel ASTM A 53, schedule 40.
  - 2. Fittings: ASME B16.3, malleable iron, ASTM A 234 forged steel welding type, or pregrooved cast iron fittings.
  - 3. Joints: Screwed up to 2 inches in size. Over 2 inches welded or mechanical joint coupling with zero flex for grooved piping.

### 2.3 ROOF DRAINS

- A. Manufacturers:
  - 1. Jay R. Smith.
  - 2. Josam.
  - 3. Tyler/Wade.
  - 4. Zurn.
- B. Provide roof drains which have a coated cast iron body with clamping collar with integral gravel guard, adjustable extension, secondary clamping collar with o-ring and secured optional aluminum dome similar to Zurn Z-100EA. Provide optional

underdeck clamp and roof sump receiver.

## 2.4 OVERFLOW DRAINS

- A. Manufacturers:
  - 1. Jay R. Smith.
  - 2. Josam.
  - 3. Tyler/Wade.
  - 4. Zurn.
  
- B. Provide overflow drains which have a coated cast iron body with a non-adjustable 3 inch high water level regulator, with combination membrane flashing/clamp gravel guard, and optional aluminum dome similar to Zurn Z-103. Provide underdeck clamp and roof sump receiver.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Route piping in orderly manner and maintain gradient.
- B. Install piping to conserve building space and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for installation of insulation and access to valves and fittings.
- F. Establish elevations of buried piping outside the building to be below "frost line."
- G. Establish invert elevations, slopes for drainage to 1/8-inch per foot (1 percent) minimum above the floor. Maintain gradients.
- H. Excavate and backfill in accordance with Division 15 - Mechanical General Provisions.
- I. Install bell and spigot pipe with bell end upstream, below the floor.
- J. Insulate all horizontal piping and the underside of each roof drain body.

### 3.2 SERVICE CONNECTIONS

- A. Connect to existing storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

END OF SECTION 15160



## SECTION 15184

### REFRIGERATION PIPING AND SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.

##### 1.3 RELATED SECTIONS

- A. Section 15083 - Piping Insulation.
- B. Section 15737 - Split System Air Conditioners.

##### 1.4 REFERENCES

- A. UL - Underwriters Laboratory.

##### 1.5 SUBMITTALS

- A. Include product data on pipe materials, pipe fittings, valves and accessories.
- B. Include schedule indicating manufacturer, model number, size, location, rated capacity and features for each specialty.

##### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until use.

## PART 2 - PRODUCTS

### 2.1 PIPING

- A. Copper Tubing: Type ACR, hard drawn.
  - 1. Fittings: Wrought copper with long radius elbows.
  - 2. Joints: Solder, Grade 95TA.

### 2.2 REFRIGERANT

- A. R-22.

### 2.3 MOISTURE AND LIQUID INDICATORS

- A. Single port type, UL listed with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap.

### 2.4 REFRIGERANT FILTER DRIER

- A. One direction flow for air conditioners with molded porous core to remove moisture and foreign matter from the refrigerant stream.

### 2.5 VALVES

- A. Diaphragm Packless Valves (Sizes 1-1/8 Inch and Smaller): UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends with positive backseating; for maximum working pressure of 500 pounds per square inch and maximum temperature of 275 degrees F.
- B. Packed Angle Valves (Sizes Over 1-1/8 Inch): Forged brass, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 pounds per square inch and maximum temperature of 275 degrees F.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs and clean joints bright with fine sandpaper and steel wool.
- B. Remove scale and dirt on inside and outside before assembly.

### 3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.

- B. Route piping in an orderly manner, plumb and parallel to building structure and maintain gradient. Install piping in accordance with the recommendations of the refrigeration equipment manufacturer, including pipe sizes, refrigerant system evacuation and leak testing.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping 1 percent in direction of oil return.
- E. Provide non-conducting dielectric connections when joining dissimilar metals.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access to concealed valves and fittings.
- I. Prepare pipe, fittings, supports and accessories not pre-finished ready for finish painting.
- J. Insulate all liquid and suction piping.

### 3.3 APPLICATION

- A. Provide line size liquid indicators in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.
- B. Provide replaceable cartridge filter-driers vertically in liquid line adjacent to receivers with three valve bypass assembly to permit isolation of driers for servicing.
- C. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.
- D. Utilize flexible connectors at or near compressors where piping configuration does not absorb vibration.

END OF SECTION 15184





## SECTION 15185

### CHEMICAL WATER TREATMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Water treatment for HVAC piping systems; including:
  - 1. Cleaning of piping systems.
  - 2. Chemical feeder equipment.
  - 3. Treatment for closed systems.

##### 1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Pumps.
- B. Hydronic Piping.
- C. Induced Draft Cooling Tower.

##### 1.4 SUBMITTALS

- A. Include product data for all chemical treatment materials, chemicals and equipment.
- B. Include manufacturer's installation instructions.
- C. Include shop drawings indicating all system schematics, equipment locations and controls schematics.
- D. Provide operation and maintenance manual.

##### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience with local representatives with water analysis laboratories and full-time service personnel within 50-mile radius of site.
- B. Conform to applicable EPA code for addition of toxic, legally prohibited chemicals to building mechanical systems and for delivery to public sewage systems.

## 1.6 MAINTENANCE SERVICE

- A. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- C. Provide laboratory and technical assistance services for warranty period.
- D. Include two eight hour training courses for operating personnel, instructing them on installation, care, maintenance, testing and operation of water treatment systems. Arrange course at start-up of systems.
- E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly.
- F. Evaluate success of water treatment program, and make recommendations in writing based upon these inspections.
- G. Provide sufficient chemicals for treatment and testing during warranty period.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Betz.
- B. Mogul.
- C. Nalco.

### 2.2 MATERIALS

- A. System Cleaner:
  - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - 2. Algicide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite.
  - 3. Muriatic acid to remove mill scale.
- B. Closed System Treatment (Water):
  - 1. Sequestering agent to reduce deposits and adjust pH.
  - 2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate or sulphites.
  - 3. Conductivity enhancers; phosphates or phosphonates.

- C. Condenser Water System Treatment (Cooling Tower):
1. Sequestering agent to inhibit scaling.
  2. Acid to reduce alkalinity and pH.
  3. Corrosion inhibitor.
  4. Algicide.
  5. Wall Rack:
    - a. Controller, chemical pumps and associated piping shall be mounted on prefabricated floor supported wall rack.
    - b. Design and arrangement of equipment shall be as shown on Drawings.
    - c. Product: Lakewood Instruments, "Model 9303".

## 2.3 EQUIPMENT

- A. Bypass (Pot) Filter/Feeder: Five gallon cartridge type filter housing, as shown on the drawings, quick opening cap for working pressure of 175 pounds per square inch-gage. Construct of materials that are impervious to the products being dispersed.
- B. Chemical Metering Pump:
1. Positive displacement or diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive and relief valve.
  2. Products: LMI, "A151-925" or "M151-955".
- C. Liquid Level Switch: Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump and low level alarm.
- D. Conductivity Controller:
1. Packaged monitor controller with solid state circuiting, 5 percent accuracy, linear dial adjustment, built-in calibration switch, ON-OFF switch and light, control function light, output to control circuit.
  2. Product: LMI, "Model 175".
- E. Water Meter: Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact register, single pole, double throw dry contact switch.
- F. Solenoid Valves: Forged brass body globe pattern, normally open or closed as required, general purpose solenoid enclosure and continuous duty coil.
- G. Timers:
1. Electronic timers, infinitely adjustable over full range, 150 second and five minute range, mounted together in cabinet with HANDS-OFF-AUTO switches and status lights.
  2. Product: LMI, "Model 65" timer, microprocessor based, for two biocides.

## 2.4 TEST EQUIPMENT

- A. Provide test cabinet with local and fluorescent light, capable of accommodating 4 to 10 ml zeroing titrating burettes and associated reagents.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Provide systems that are operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.

### 3.2 CLEANING SEQUENCE

- A. Add cleaner to closed systems at concentration as recommended by manufacturer. For steam systems, fill boilers only with cleaner and water.
- B. Add muriatic acid to the systems in the concentration recommended by the manufacturer, to remove mil scale. Flush system completely with water and test to see that traces of muriatic acid have been removed.
- C. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for six hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
- D. Chilled Water Systems: Circulate for 48 hours, then drain systems as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed.
- E. Steam Systems: Apply heat, slowly raising boiler temperature to 160 degrees F and maintain for 12 hours minimum. Cool, then drain as quickly as possible. Refill with clean water, drain, refill and check for sludge. Repeat until system is free of sludge. Apply heat to produce steam for piping system and maintain for eight hours minimum. Bypass traps and waste condensate.
- F. Use neutralizer agents on recommendation of system cleaner supplier and approval of A/E.
- G. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- H. Remove, clean, and replace strainer screens.
- I. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### 3.3 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install across circulating pumps as indicated on Drawings.

- B. Introduce closed system treatment through bypass feeder when required or indicated by test.
- C. Provide 3/4-inch water coupon rack around circulating pumps with space for four test specimens.

### 3.4 CONDENSER WATER SYSTEMS (COOLING TOWER)

- A. Provide automatic condenser water control systems for inhibitor feed, blowdown and biocide feeds. Meter-activate inhibitor application and conductivity activate the blowdown. Meter feed biocide with blowdown locked out to ensure biocide retention time.
- B. Incorporate solid-state integrated circuits and digital LED displays in the control system, housed in NEMA 12 steel enclosure. Provide gasketed and lockable door.
- C. Base dissolved solids control on conductivity and include:
  1. LED digital readout display (microhm/cm).
  2. Temperature compensated sensor probe adaptable to sample stream manifold.
  3. High, low, normal conductance indicator lights (LED).
  4. High or low conductance alarm light (flash or steady switch), trip points field adjustable. Provide flash or steady switch silence position.
  5. Illuminated legend to indicate "ALARM" whenever alarm condition exists.
  6. Hand-off-automatic switch for solenoid bleed valve.
  7. Illuminated legend shall indicate "BLEED" when valve is operated.
  8. Adjustable hysteresis or dead-band (internal).
- D. Base inhibitor feed control on make-up volume and include:
  1. Solid-state counter (1 to 15 field selectable).
  2. Solid-state timer (adjustable 1/4 to 5 minutes).
  3. Test switch.
  4. Hand-off-automatic switch for chemical pump.
  5. Illuminated legend to indicate "FEED" when pump is activated.
  6. Solid state lock-out timer (adjustable 1/4 to three hours) and indicator light. Deactivate the pump and activate alarm circuits with the lock-out timer.
  7. Panel totalizer (amount of makeup), electro-mechanical type.
- E. Biocide programmer to include:
  1. 24-hour timer with 14-day skip feature to permit activation any hour of the day.
  2. Precision solid-state bleed lock-out timer (0 to 9 hours) and biocide pump timer (0 to 2 1/4 hours), clock controlled.
  3. Solid-state alternator to enable the use of two different formulations.
  4. Digital display of the time of day (24 hours).
  5. LED display of day of week (14 days).
  6. Fast and slow clock set controls (internal).
  7. Battery back-up so clock is not disturbed by power outages, quartz

- timekeeping accuracy.
8. Hand-off-automatic switches for biocide pumps.
  9. Illuminated legend to indicate "BIOCIDE A" or "BIOCIDE B" when pump is activated.
- F. Provide water meter on system make-up, wired to control system.
- G. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water system. Provide agitator as required.
- H. Provide conductivity controller to sample condenser water and operate 3/4-inch solenoid bleed valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.
- I. Introduce algicide to tower by continuous feed with solution pump.
- J. Provide liquid level switch in each solution tank to de-activate solution pump and agitator and signal mechanical alarm system.
- K. Provide 3/4-inch water coupon rack around circulating pumps with space for four test specimens.
- L. Submit reports indicating analysis of system water after cleaning and after treatment.

END OF SECTION 15185

**SECTION 15190**  
**NATURAL GAS PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Piping, fittings, valves, fuel oil pumps and tanks for fuel piping systems.

**1.3 RELATED SECTIONS**

- A. Section 02315 - Excavation and Fill: Product requirements for underground piping and tanks for placement by this section.
- B. Section 02320 - Backfill.
- C. Section 03300 - Cast-in-Place Concrete: Product requirements for concrete ballast and fill pads for underground tank for placement by this section.
- D. Section 08310 - Access Doors and Frames: Product requirements for Access Doors for placement by this section.
- E. Section 09910 - Paints: Product requirements for painting for placement by this section.
- F. Section 15075 - Mechanical Identification: Product requirements for valve and pipe identification for placement by this section.
- G. Section 16150 - Wire Connections and Devices: Execution requirements for electric connections specified by this section.

**1.4 REFERENCES**

- A. ACT 100 - Fabrication of FRP Clad/Composite Underground Storage Tanks.
- B. API Spec 12P - Fiberglass Reinforced Plastic Tanks.
- C. API 650 - Welded Steel Tanks for Oil Storage.
- D. API 1615 - Installation of Underground Petroleum Storage Systems.
- E. API 1632 - Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.
- F. API 2000 - Venting Atmospheric and Low Pressure Storage Tanks.

- G. ASME SEC IX - Welding and Brazing Qualifications.
- H. ASME B16.3 - Malleable Iron Threaded Fittings.
- I. ASME B31.1 - Power Piping.
- J. ASME B31.4 - Liquid Petroleum Transportation Piping Systems.
- K. ASME B31.9 - Building Service Piping.
- L. ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings.
- M. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- N. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- O. ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
- P. ASTM A 53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- Q. ASTM A 234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- R. ASTM D 2310 - Machine-Made Reinforced Thermosetting Resin Pipe.
- S. ASTM D 2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- T. ASTM D 2996 - Filament-Wound Reinforced Thermosetting Resin Pipe.
- U. ASTM D 4021 - Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks.
- V. AWS A5.8 - Brazing Filler Metal.
- W. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- X. NACE RP-01-69 - Control of External Corrosion on Underground or Submerged Piping Systems.
- Y. NACE RP-02-85 - Control of External Corrosion on Metallic Buried, Partially Buried or Submerged Liquid Storage Systems.
- Z. NFPA 30 - Flammable and Combustible Liquids Code.
- AA. NFPA 31 - Installation of Oil Burning Equipment.
- BB. NFPA 54 - National Fuel Gas Code.



- CC. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
- DD. STI sti-P3 ACT-100 Specification for the Fabrication of FRP Clad/Composite Underground Storage Tanks.
- EE. UL 58 - Steel Underground Tanks for Flammable and Combustible Liquids.
- FF. UL 80 - Steel Inside Tanks Oil-Burner Fuel.
- GG. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.
- HH. UL 1316 - Glass-Fiber-Reinforced Plastic Underground Tanks for Petroleum Products.
- II. UL 1479 - Fire Tests of Through-Penetration Firestops.

## 1.5 DEFINITIONS

- A. Where the designation GAS is used, it is the abbreviation for Natural Gas.

## 1.6 SUBMITTALS

- A. Shop Drawings: Indicate tanks, system layout, pipe sizes, location, and elevations. For fuel oil tanks, indicate dimensions and accessories including manholes and hold down straps.
- B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Manufacturer's Installation Instructions: Submit oil pump data.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record actual locations of valves, piping system, storage tanks, and system components.
- F. Operation and Maintenance Data: Submit installation instructions, spare parts lists.

## 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME SEC IX and NFPA 30, NFPA 31, NFPA 54, and NFPA 58.
- B. Maintain one copy of each document on site.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing Work of this section

with minimum three years documented experience and approved by manufacturer.

#### 1.8 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing Work of this section.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Provide temporary protective coating on cast iron and steel valves.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

#### 1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.12 WARRANTY

- A. Provide five-year manufacturer warranty for pumps and valves excluding packing.

#### 1.13 EXTRA MATERIALS

- A. Supply two packing kits for each size valve.

### PART 2 - PRODUCTS

#### 2.1 SEE CONSTRUCTION DRAWINGS

#### 2.2 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A 53 Schedule 40 black.
  - 1. Fittings: ASTM A 234/A234M forged steel welding type.
  - 2. Joints: ASME B31.1, ASME B31.2, ASME B31.9, ASME SEC 9, welded.
  - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

#### 2.3 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A 53 Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A234M forged steel welding type.
  - 2. Joints: NFPA 54, threaded or welded to ANSI B31.1, ANSI B31.2, ANSI

B31.9, ASME Sec 1.

- B. Copper Tubing: ASTM B 88, Type K annealed.
  - 1. Fittings: ASME B16.26 cast bronze.
  - 2. Joints: Flared.

## 2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 inches and Under:
  - 1. Ferrous pipe: 150-pounds per square inch malleable iron threaded unions.
  - 2. Copper tube: 150-pounds per square inch bronze unions with brazed joints.
- B. Pipe Size Over 2 inches:
  - 1. Ferrous pipe: 150 pounds per square inch forged steel slip-on flanges; 1/16-inch thick preformed neoprene gaskets.
  - 2. Copper tube: 150 pounds per square inch slip-on bronze flanges; 1/16-inch thick preformed neoprene gaskets.

## 2.5 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 31, ANSI B31.1, ANSI B31.4.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- F. Vertical Support: [Angle ring.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.6 GATE VALVES

- A. Up To and Including 2 inches: MSS SP-80, Class 150, bronze body, bronze trim, rising stem, hand wheel, inside screw, solid wedge disc, threaded ends.
- B. 2 inches and Larger: MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, hand wheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

## 2.7 GLOBE VALVES

- A. Up To and Including 2 inches: MSS SP-80, Class 125, bronze body, bronze trim, hand wheel, bronze disc, threaded ends.
- B. 2 inches and Larger: MSS SP-85, Class 125, iron body, bronze trim, hand wheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

## 2.8 BALL VALVES

- A. MSS SP-110, Class 150, 400 pounds per square inch CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with threaded ends.

## 2.9 SWING CHECK VALVES

- A. Up to 2 inches: MSS SP-80, Class 125, bronze body and cap, bronze swing disc, threaded ends.
- B. 2 inches and Larger: MSS SP-71, Class 125, iron body, bronze swing disc, flanged ends.

## 2.10 RELIEF VALVES

- A. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 60 pounds per square inch, UL listed for fuel oil and capacities ASME certified and labeled.

## 2.11 STRAINERS

- A. Threaded brass body for 175 pounds per square inch CWP Class 150, threaded, Y pattern with 1/32-inch stainless steel perforated screen.

## 2.12 FLEXIBLE CONNECTORS

- A. Bronze inner hose and braided exterior sleeve, suitable for minimum 200 pounds per square inch CWP and 250 degrees F.

## 2.13 FIRE STOP SYSTEMS

- A. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E 814 and UL 1479.
- B. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours per ASTM E 814 and UL 1479.

## 2.14 EARTHQUAKE VALVE

- A. Earthquake gas shut off valve manufactured by Pacific Seismic Products, Model KOSO EV314 – 60 to EV317F
- B. 60 PSI maximum working pressure

Horizontal Valve provide flanged connections provide sight glass.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Excavate and Backfill in accordance with Section 02315.

### 3.3 EXISTING WORK

- A. Remove exposed abandoned tanks, including abandoned piping above accessible ceiling finishes. Cut flush with walls and floors, and patch surfaces.
- B. Disconnect abandoned and remove if raceway servicing them is abandoned and removed. Ensure access to existing and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.
- C. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- D. Clean and repair existing which remain or are to be reinstalled.

### 3.4 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install to NACE RP-01-69.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.

- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
- H. Establish elevations of buried piping outside the building to ensure not less than 1.5 feet of cover.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.
- L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.
- M. Identify piping systems including underground piping.
- N. Install valves with stems upright or horizontal, not inverted.
- O. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- P. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7 inch wg

### 3.5 PIPE HANGER SPACING

#### A. Metal Piping:

Pipe size: 1/2 to 1-1/4 inches:

Maximum hanger spacing: 6.5 feet.

Hanger rod diameter: 3/8-inches.

Pipe size 1-1/2 to 2 inches:

Maximum hanger spacing: 10 feet.

Hanger rod diameter: 3/8-inch.

Pipe size: 2-1/2 to 3 inches:

Maximum hanger spacing: 10 feet.

Hanger rod diameter: 1/2-inch.

Pipe size: 4 to 6 inches:

Maximum hanger spacing: 10 feet.

Hanger rod diameter: 5/8-inch.

Pipe size: 8 to 12 inches:

Maximum hanger spacing: 14 feet.

Hanger rod diameter: 7/8-inch.

END OF SECTION 15190





**SECTION 15410**  
**PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Water closets, urinals, lavatories, sinks, service sinks, showers, and emergency eyewash.

**1.3 RELATED SECTIONS**

- A. Section 15060 - Hangers and Supports.
- B. Section 15140 - Domestic Water and Sanitary Drainage Piping.
- C. Section 15950 - Testing, Adjusting and Balancing.

**1.4 SUBMITTALS**

- A. Include fixtures, sizes, utility sizes, trim and finishes.
- B. Provide operation and maintenance manual.

**1.5 QUALITY ASSURANCE**

- A. Fixtures: By same manufacturer for each type product specified throughout unless noted otherwise.
- B. Trim: By same manufacturer for each product specified throughout unless noted otherwise.

**1.6 DELIVERY, STORAGE AND HANDLING**

- A. Deliver and store fixtures in shipping containers with labeling in place.
- B. Handle fixtures with care to insure against breakage.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Fixtures:
  - 1. American Standard.
  - 2. Kohler.
  - 3. J.R. Smith.
  - 4. Elkay.
  
- B. Fixture Trim:
  - 1. Chicago.
  - 2. Kohler.
  - 3. Speakman.
  - 4. Delta.
  - 5. Zurn Industries.
  - 6. Elkay.
  - 7. Jay R. Smith
  
- C. Flush Valves:
  - 1. Sloan.
  - 2. Zurn Industries.
  
- D. Water Closet Seats:
  - 1. Olsonite.
  
- E. Fixture Carriers:
  - 1. Jay R. Smith.
  - 2. Josam.
  - 3. Tyler/Wade.
  - 4. Zurn Industries.
  
- F. Wash Basins:
  - 1. American Standard
  
- G. Emergency Eyewash:
  - 1. Guardian.
  - 2. Haws.
  - 3. Speakman.

### 2.2 SEE CONSTRUCTION DOCUMENTS FOR PLUMBING FIXTURES

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Review millwork shop drawings. Confirm location with architectural drawings and size of fixtures and openings before rough-in and installation.
  
- B. Verify adjacent construction is ready to receive rough-in work of this Section.

### 3.2 INSTALLATION

- A. Install each fixture with trap, unless noted otherwise on the drawings, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Division 7 - Waterproofing; color to match fixture.
- F. Mount fixtures to the following heights above finished floor:
  - 1. Water Closet:
    - a. Standard: 15 inches to top of bowl rim.
    - b. Handicapped: 17 to 19 inches to top of seat.
  - 2. Urinal:
    - a. Standard: 24 inches to top of bowl rim.
    - b. Handicapped: 17 inches to top of bowl rim.
  - 3. Lavatory Wall-Hung:
    - a. Standard: 31 inches to top of bowl rim.
    - b. Handicapped: 34 inches to top of bowl rim.
  - 4. Water Closet Flush Valves: 11 inches minimum above bowl rim, oriented away from adjacent wall at handicapped water closets.
- G. Provide wall and ceiling access panels for all valves, trap primers, water hammer arrestors, waste and vent clean outs, and where noted on drawings.

### 3.3 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion clean plumbing fixtures and equipment.
- C. Solidly attach water closet carrier feet to floor with all screws, as recommended by manufacturer.

END OF SECTION 15410



## SECTION 15480

### DOMESTIC WATER HEATERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Heat exchangers.
- B. Water heaters.
- C. Hot water generator.

##### 1.3 RELATED SECTIONS

- A. Section 15060 - Hangers and Supports.
- B. Section 15070 - Vibration Isolation.
- C. Section 15082 - Equipment Insulation.

##### 1.4 REFERENCES

- A. ASHRAE 90A - Water Heater Energy Efficiencies.
- B. ASME Section 8D - Pressure Vessels.
- C. NFPA 70 - National Electrical Code.

##### 1.5 SUBMITTALS

- A. Product Data:
  - 1. Submit heat exchanger dimensions, size of tappings, and performance data.
  - 2. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- B. Certification: Include manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- C. Provide operation and maintenance manuals for plumbing equipment.

##### 1.6 QUALITY ASSURANCE

- A. Provide equipment with manufacturer's name, model number, and rating/capacity

identified.

- B. Ensure products and installation of specified products are in accordance with recommendations and requirements of:
  - 1. American Gas Association (AGA).
  - 2. National Sanitation Foundation (NSF).
  - 3. American Society of Mechanical Engineers (ASME).
  - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
  - 5. National Electrical Manufacturers' Association (NEMA).
  - 6. Underwriters Laboratories (UL).
- C. Regulatory Requirements: Meet requirements of ASME Section 8D for manufacture of pressure vessels for heat exchangers.

## PART 2 - PRODUCTS

### 2.1 GAS-FIRED WATER HEATER (RESIDENTIAL GRADE)

- A. Manufacturers:
  - 1. A. O. Smith.
  - 2. Lochinvar.
  - 3. Ruud/Rheem.
  - 4. State.
- B. Automatic, natural gas fired, vertical storage type with capacity and recovery rates as scheduled with 100 degrees F temperature rise, 150 pounds per square inch-gage maximum working pressure.
- C. Glass lined, welded steel tank; single flue passage, flue baffle and draft hood; thermally insulated with 2-inch thick glass fiber; encased in corrosion-resistant steel jacket with high-density magnesium anode; baked-on enamel finish; floor shield and legs.
- D. Automatic water thermostat with externally adjustable temperature range from 120 degrees F to 180 degrees F with high temperature cut-off set at 190 degrees F; built-in gas pressure regulator; cast iron or sheet metal burner; 100 percent safety shut-off pilot and thermocouple.
- E. Brass water connections and dip tube, drain valve, and ASME temperature and pressure relief valve.
- F. Provide with an automatic gas shut-off device to shut-off entire gas supply in event of excessive temperature in the tank.
- G. Provide with an AGA certified draft hood.
- H. Meet requirements of ASHRAE 90A for energy efficiencies and minimum energy factor required by Federal "National Appliance Energy Conservation Act of 1987."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install tanks in accordance with manufacturer's instructions.
- B. Install unit with clearance for tube bundle removal without disturbing other installed equipment or piping.
- C. Pipe relief valves and drains to nearest floor drain.
- D. Support unit on pipe stand.
- E. Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Provide steam pressure gage at exchanger inlet.
- F. Provide steam traps and valves as indicated. Pitch condensate return 1-inch in 20 feet (1:250) to return pump.

END OF SECTION 15480





## SECTION 15510

### HEATING BOILER AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Boilers, controls and boiler trim, condensate connections, hot water connections, fuel burning system and connections, and draft fan.

##### 1.3 RELATED SECTIONS

- A. Section 15120 - Piping Specialties.
- B. Section 15140 - Domestic Water and Sanitary Drainage Piping: Execution requirements for cold water piping connections to boilers specified by this section.
- C. Section 15190 - Fuel Piping: Execution requirements for oil and gas piping connections to boilers specified by this section.
- D. Section 16150 - Wire Connections and Devices: Execution requirements for electric connections to boilers specified by this section.
- E. Section 16220 - Motors and Controllers: Product requirements for electric motors for placement by this section.

##### 1.4 REFERENCES

- A. AGA - Directory of Certified Appliances and Accessories.
- B. AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- C. ASME SEC I - Boiler and Pressure Vessels Code - Rules for Construction of Power Boilers.
- D. ASME SEC IV - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.
- E. ASME SEC VIII DIV 1 - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
- F. HI - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

- H. NFPA 31 - Installation of Oil Burning Equipment.
- I. NFPA 54 (AGA Z223.1) - National Fuel Gas Code.
- J. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
- K. UL 726 - Oil-Fired Boiler Assemblies.

#### 1.5 SUBMITTALS

- A. Product Data: Submit general layout and dimensions. Include size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.
- B. Test Reports: Indicate specified performance and efficiency is met or exceeded. Provide combustion test that includes boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.
- F. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

#### 1.6 QUALITY ASSURANCE

- A. Conform to ASME SEC I, SEC IV, and UL 726 for construction of boilers. The boiler shall be registered with the National Board Of Boiler And Pressure Vessel Inspectors
- B. Unit Certification: AGA certified.
- C. Conform to applicable code for internal wiring of factory wired equipment.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.
- E. Maintain one copy of each document on site.
- F. Manufacturer Qualifications: Company specializing in manufacturing products

specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

- G. Installer Qualifications: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

#### 1.7 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing Work of this section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.
- B. Protect boilers from damage by leaving packing in place until installation.

#### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.10 WARRANTY

- A. Provide five-year manufacturers warranty for boilers.

#### 1.11 MAINTENANCE SERVICE

- A. Provide service and maintenance of boilers for one year from Date of Substantial Completion.

#### 1.12 MAINTENANCE MATERIALS

- A. Provide wire brush and handle for fire tube boiler cleaning.

#### 1.13 EXTRA MATERIALS

- A. Supply one set of circulator pump seals.

### PART 2 - PRODUCTS

#### 2.1 FIRE TUBE BOILERS

- A. Manufacturers:
  - 1. Fulton
  - 2. Johnson Boiler Co.
  - 3. Teledyne Laars.
- B. Description: Factory assembled, high efficiency, factory fire tested, self contained, readily transported unit ready for automatic operation except for

connection of water, fuel, electrical, and vent services.

- C. Unit: Mount on integral structural steel frame base and include integral forced draft burner, burner controls, boiler trim, refractory, insulation and jacket.

## 2.2 FIRE TUBE BOILER SHELL

- A. Construct to applicable ASME Boiler and Pressure Vessels Code for allowable working pressure of 125 pounds per square inch water.
- B. Provide two lifting eyes on top of boiler.
- C. Provide hand holes and arm holes for boiler inspection and cleaning.
- D. Factory-paint boiler, base, and other components with hard finish silicone enamel.
- E. Water entering hot water boiler thoroughly mixed with hot boiler water through jet induced circulation.

## 2.3 FIRE TUBE HOT WATER BOILER TRIM

- A. ASME rated pressure relief valve, 80 pounds per square inch-gage.
- B. Water temperature gage.
- C. Water pressure gage.
- D. Low water cut-off to prevent burner operation when boiler water falls below safe level.
- E. Operating temperature controller to control burner to maintain water temperature set point.
- F. High limit temperature controller with manual reset for burner to prevent boiler water temperature from exceeding safe system temperature.
- G. Boiler air vent. Automatic.

## 2.4 FIRE TUBE BOILER FUEL BURNING SYSTEM

- A. General: Forced draft automatic burner integral with front head of boiler designed to burn natural gas, modulating with low fire ignition position and automatically maintains fuel-air ratio.
  - 1. Blower: Statically and dynamically balanced to supply combustion air; direct connected to motor.
  - 2. Damper Motor: Single motor controlling combustion air damper and fuel valves.
- B. Gas Burner: Forced draft, high-radiant multi-port power burner with electric

ignition. Natural gas burner piping, include on unit complete gas train including high and low gas pressure switches, plug valve, and gas pressure regulator.

## 2.5 FIRE TUBE BOILER CONTROL PANEL

- A. Mount panel on boiler. Hinged metal cabinet with key lock shall contain programming relay, blower motor starter.
- B. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, pilot, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.
- C. Manual/automatic selector switch and damper motor positioning switch to permit automatic firing in accordance with load demand, or manual control of firing rate at any desired point between low fire and maximum rating.
- D. Electronic detector to prevent primary fuel valves from opening until pilot flame is established.
- E. Panel shall include indicating lights to show low water level, flame failure, fuel valve open and load demand. Mount indicating lights and switches in hinged drop-panel for wiring access.
- F. Provide Sequence of Operation per drawing M402.
- G. Provide boiler notes 1 through 23 of the Boiler Schedule per drawing M702.

## 2.6 SOURCE QUALITY CONTROL (AND TESTS)

- A. Make completed fire tube boilers available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.
- B. Allow witnessing of factory inspections and tests at manufacturers test facility. Notify Owner at least seven days before inspections and tests are scheduled.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with NFPA 54 NFPA 31 NFPA 58.
- B. Install boiler on level steel housekeeping base, minimum 3-1/2 inches high and 6 inches larger on each side than boiler base.
- C. Provide connection of natural gas service in accordance with NFPA 54 (AGA Z223.1) NFPA 58 NFPA 31.

- D. Provide piping connections and accessories as indicated; refer to Section 15120, Section 15140, and Section 15190.
- E. Pipe relief valves and drain valves to nearest floor drain.
- F. Install circulator and diaphragm expansion tank on boiler.
- G. Provide for connection to electrical service. Refer to Section 16150.
- H. Mount thermometer in boiler breeching within 12 inches of flue nozzle for fire tube boilers. Refer to Section 15550.

### 3.2 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance procedures.

END OF SECTION15510

## **SECTION 15550**

### **FLUE PIPE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Flue pipe for gas fired equipment, including manufactured double-wall flue pipe.

##### **1.3 REFERENCES**

- A. ASHRAE Handbook - HVAC Systems and Equipment.
- B. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- C. NFPA 54 - National Fuel Gas Code.
- D. UL 103 -Factory-built Chimneys for Residential Type and Building Heating Appliances.
- E. UL 441 - Gas Vents.

##### **1.4 DEFINITIONS**

- A. Breeching: Vent connector.
- B. Flue Pipe: Vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

##### **1.5 DESIGN REQUIREMENTS**

- A. Comply with NFPA 211 and provide UL listing label for factory built vents used for venting natural draft appliances.

## 1.6 SUBMITTALS

- A. Include product data and shop drawings indicating size, required clearances, construction details and required supports.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of products specified in this Section with minimum ten years documented experience.
- B. Regulatory Requirements:
  - 1. Conform to NFPA 54 code for installation of natural gas burning appliances and equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Metalbestos.
- B. Rite-Vent.
- C. Or equal.

### 2.2 DOUBLE WALL METAL STACKS

- A. Provide double wall metal stacks, tested to UL 103 for use with building heating equipment, in compliance with NFPA 211.
- B. Fabricate with 1 inch minimum air space between walls. Construct inner jacket of 20 gage ASTM A 167 Type 316 stainless steel. Construct outer jacket of Type 316 stainless steel 24 gage for sizes 10 inches to 24 inches and 20 gage for sizes 28 inches to 48 inches.
- C. Provide accessories each bearing factory applied UL label.
  - 1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
  - 2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
  - 3. Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

### 2.3 DOUBLE WALL GAS VENTS 6 INCHES AND SMALLER

- A. Fabricate inner pipe of sheet aluminum and outer pipe of galvanized sheet steel, tested in compliance with UL 441.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with ASHRAE Handbook - HVAC Systems and Equipment and NFPA 54.
- C. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- D. Level and plumb stacks. Provide guys and anchor as required.
- E. Clean stacks during installation, removing dust and debris.
- F. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of stacks.

END OF SECTION 15550



## SECTION 15642

### CLOSED CIRCUIT COOLING TOWER

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Cooling tower.
- B. Accessories.

##### 1.3 RELATED SECTIONS

- A. Section 15060 - Hangers and Supports.
- B. Section 15070 - Vibration Isolation.
- C. Section 15185 - Chemical Water Treatment.
- D. Section 15900 - Controls.
- E. Section 15950 - Testing, Adjusting and Balancing.
- F. Section 16220 - Motors and Controllers.

##### 1.4 REFERENCES

- A. AFBMA 9 - Load Rating and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Rating and Fatigue Life for Roller Bearings.
- C. CTI ATC-105 - Acceptance Test Code for Water Cooling Towers.
- D. CTI 201 - Standard for the Certification of Water-Cooling Tower Thermal Performance.

##### 1.5 SUBMITTALS

- A. Include product data indicating all rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements, wiring diagrams and location and size of field connections.
- B. Certify performance based on CTI 201, and submit performance curve plotting leaving water temperature against wet bulb temperature.

- C. Indicate on shop drawings suggested structural steel supports including dimensions, sizes and locations for mounting bolt holes.
- D. Provide operation and maintenance manual.

#### 1.6 QUALITY ASSURANCE

- A. Provide A/E with manufacturer's certification that materials meet or exceed minimum requirements as specified.

#### 1.7 WARRANTY

- A. Manufacturer to provide five-year warranty against failure of any mechanical equipment component of the fan driven system and its supports, with the exception of the motor. Include repair or replacement of defective material in warranty.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Baltimore Air Co.
- B. Marley.
- C. Evapco

#### 2.2 MANUFACTURED UNIT

- A. Provide complete unit for outdoor use, factory assembled, vertical discharge, induced draft type with fan, surface sections, drift eliminators and motor as scheduled on the drawings.

#### 2.3 COMPONENTS

- A. Framework and Casing: Heavy gage steel protected against corrosion by G-210 galvanizing. Hot-dip galvanized all components subjected to factory welding after fabrication to a zinc thickness equivalent of G-210.
- B. Louvers: PVC or fiberglass, reinforced polyester spaced to minimize air resistance and splashout.
- C. Access: Install large access doors at both ends of tower to eliminators and air plenum.
- D. Fill: Sheets of fire retardant polyvinyl chloride plastic hung from hot-dipped galvanized structural tubing supports.
- E. Float Valves: Provide brass or bronze makeup valve with plastic or copper float.

- F. Finish: Provide all steel components with G-210 hot-dipped galvanized steel with edges protected with zinc rich compound.

## 2.4 ACCESSORIES

- A. Per equipment schedule.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install tower on structural steel beams as instructed by manufacturer.
- C. Install tower on vibration isolators.
- D. Connect condenser water piping with flanged inlet connections to tower. Outlet connections shall be flanged, beveled for welding or grooved for mechanical couplings. Pitch condenser water supply to tower and condenser water suction away from tower.
- E. Connect makeup water piping with flanged or union connections to tower. Pitch to tower.
- F. Connect overflow, bleed and drain to drain.

END OF SECTION 15642



## SECTION 15732

### PACKAGED ROOFTOP AIR CONDITIONING UNITS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Roof mounted, self-contained units, with electric cooling, and gas-fired electric or reverse refrigeration cycle (heat pump) heating and related controls; including:
  - 1. Packaged rooftop unit.
  - 2. Controls.
  - 3. Remote panel.
  - 4. Roof mounting frame and base.
  - 5. Maintenance service.

##### 1.3 RELATED SECTIONS

- A. Section 07120 - Built-up Bituminous Waterproofing.
- B. Section 07130 - Sheet Waterproofing.
- C. Section 07140 - Fluid-Applied Waterproofing.
- D. Section 07170 - Bentonite Waterproofing.
- E. Section 15070 - Vibration Isolation.
- F. Section 15081 - Duct Insulation.
- G. Section 15862 - Air Filters.
- H. Section 15900 - Controls.
- I. Section 15950 - Testing, Adjusting and Balancing.
- J. Section 16220 - Motors and Controllers.

##### 1.4 REFERENCES

- A. AGA - American Gas Association.
- B. ARI 210 - Unitary Air-Conditioning Equipment.
- C. ARI 240 - Air Source Unitary Heat Pump Equipment.

- D. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- E. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

#### 1.5 SUBMITTALS

- A. Include product data and schematic layouts showing condensing units, cooling coils, refrigerant piping and accessories required for complete system. Include complete pipe sizing data.
- B. Include rated capacities, dimensions, weights, accessories, required clearances, electrical requirements, wiring diagrams and location and size of field connections.
- C. Include manufacturer's installation instructions.
- D. Provide operation and maintenance manual.

#### 1.6 MAINTENANCE SERVICE

- A. Furnish complete service and maintenance of packaged rooftop units for one year from date of substantial completion.
- B. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data including minimum of six filter replacements, minimum of one fan belt replacement and controls checkout, adjustments and recalibrations.
- D. Submit copy of service call work order or report and include description of work performed.

#### 1.7 EXTRA MATERIALS

- A. Provide one set of filters.

#### 1.8 QUALITY ASSURANCE

- A. Provide units which are approved by AGA.

#### 1.9 WARRANTY

- A. Provide five-year manufacturer's material replacement warranty for compressor.



## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Carrier Corp.
- B. AAON, Inc.
- C. Trane Co.

### 2.2 MANUFACTURED UNITS

- A. Provide roof mounted units complete with gas burner or electric heating elements and electric refrigeration as scheduled.
- B. Provide units which are self-contained, packaged, factory assembled and prewired consisting of insulated cabinet and frame, supply fan, heat exchanger and burner or electric heating elements, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

### 2.3 MATERIALS

- A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels, with quick fasteners, screwdriver operated flush cam type or locking door handle type with piano hinges. Provide structural members a minimum of 18 gage with access doors or removable panels a minimum of 20 gage.
- B. Insulation: 1 inch thick neoprene coated glass fiber on surfaces where conditioned air is handled. Protect edges from erosion.
- C. Heat Exchangers: Aluminized or stainless steel of welded construction.
- D. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley and rubber isolated hinge mounted motor or direct drive. Isolate complete fan assembly.
- E. Air Filters: 1-inch thick permanent washable.
- F. Roof Mounting Frame: 14-inch high galvanized steel channel frame with gaskets and nailer strips.

### 2.4 BURNER

- A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device and automatic 100 percent shutoff pilot.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor and after air flow proven and slight

delivery, allow gas valve to open.

- C. High Limit Control: Provide a temperature sensor with fixed stop at maximum permissible setting, which will de-energize the burner on excessive bonnet temperature, and energize the burner when temperature drops to lower safe value.
- D. Supply Fan Control: Provide temperature sensor sensing bonnet temperatures and independent of burner controls or adjustable time delay relays with switch for continuous fan operation.

## 2.5 EVAPORATOR COIL

- A. Provide copper or aluminum tube and aluminum fin assembly with galvanized drain pan and connection.
- B. Provide thermostatic expansion valves and alternate row circuiting for units 7-1/2 tons cooling capacity and larger.

## 2.6 COMPRESSOR

- A. Provide the compressor which is hermetic or semi-hermetic, 3600 rotations per minute maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter dryer.
- B. Delay compressor start with five minute timed off circuit.
- C. Provide outdoor thermostat which will energize compressor control circuit above 35 degrees F ambient.
- D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve and solid state defrost control utilizing thermistors.
- E. Provide hot gas bypass or cycling compressors for capacity control.

## 2.7 CONDENSER

- A. Provide coil with copper or aluminum tube and aluminum fin assembly with subcooling rows.
- B. Provide condenser fans which are direct drive propeller fans, resiliently mounted with fan guard, motor overload protection wired to operate with compressor.
- C. Provide heat pressure control by refrigerant pressure switches cycling the condenser fans for unit operation down to 35 degrees F outdoor temperature.

## 2.8 SUPPLY / RETURN CASING

- A. Dampers: Provide outside, return and relief dampers with damper operator and control package to automatically vary outside air quantity.
- B. Gaskets: Provide tight fitting dampers with edge gasket, maximum leakage 5 percent at 2 inches WC pressure differential.
- C. Damper Operator: Provide 24 volt with gear train sealed in oil with spring return on units 7-1/2 tons cooling capacity and larger.

## 2.9 OPERATING CONTROLS - SINGLE ZONE UNITS

- A. Electric solid state microcomputer based room thermostat located as indicated in service area with remote sensor located as indicated.
- B. Incorporate the following in room thermostat:
  - 1. Automatic switching from heating to cooling.
  - 2. Preferential rate control to minimize overshoot and deviation from set point.
  - 3. Set-up for four separate temperatures per day.
  - 4. Instant override of set point for continuous or timed period from one hour to 31 days.
  - 5. Short cycle protection.
  - 6. Programming based on weekdays, Saturday and Sunday.
  - 7. Switch selection features including imperial or metric display, 12 or 24-hour clock, keyboard disable, remote sensor, fan ON-AUTO switch.
- C. Include room thermostat display as follows:
  - 1. Time of day.
  - 2. Actual room temperature.
  - 3. Programmed temperature.
  - 4. Programmed time.
  - 5. Duration of timed override.
  - 6. Day of work.
  - 7. System model indication: heating, cooling, auto, off, fan auto and fan on.
  - 8. Stage (heating or cooling) operation.

## 2.10 PERFORMANCE

- A. Base performance on ARI 210 test conditions unless specified otherwise. Sound rating numbers are in accordance with ARI 270.
- B. Rated heating and cooling capacities shall be as scheduled on the drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting frame level.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide initial startup and shutdown during first year of operation including routine servicing and checkout.

END OF SECTION 15732

## SECTION 15737

### SPLIT SYSTEM AIR CONDITIONERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Direct expansion (DX) air conditioning system, including:
  - 1. Air handler.
  - 2. Outdoor condensing unit.
  - 3. Thermostat.

##### 1.3 RELATED SECTIONS

- A. Section 15083 - Piping Insulation.
- B. Section 15184 - Refrigeration Piping and Specialties.
- C. Section 16220 - Motors and Controllers.

##### 1.4 REFERENCES

- A. ARI 240 - Air Source Unitary Heat Pump Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

##### 1.5 SUBMITTALS

- A. Include product data and schematic layouts showing condensing units, cooling coils, refrigerant piping and accessories required for complete system. Include complete pipe sizing data.
- B. Include rated capacities, dimensions, weights, accessories, required clearances, electrical requirements, wiring diagrams and location and size of field connections.
- C. Include manufacturer's installation instructions.
- D. Provide operation and maintenance manual.

##### 1.6 QUALITY ASSURANCE

- A. Provide capacity ratings with ARI certification.

## 1.7 WARRANTY

- A. Provide five-year manufacturer's material replacement warranty on compressor.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Carrier.
- B. Lennox.
- C. McQuay.
- D. Trane.

### 2.2 SYSTEM DESCRIPTION

- A. Provide split system air conditioning unit consisting of horizontal discharge as indicated on Drawings, indoor air handler, outdoor condensing unit, refrigerant piping, fittings and accessories, and controls. Factory assemble components and test unit.
- B. Heating and Cooling Capacities: As indicated on Drawings.

### 2.3 AIR HANDLERS

- A. Horizontal unit with rear return as required by unit configuration as indicated on Drawings. Provide insulated cabinet with enamel finish.
- B. Direct expansion, copper cooling coil (aluminum plate fins) with thermal expansion valve and belted centrifugal fan.
- C. Electric heater.

### 2.4 CONDENSING UNITS

- A. Provide condensing units as scheduled; self-contained, packaged, factory assembled and prewired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral subcooling coil, controls, liquid receiver and screens.
- B. Provide corrosion resistant materials for unit parts which come in contact with refrigerant.
- C. Provide timer conduits to prevent rapid loading and unloading of compressor.
- D. Fabricate cabinet from galvanized steel, with baked enamel finish; provide removable access doors or panels with quick fasteners.

- E. Compressor: Hermetically sealed or semi-hermetic type, 1,750 rotations per minute, resiliently mounted with positive lubrication, crankcase heater, cylinder unloaders for capacity modulation, motor overload protection, service valves, filter drier, suction and discharge valves, with gage ports, and high and low pressure safety controls.
- F. Condenser:
  - 1. Seamless copper or aluminum tubing with aluminum fins coil.
  - 2. Provide condenser fans which discharge, vertically and have direct drive or fans resiliently mounted with guard and motor.
  - 3. Provide unit with permanently lubricated ball bearing type with built-in current and overload protection.

## 2.5 PIPING

- A. Provide one refrigerant line filter dryer and outside pressure taps in each refrigerant circuit.

## 2.6 CONTROLS

- A. Provide unit with high and low pressure cutouts for compressor, non-recycling pumpdown, reset relay and oil pressure safety control (7-1/2 ton units and larger). Provide with controls to permit operation down to 0 degree F ambient temperature at minimum compressor load.
- B. Provide indoor thermostat with automatic heat/cool and fan/off/auto switch.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Verify proper refrigerant charge and operating pressures. Supplement factory charge (R-22) if necessary.

END OF SECTION 15737





## SECTION 15740

### WATER SOURCE HEAT PUMP UNITS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Package terminal heat pump units and controls.

##### 1.3 RELATED SECTIONS

- A. Section 15070 - Vibration Isolation: Product requirements for vibration isolators for placement by this section.
- B. Section 15820 - Duct Accessories: Product requirements for flexible connections for placement by this section.
- C. Section 15862 - Air Filters: Product requirements for Air Filters for placement by this section.
- D. Section 15900 - Controls.
- E. Section 16150 - Wire Connections and Devices: Execution requirements for electrical connection to units specified by this section.
- F. Section 16220 - Motors and Controllers: Product requirements for electric motors for placement by this section.

##### 1.4 REFERENCES

- A. ARI 210 - Unitary Air-Conditioning Equipment.
- B. ARI 240 - Air Source Unitary Heat Pump Equipment.
- C. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

##### 1.5 SUBMITTALS

- A. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- B. Product Data: Submit drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements. Provide capacity and dimensions of manufactured products and assemblies required for this Project.

Indicate electrical service with electrical characteristics and connection requirements, and duct connections. Provide data for manufactured products and assemblies. Indicate glycol, drain, thermostatic valves, and electrical rough-in connections with electrical characteristics and connection requirements.

- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record actual locations of controls that are separate from units.
- F. Operation and Maintenance Data: Submit.

#### 1.6 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- C. Installer Qualifications: Company specializing in performing Work of this Section with minimum three years documented experience.

#### 1.7 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing Work of this Section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept heat pump units on site in factory packaging. Inspect for damage.
- B. Protect terminal heat pump units from damage by providing temporary covers until construction is complete in adjacent space. Protect rooftop heat pump units from damage by storing off the roof until the roof mounting curbs are in place.

#### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.10 WARRANTY

- A. Provide five-year manufacturer's warranty for compressors.

#### 1.11 MAINTENANCE SERVICE

- A. Provide service and maintenance of packaged heat pump roof top units for one year from Date of Substantial Completion. Include maintenance items as shown

in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments. Provide 24-hour emergency service on breakdowns and malfunctions.

#### 1.12 EXTRA MATERIALS

- A. Supply one set of filters for each unit.

### PART 2 - PRODUCTS

#### 2.1 WATER SOURCE HEAT PUMP UNITS

- A. Manufacturers:
  - 1. Carrier Corp.
  - 2. Lennox International.
  - 3. Trane
- B. Provide units per equipment schedule.

#### 2.2 CONTROLS

- A. Control Module: Remote mounted programable thermostat with fan/off/auto switch.

### PART 3 - EXECUTION

- A. Locate remote panels where indicated.
- B. Connect controls to remote locations.
- C. Mount indoor units on vibration isolators.
- D. Connect indoor units to supply and return ductwork with flexible connections.
- E. Pipe condensate from drain pan to condensate pump to condensate drainage system.

#### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide initial start-up and shutdown during first year of operation, including routine servicing and checkout.
- B. Demonstrate unit operation and maintenance.

END OF SECTION 15740



## **SECTION 15810**

### **DUCTS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Ductwork.
- B. Supports.
- C. Duct cleaning.

##### **1.3 RELATED SECTIONS**

- A. Section 09910 - Paints.
- B. Section 15060 - Hangers and Supports.
- C. Section 15081 - Duct Insulation.
- D. Section 15820 - Duct Accessories.
- E. Section 15850 - Air Outlets and Inlets.
- F. Section 15950 - Testing, Adjusting and Balancing.

##### **1.4 REFERENCES**

- A. ASHRAE - Handbook 1993 Fundamentals; Chapter 32 - Duct Design.
- B. ASHRAE - Handbook 1992 HVAC Systems and Equipment; Chapter 16 - Duct Construction.
- C. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- D. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- F. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- G. SMACNA 1035 - HVAC Duct Construction Standards - Metal and Flexible.

H. UL 181 - Factory-Made Air Ducts and Air Connectors.

## 1.5 DEFINITIONS

A. Duct Sizes: Sizes shown on Drawings are inside clear dimensions. For lined ducts the drawings duct size have already been increased for lining.

## 1.6 SUBMITTALS

A. Indicate ductwork and fittings and gages, sizes, welds, and layout with bottom of duct elevation prior to start of work for duct systems.

## 1.7 QUALITY ASSURANCE

A. Provide ductwork in accordance with NFPA 90A and NFPA 90B.

B. Provide copy of SMACNA 1035 on site for use by site inspector.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Omni Duct.

B. Peabody Spunstrand.

C. Spiral Pipe of Texas, Inc.

D. United-McGill Corporation.

### 2.2 MATERIALS

A. Noncombustible, Class O in accordance with NFPA 90A or meeting requirements for Class 1 air duct materials in accordance with UL 181.

B. Steel Ducts: ASTM A 653 or ASTM A 527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 ounce per square foot for each side.

C. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 2 inches WG positive and 1-1/2 inches WG negative.

D. Insulated Flexible Ducts: Flexible duct, wrapped with minimum 1-inch thick flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 "k" value at 75 degrees F.

E. Fasteners: Rivets, bolts, or sheet metal screws for steel ducts. Weld joints in stainless steel ductwork.

- F. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded. In corrosive areas, use reinforced fiberglass coating on supports. Use double nuts and lock washers on threaded rod supports.
- G. Exposed Ductwork: Provide with coating to allow painting.
- H. Provide gage stamped on metal.

## 2.3 FITTINGS

- A. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide double thickness turning vanes. Provide turning vanes to prevent liner damage where acoustical lining is indicated.
- B. Increase duct sizes gradually, not exceeding 15-degree transition angle wherever possible not to exceed 45 degrees on concentric transitions and 30 degrees on eccentric transitions.
- C. Provide standard 45-degree entry takeoffs unless otherwise indicated as a 90-degree conical tee connection.

## 2.4 DUCTWORK

- A. Fabricate and support in accordance with SMACNA 1035 and ASHRAE Handbook Fundamentals and ASHRAE Handbook HVAC Systems and Equipment, except as indicated. Provide duct material, gages, and reinforcing for operating pressures indicated.
- B. Pressure Classifications:
  - 1. 2-inch WG positive or negative static pressure and velocities less than 2,000 feet per minute, SMACNA seal Class A on duct upstream from boxes.
  - 2. Round ducts in lieu of specific individual rectangular ductwork sizes shown on Drawings will not be allowed.
- C. Exposed Locations: Spiral duct.
- D. Provide easements where ductwork conflicts with piping and structure. Split into two ducts maintaining original duct area where easements exceed 20 percent of duct area.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Seal joints and seams by continuously embedding 4-inch wide strip of fiberglass cloth in mastic and covering with second layer of mastic.
  - 1. Mastic:
    - a. Miracle Adhesive D618.
    - b. Hardcast 601.
  - 2. Contractor's Option: "Ductmate".

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Provide temporary closures of metal or taped polyethylene on open ductwork during construction to prevent construction dust from entering ductwork system.

### 3.2 INSTALLATION

- A. Provide balancing dampers at points of supply, return, and exhaust where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw cap to ensure against air leakage. Extend tube to clear insulation.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- E. Connect diffusers to low pressure ducts with 5-foot maximum length of flexible duct. Hold in place with strap or clamp.
- F. Support ductwork in accordance with SMACNA requirements. Seismically brace ductwork in accordance with SMACNA Seismic Restraint Manual Guidelines For Mechanical Systems.
- G. Adhere to Drawings as closely as possible. If approved by A/E, run and shape of ducts may vary and offsets may be made during progress of work, if required to meet structural or other interferences.
- H. Fabricate ducts to prevent seams of joints being cut for installation of grilles, registers, or outlets.
- I. Reinforce ducts to prevent buckling, breathing, vibrations, or unnecessary noises, as during start-up, shutdown, and continuous operation of air handling system, reinforcing shall be as recommended in ASHRAE Guide and Data Book and SMACNA 1035.

### 3.3 PAINTING

- A. Paint exposed ductwork per the direction of the A/E.



### 3.4 ADJUSTING AND CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

### 3.5 DUCTWORK APPLICATION SCHEDULE

Air System	Material
Supply	Galvanized Steel
Return and Relief	Galvanized Steel
Exhaust	Galvanized Steel
Outside Air Intake	Galvanized Steel
Ventilation	Galvanized Steel

### 3.6 DUCTWORK PRESSURE CLASSIFICATION SCHEDULE

- A. All ductwork shall be constructed for a 2 inch pressure classification.

END OF SECTION 15810



**SECTION 15820**  
**DUCT ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Volume control dampers.
- B. Combination fire and smoke dampers.
- C. Backdraft dampers.
- D. Flexible duct connections.
- E. Duct access doors.
- F. Duct test holes.

**1.3 RELATED SECTIONS**

- A. Section 15070 - Vibration Isolation.
- B. Section 15081 - Duct Insulation.
- C. Section 15810 - Ducts.
- D. Section 15850 - Air Outlets and Inlets.

**1.4 REFERENCES**

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA 1035 - HVAC Duct Construction Standards - Metal and Flexible.
- C. UL 33 - Heat Responsive Links for Fire-Protection Service.
- D. UL 555 - Fire Dampers.
- E. UL 555S - Safety Leakage Rated Dampers for Use in Smoke Control Systems.

**1.5 SUBMITTALS**

- A. Include shop drawings for shop fabricated assemblies indicated, including volume control dampers, duct access doors, and duct test holes. Provide

product data for hardware used.

- B. Combination Fire and Smoke Dampers: Provide UL installation drawing.
- C. Include manufacturer's installation instructions.
- D. Provide operation and maintenance manual.

## PART 2 - PRODUCTS

### 2.1 VOLUME CONTROL DAMPERS (MVD)

- A. Fabricate in accordance with SMACNA 1035 and as indicated.
- B. Provide balancing dampers downstream of duct splits where possible, provide splitters, if not possible. Fabricate splitter dampers of material same gage as duct to 24-inch size in either direction, and two gages heavier for sizes over 24 inches. Fabricate splitter dampers of sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4-inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- C. Fabricate single blade dampers for duct sizes to 12 inches high by 30 inches wide.
- D. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes, 12 inches high by 48 inches wide. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. Provide end bearings except in round ductwork 12 inches and smaller. Provide oil-impregnated nylon or sintered bronze bearings on multiple blade dampers.
- F. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Provide regulator at both ends where rod lengths exceed 30 inches.
- G. Mount quadrant regulators on stand-off mounting brackets, bases, or adapters on insulated ducts.

### 2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S for dynamic closure under flow and pressure for the designed systems, and as indicated.
- B. Provide factory sleeve for each damper. Provide damper operator on exterior of sleeve and link to damper operating shaft.
- C. Fabricate with multiple blades with stainless steel sleeve bearings.
- D. Provide operators of the spring return, pneumatic type, suitable for operation on 0 to 20 pounds per square inch-gage instrument air or electric type suitable to operate on voltage indicated on Drawings. Provide UL-listed and labelled

operators. Provide end switches to indicate damper position. Provide 165 degree F fusible link.

E. Fire Rating: 1-1/2 hours.

### 2.3 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18 inches by 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gage galvanized steel, with center pivoted blades of maximum 6-inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

### 2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA 1035.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 ounce per square yard, approximately 6 inches wide, crimped into metal edging strip. Provide electrical bonding jumpers across flexible connection.

### 2.5 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA 1035 unless otherwise indicated. Fabricate doors of the same material as the duct construction.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors with sealing gaskets and quick fastening locking devices. Provide minimum 1-inch thick insulation with sheet metal cover for insulated ductwork.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 inches by 48 inches. Provide additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners will not be acceptable.

### 2.6 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Provide factory fabricated permanent test holes, air tight flanged fittings with

screw cap. Provide extended neck fittings to clear insulation.

## 2.7 INTAKE SCREENS

- A. Provide 1/2-inch by 1/2-inch galvanized screen mounted in heavy-duty galvanized frame for outside air connections and return air connections without return grilles.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts and as required for air balancing. Use splitter dampers to achieve required air flow quantities.
- C. Provide combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- D. Demonstrate resetting of fire dampers to authorities having jurisdiction and A/E.
- E. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access.
- H. Provide duct test plugs at inlet and outlet of equipment for testing and balancing purposes.
- I. Provide volume control dampers on each branch duct leading to each air outlet whether indicated on Drawings or not.
- J. Provide required straight sections of duct upstream and downstream of flow measuring devices. Refer to manufacturer's data for required dimensions.
- K. Dampers shall be 100 percent open prior to beginning testing and balancing.

3.2 PAINTING

- A. Paint exposed ductwork and devices, excluding flexible connections per the direction of the A/E.

END OF SECTION 15820





**SECTION 15834**  
**CENTRIFUGAL FANS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Centrifugal fans for mechanical systems and associated items normally found with fan installation; including:
  - 1. Backward inclined centrifugal fans.
  - 2. Inline centrifugal fans.
  - 3. Motors and drives.
  - 4. Belt guards.
  - 5. Inlet/outlet screens.
  - 6. Access doors.
  - 7. Scroll drains.

**1.3 RELATED SECTIONS**

- A. Section 15060 - Hangers and Supports.
- B. Section 15070 - Vibration Isolation.
- C. Section 15810 - Ducts.
- D. Section 15900 - Controls.
- E. Section 15950 - Testing, Adjusting and Balancing.

**1.4 REFERENCES**

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.
- E. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- F. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

G. SMACNA 1035 - HVAC Duct Construction Standard - Metal and Flexible.

#### 1.5 SUBMITTALS

- A. Include fan curves with specified operating point clearly plotted.
- B. Include sound power levels for both fan inlet and outlet at rated capacity.
- C. Indicate special coating when required.
- D. Provide operation and maintenance manual.

#### 1.6 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300.
- C. Fabrication: Conform to AMCA 99.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acme Fan.
- B. U.S. Fan International.
- C. Cook Fan.
- D. Trane Company.

#### 2.2 GENERAL

- A. Select fans such that they do not increase motor size, increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from specified criteria. Provide fans capable of accommodating static pressure variations of plus 10 percent.
- B. Base performance on sea level conditions.
- C. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas.
- D. Coat all parts of fan housing, blades, etc., exposed to corrosive air stream with specified material.

## 2.3 WHEEL AND INLET

- A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy backplate, backwardly curved blades welded or riveted to flange and backplate; cast-iron or cast steel hub riveted to backplate and keyed to shaft with set screws and key.

## 2.4 HOUSING

- A. Heavy gage steel, spot welded for AMCA 99 designated Classes I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.
- B. Factory finish before assembly with enamel or prime coat. For fans handling air downstream of humidifiers, fabricate of galvanized steel. Prime coating on aluminum parts is not required.
- C. Provide bolted construction with horizontal flanged split housing.
- D. Fume Hood Fan Housing: Cast iron with three coats of air dried Heresite. Apply Heresite to all parts of the fan housing both internal and external.
- E. Corrosive Resistant Housing: PVC or fiberglass.

## 2.5 MOTORS AND DRIVES

- A. Motors: As indicated, in compliance with section on motors, this division.
- B. Bearings: AFBMA 9, L-50 life at 100,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or AFBMA 11 L-50 life at 400,000 hours pillow block type, self-aligning, grease-lubricated roller bearings.
- C. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil. Provide 316 stainless steel shafts for corrosive applications.
- D. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves selected so required rotations per minute is obtained with sheaves set at mid-position. Include an additional set of drives for each fan to be used for final adjustments. After correct speed has been determined with variable sheave, provide two belts.
- E. Belt Guard: Fabricate to SMACNA 1035; of 12 gage 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

## 2.6 ACCESSORIES

- A. Inlet/Outlet Screens: Galvanized steel welded grid.
- B. Access Doors: Shaped to conform to scroll with quick opening latches and

gaskets.

- C. Cover: Provide weatherproof cover for motor and drive where fans are exposed to the weather.
- D. Provide back draft damper.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. Install fans as indicated or specified with resilient mountings and flexible electrical leads.
- C. Install flexible connections specified in section on ductwork accessories between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- D. Install fan restraining snubbers. Install flexible connectors so that they are not in tension while running.
- E. Provide variable sheaves required for final air balance.
- F. Provide safety screen where inlet or outlet is exposed.
- G. Provide backdraft dampers on discharge of exhaust fans and as indicated.
- H. Install roof mounted fans on factory curbs.

### 3.2 PAINTING

- A. Provide fans with factory finish in accordance with the manufacturer's standard. Touch up scratches and marks from handling and placement of equipment with masking enamel to match manufacturer's color.
- B. Where exhaust fans are required to have Heresite coating, have units factory finished with required number of coats prior to shipping to the job site.

END OF SECTION 15834

**SECTION 15836**  
**POWER VENTILATORS**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.02 SECTION INCLUDES**

- A. Furnish and install roof and wall exhausters and cabinet and ceiling exhaust fans for mechanical systems.

**1.03 RELATED SECTIONS**

- A. Section 15060 - Hangers and Supports.
- B. Section 15070 - Vibration Isolation.
- C. Section 15810 - Ducts.
- D. Section 15834 - Centrifugal Fans.
- E. Section 15950 - Testing, Adjusting and Balancing.
- F. Section 16220 - Motors and Controllers.

**1.04 REFERENCES**

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- E. SMACNA - Low Pressure Duct Construction Standard.

**1.05 SUBMITTALS**

- A. Include fan curves with specified operating point clearly plotted.
- B. Include sound power levels for both fan inlet and outlet at rated capacity.
- C. Indicate special coating when required.
- D. Provide operation and maintenance manual.

## 1.06 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300.
- C. Fabrication: Conform to AMCA 99.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acme.
- B. Carnes.
- C. Cook.
- D. Penn.

### 2.02 ROOF EXHAUSTERS

- A. Centrifugal or Axial Fan Unit: Backward inclined or airfoil design, v-belt or direct driven, with spun aluminum housing; resilient mounted motor and drive assembly; 1/2-inch mesh, 16 gauge aluminum birdscreen; square base to suit roof curb with continuous curb gaskets; secured with cadmium plated or stainless steel bolts and screws.
- B. Roof Curb: 12 inch high with continuously welded seams, built-in cant strip, 1 inch insulation and curb bottom, hinged curb adapter and factory installed door nailer strip. Where scheduled, provide interior baffle with acoustic insulation and increase curb height as required.
- C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- D. Backdraft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.
- E. Sheaves: Cast-iron or steel, dynamically balanced, bored to fit shafts and keyed; adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; and will not overload motor when adjusted to maximum pitch; fan shaft with self-aligning pre-lubricated ball bearings.
- F. Apply three coats of air dried Heresite coating both internal and external to all roof exhausters from corrosive areas.

## 2.03 WALL EXHAUSTERS

- A. Centrifugal or Axial Fan Unit: V-belt or direct driven, with spun aluminum housing; resiliently mounted motor and drive assembly; 1/2-inch mesh 16 gauge aluminum or galvanized steel bird screen; secured with cadmium plated or stainless steel bolts and screws.
- B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- C. Backdraft Damper: Gravity activated, aluminum construction, felt edged with nylon bearings.
- D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with lag screws to roof curb.
- C. Install flexible ductwork connections when fan connects to ductwork.
- D. Provide all ventilating and exhaust fans with integral vibration isolation or mount or suspend unit with vibration isolators.

### 3.02 PAINTING

- A. Provide equipment with factory finish in accordance with the manufacturer's standards. Touch up scratches and marks from handling and installation with masking enamel to match manufacturer's color.
- B. Where exhaust fans are required to have Heresite coating, have units factory finished with required number of coats prior to shipping to the job site.

END OF SECTION 15836





## SECTION 15850

### AIR OUTLETS AND INLETS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Wall, and ceiling diffusers, registers and grilles, louvers, and roof vents.

##### 1.3 RELATED SECTIONS

- A. Section 10200 "Louvers" for architectural louvers set in exterior walls including L1 and L2.
- B. Section 15810 - Ducts.
- C. Section 15820 - Duct Accessories.
- D. Section 15950 - Testing, Adjusting and Balancing.

##### 1.4 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. ARI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA 1035 - HVAC Duct Construction Standards - Metal and Flexible.

##### 1.5 SUBMITTALS

- A. Include product data for outlets and inlets indicating type, size, location, application, and noise level.
- B. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- C. Include manufacturer's installation instructions.

## 1.6 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.
- C. Conform to NFPA 90A.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Ceiling Diffusers:
  - 1. Tuttle & Bailey.
  - 2. Krueger Manufacturing Company.
  - 3. Titus Products.
- B. Louvers:
  - 1. Airolite.
  - 2. Ruskin.
- C. Roof Vents:
  - 1. ACME.
  - 2. Cook.

### 2.2 RECTANGULAR CEILING DIFFUSERS

- A. Rectangular, adjustable pattern, stamped, multicore type diffuser to discharge air in 360-degree pattern with sectorizing baffles where indicated.
- B. Provide surface mount type frame. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabricate of steel with baked enamel off-white finish.
- D. Provide radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

### 2.3 PERFORATED FACE CEILING DIFFUSERS

- A. Perforated face with fully adjustable pattern and removable face.
- B. Provide surface mount type frame. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabricate of steel with steel or aluminum frame and baked enamel off-white finish.
- D. Provide radial opposed blade damper and multi-louvered equalizing grid with

damper adjustable from diffuser face.

#### 2.4 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Fixed grilles of 1/2-inch by 1/2-inch by 1/2-inch louvers.
- B. Fabricate 1 inch margin frame with countersunk screw mounting for gypsum board ceiling or lay-in frame for suspended grid ceilings.
- C. Fabricate of aluminum with factory baked enamel finish.
- D. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

#### 2.5 WALL SUPPLY REGISTERS/GRILLES

- A. Streamlined and individually adjustable blades, depth of which exceeds 3/4-inch maximum spacing with spring or other device to set blades, vertical face, double deflection.
- B. Fabricate 1-inch margin frame with countersunk screw mounting and gasket.
- C. Fabricate of steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

#### 2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Streamlined blades, depth of which exceeds 3/4-inch spacing, with spring or other device to set blades, vertical face.
- B. Fabricate 1-inch margin frame with countersunk screw mounting.
- C. Fabricate of steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

#### 2.7 DOOR GRILLES

- A. V-shaped louvers of 20 gage steel, 1 inch deep on 1/2-inch centers.

- B. Provide 20 gage steel frame with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

## 2.8 LOUVERS

- A. Architectural louvers set in exterior walls, including L1 and L2, are specified in Section 10200 "Louvers."
- B. Provide 6-inch deep louvers with blades on 45-degree slope with center baffle and return bend, heavy channel frame, birdscreen on interior side with 1/2-inch square mesh for exhaust and 3/4-inch for intake.
- C. Fabricate of 12 gage extruded aluminum, welded assembly, with factory prime coat finish.
- D. Furnish with exterior angle flange for installation.
- E. Fabricate louver penthouses with mitered corners and reinforce with structural angles.
- F. Pass 750 feet per minute free velocity with less than 0.10 inches of water pressure drop, based in accordance with AMCA 500. Water penetration less than 0.025 ounce of water per foot of free area at 900 feet per minute. Provide a minimum of 45 percent free area.

## 2.9 ROOF VENTS

- A. Fabricate air inlet or exhaust hoods in accordance with SMACNA 1035, Class 1 inch, Duct Construction Standards.
- B. Fabricate of galvanized steel, minimum 16 gage base and 20 gage hood, or aluminum, minimum 16 gage base and 18 gage hood; suitably reinforced; with removable hood; birdscreen with 1/2-inch square mesh for exhaust and 3/4-inch for intake, and factory prime coat finish.
- C. Mount unit on minimum 12-inch high curb base with insulation between duct and curb.
- D. Make hood outlet area minimum of twice throat area.

## 2.10 GOOSENECKS

- A. Fabricate in accordance with SMACNA 1035, Class 1 inch, of minimum 18 gage galvanized steel.
- B. Mount on minimum 12-inch high curb base where size exceeds 9-inch by 9-inch.

## 2.11 CORROSION PROTECTION

- A. Coat all inlets and outlets in corrosive areas with two coats air dried Heresite.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.
- F. Provide all specialties and frames for air devices required for installation in ceiling type indicated in architectural documents. Provide all cutting and patching of T-bars, gypsum board and other ceiling systems as required for installation of air devices.

END OF SECTION 15850



## **SECTION 15862**

### **AIR FILTERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Disposable panel filters.
- B. Filter frames.
- C. Filter gages.

##### **1.3 RELATED SECTIONS**

- A. Section 15530 – Air Handling Units.
- B. Section 15740 – Split System Heat Pumps.
- C. Section 15810 - Ducts.

##### **1.4 REFERENCES**

- A. UL 900 - Test Performance of Air Filter Units.
- B. ASHRAE 52 - Method of Testing Air Cleaning Devices used in General Ventilation for Removing Particulate Matter.

##### **1.5 SUBMITTALS**

- A. Include filter media, filter performance data, filter assembly and filter frames.
- B. Provide operation and maintenance manual.

##### **1.6 QUALITY ASSURANCE**

- A. Provide filter media that is UL 900 listed, Class 1 or Class 2, as approved by local authorities.
- B. Provide all filters as product of one manufacturer.
- C. Assemble filter components to form filter banks from products of one manufacturer.

## 1.7 EXTRA MATERIALS

- A. Provide two spare sets of disposable panel filters at project final acceptance for each piece of equipment requiring filters.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. American Air Filter.
- B. Cam-Farr.
- C. Continental.
- D. Owens Corning.

### 2.2 DISPOSABLE PANEL FILTERS

- A. Media: 2-inch thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive. Provide industry standard sizes as required for installation.
- B. Rating: 500 feet per minute face velocity, 0.15-inch WG initial resistance, 0.50-inches WG recommended final resistance.
- C. Provide filter media in permanent removable frames.
- D. Holding Frames: 20 gage minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

### 2.3 FILTER FRAMES

- A. Fabricate filter frames and supporting structures of 16 gage galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
- B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for required installation of filter media minimum 2 inch thick; for extended surface and high efficiency particulate filters, provide for upstream mounting.
- C. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gage galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extended aluminum tracks or channels for primary and secondary filters with positive sealing gaskets.

### 2.4 FILTER SECTIONS

- A. Inclined Manometer: One piece molded plastic with epoxy coated aluminum



scale, inclined-vertical indicating tube and built-in spirit level, range 0 inches to 5 inches WG, 3 percent of full scale accuracy.

- B. Accessories: Static pressure tips with integral compression fittings, 1/4-inch aluminum tubing, two-way or three-way vent valves.
- C. Inclined Manometer used for Enthalpy Wheel unit.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters temporary or permanent are in place. Replace temporary filters used during construction.
- D. Install filter gage static pressure tips upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level. Used on Enthalpy Wheel unit.
- E. Provide inclined gage manometer with red gage oil at filter bank of Enthalpy Wheel unit. Provide at least 2 ounces of red gage oil for replacement in each manometer.

END OF SECTION 15862



## SECTION 15900

### CONTROLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Automatic temperature controls, control and instrumentation equipment, automation equipment, and installation electric/electronic control. Provide system of controls that will completely accomplish implied or intended functions of control system as shown on Drawings and as specified.

##### 1.3 RELATED SECTIONS

- A. Section 15130 – Pumps.
- B. Section 15185 – Chemical Water Treatment.
- C. Section 15510 – Heating Boiler and Accessories.
- D. Section 15642 -- Closed Circuit Cooling Tower.
- E. Section 15737 – Split System Air Conditioners.
- F. Section 15740 – Water Source Heat Pump Units.
- G. Section 15834 -- Centrifugal Fans.
- H. Section 15836 – Power Ventilators.
- I. Section 15950 – Testing Adjusting And Balancing.
- J. Section 16132 - Conduit.

##### 1.4 SUBMITTALS

- A. Include manufacturer's certified rating data, description literature, catalog cuts, and shop drawings, for proposed:
  - 1. Control devices and equipment.
  - 2. Control dampers and valves.
  - 3. Control panels.
  - 4. Programmable Thermostat.
- B. Include control and interlock wiring diagrams and descriptions on operation of all control systems and their effect on other equipment and systems.
- C. A review of any submittal, which results in a requirement for Contractor to resubmit, shall not be justified basis for work delay or additional compensation.
- D. Arrange a non-disclosure agreement with the manufacturers to permit the Owner to obtain and use documentation on the system of software.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Honeywell.
- B. Johnson Controls.
- C. KELE.
- D. Or Equal.

### 2.2 MATERIALS

- A. It is the intention of this portion of the specifications to set a minimum standard of quality for all equipment and devices used in the control system and at the various control panels. Any reference to any equipment item, control system or panel shall be construed to apply equally to all similar items, systems or panels as may be applicable in the opinion of A/E. All hardware employed within this system shall be of the "first quality" grade. Equipment shall be selected on the basis of durability, serviceability and function. Provide only UL listed equipment.
- B. The equipment furnished under this section of the specifications shall be supplied as a complete system produced under the responsibility of the controls contractor utilizing all of the various components specified to meet the function and accuracies described within this section of the specifications.

### 2.3 AUTOMATIC TEMPERATURE CONTROL EQUIPMENT

- A. A. Programmable Thermostats:

All programmable thermostats are required to have the capability to be programmed for temperature operation in the occupied mode and the unoccupied mode. Separate heating and cooling set points and auto-changeover capability allow occupied and unoccupied programming for extreme temperature control and for energy savings.

The occupied mode is required to be activated before heating and cooling set points can be maintained.

Both the heating and cooling set points shall be independently adjustable in such a manner that the temperature difference between heating and cooling set points develops an energy dead band of 5 degrees. When the space temperature is within the dead band, neither heating nor cooling energy is added to the space. The supply fan runs continuously during occupied mode. Protective Guards: Provide on all thermostats in corridors, lobbies, meeting rooms, toilet rooms, instruction rooms and similar areas with vandal proof screws and finished in clear plastic.

- B. Electric solid state microcomputer based wall mounted room thermostat, located as indicated at a height of 48 inches above the floor.

- C. Room thermostat shall incorporate:
1. Automatic switching from cooling to heating.
  2. Instant override of set point for continuous or timed period from one hour to 31 days.
  3. Short cycle protection.
  4. Programming based on weekdays, Saturday and Sunday.
  5. Switch selection features including imperial or metric display, 12 or 24-hour clock, keyboard disable, and fan-on-auto switch.
- D. Room thermostat display shall include:
1. Time of day.
  2. Actual room temperature.
  3. Programmed temperature.
  4. Programmed time.
  5. Duration of timed override.
  6. Day of week.
  7. System model indication: cooling, heating, auto, off, fan auto, fan on.  
Stage (heating or cooling) operation.
- E. Temperature Sensors:
1. Solid state electronic factory calibrated to within 1/2 degree F, interchangeable. Provide wall sensors in tamper-proof enclosures.
  2. Temperature Indication Sensing Elements: For all rooms, air ducts, water pipes, or outside air sensing for temperatures to be remotely indicated and/or recorded, provide the resistance element, thermocouple or solid state time pulse generator type. Provide thermocouples and extension wire with copper constantan, 16 gage polyvinyl over polyvinyl, "premium" grade (plus or minus 3/4 degree F). Provide resistance elements or pulse generators and their respective transmission wires shall be of comparable grade and quality.
- F. Protective Guards: Provide on all controllers or transmitters in corridors, lobbies, meeting rooms, toilet rooms, instruction rooms and similar areas with vandalproof screws and finished in color selected by A/E.
- G. Smoke Detectors: Powered by Division 16 furnished and installed in ducts or equipment by Division 15.
- H. Firestats: Manual reset type with an adjustable temperature cut-off initially set at 135 degrees F. Provide firestats rated as necessary to handle the various fans to which connected to. Provide at each air handling unit and at each fan throughout the project. Where fans are interlocked with other equipment, actuation of any single firestat shall deactivate the entire system.
- I. Motorized Dampers: Provide all motorized dampers powered open and on loss of power closed.
- J. Control Dampers: Provide all outside, return, supply and exhaust controls, opposed blade type with spring return operators and with gasketed edges. Dampers to restrict leakage to 1 percent maximum with duct velocities of

2,000 feet per minute and not less than 2 inch s.p.w.c. across the damper.

- K. Electrical Wiring: Beyond that furnished under Division 16, provide herein as necessary to accomplish the intent and operations called out. All conduit required for controls shall be furnished and installed by the controls contractor. All wiring required for controls shall be furnished and installed by the controls contractor.
- L. Nameplates: Secure to all switches, indicating lights and control devices (self-tapping screws or bolts) to identify the items. Provide engraved laminated plastic, black nameplates with white letters.
- M. Start-Stop Push Buttons: Maintain or momentary to perform the required functions (Green: On; Red: Off).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Confirm all the necessary information has been provided by the manufacturers to accomplish the control as shown in the sequence of operation before shop drawings are started.

#### 3.2 INSTALLATION

- A. Provide, coordinate, and install a complete control system with all components, wiring, programming, etc. required to achieve the system operation and control as shown in the drawings and specifications.
- B. All line voltage control wiring and low voltage control wiring shall be run in rigid steel, or EMT conduit. Wiring shall be in accordance with the specifications and all applicable codes.
- C. Identify all equipment and panels. Identification shall be with labels describing equipment and panel use and function. Labels shall be engraved with contrasting text using bakelite, plastic or metal material. Labels shall be permanently glued or mechanically fastened.

#### 3.3 TRAINING

- A. Provide two (8) hours of operations and maintenance training for Owner's personnel.

END OF SECTION 15900

## SECTION 15950

### TESTING, ADJUSTING, AND BALANCING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Testing, adjusting, and balancing of mechanical and plumbing systems.
- B. The General Contractor will select a qualified, independent technical balancing firm and/or laboratory to provide balancing, testing and adjusting services. These services will be paid for by the General Contractor.
- C. Perform the balancing, testing and adjusting services with Associated Air Balance Council (AABC) certified personnel or employ a qualified, independent, technical balancing firm and/or laboratory.
- D. Each section of Division 15 - Mechanical that has products or systems listed herein incorporate this section by reference and is incomplete without the required tests stated herein.
- E. Control system for the Enthalpy Wheel unit is required to have a manufacturer furnished automated controls commissioning tester at the time of start up paid for by the mechanical contractor when purchasing the unit. The commissioning of the Enthalpy Wheel unit is not part of this section. Refer to section 15900 for commissioning of the Enthalpy Wheel unit. The air balance of the supply, return, and exhaust ductwork connected to the Enthalpy Wheel unit is part of this section and shall incorporate the requirements of this section to perform the air balance.

##### 1.3 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NFPA 12A - Halon 1301 Fire Extinguishing Systems.

##### 1.4 SUBMITTALS

- A. Test Reports:
  - 1. Submit test report forms for review minimum 90 days prior to requesting final review by A/E.
  - 2. Furnish six individually bound copies of test data. Neatly type and

arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.

3. A/E will retain one copy. Remaining copies will be returned for inclusion in operation and maintenance manuals.
4. Prior to commencing work, submit draft reports indicating adjusting, balancing and equipment data required.
5. Submit draft copies of report for review prior to final acceptance of project. Provide final copies for A/E and for inclusion in operating and maintenance manuals.

- B. Include a set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.

## 1.5 AIR SYSTEM BALANCING

### A. Quality Assurance:

1. Company specializing in the testing, adjusting and balancing of systems specified with a minimum of three years of documented experience and a member in good standing, certified to perform services, of the AABC. Perform work under supervision of AABC Certified Test and Balance Engineer.
2. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

### B. General:

1. Conform to the specifications which include, but are not limited to, the following:
  - a. Air and water flows balanced to specified quantities.
  - b. Temperature regulation verification by hourly readings for three consecutive eight-hour days.
  - c. Three inspections within 90 days of occupancy for temperature verification.
  - d. Opposite season adjustment of systems.
2. Provide sufficient funds in project cost estimate and bid proposal to cover all work required for the testing, balancing and adjusting of air distribution as determined by the balancing firm.
3. Complete the installation and operate all systems to ensure they are operating in accordance with the requirements of these specifications and drawings, and perform all other items as described hereinafter to assist the balancing firm in performing the balancing, testing and adjusting of the systems. The items include, but are not be limited to, the following:
  - a. Air Distribution Systems:
    - 1) Verify installation of all supply, return and exhaust ducts for conformity to design.
    - 2) Verify all volume, splitter, extractor and fire dampers are properly located and functional. Provide tight damper



- closure and full opening, smooth and free operation.
  - 3) Air supply, return, exhaust, transfer grilles, registers, diffusers and terminal units installed and operational.
  - 4) Blank and/or seal air handling systems, units and associates apparatus, such as heating and cooling coils, filter sections, access doors, etc., to eliminate excessive bypass or leakage of air.
  - 5) All fans (supply, return, relief and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; correct overload heater elements; and clean filters installed.
  - b. Automatic Controls except for Enthalpy Wheel unit:
    - 1) Verify that all control components are installed in accordance with project requirements, including all electrical interlocks, damper sequence air and water resets, fire stats. Stroke all controls through the full range.
    - 2) Calibrate all controlling instruments and set for the design conditions.
  - c. Cooperate with the balancing firm to provide all necessary data on the design and proper application of the system components and furnish all labor and material required to eliminate any deficiencies. List all motors, nameplate data and size of overload heater installed. Record motor amperage during operation.
  - d. The drawings and specifications indicate valves, dampers, sheaves, and miscellaneous adjustment devices required to obtain optimum operating conditions to verify that all adjustment devices are accessible and readily adjustable.
  - e. Accurately record actual locations of balancing valves and rough setting.
- C. Sequencing and Scheduling:
- 1. Sequence work to commence after completion of systems and prior to substantial completion of project.
- D. Submit reports on AABC National Standards for Total System Balance forms and include the following information:
- 1. Title Page:
    - a. Company name.
    - b. Company address.
    - c. Company telephone number.
    - d. Project name.
    - e. Project location.
    - f. Project A/E.
    - g. Project Contractor.
    - h. Project altitude.
  - 2. Air Moving Equipment:
    - a. Location.
    - b. Manufacturer.
    - c. Model.
    - d. Air flow, specified and actual.
    - e. Return air flow, specified and actual.

- f. Outside air flow, specified and actual.
  - g. Total static pressure (total external), specified and actual.
  - h. Inlet pressure.
  - i. Discharge pressure.
  - j. Fan rotations per minute.
3. Exhaust Fan Data:
- a. Location.
  - b. Manufacturer.
  - c. Model.
  - d. Air flow, specified and actual.
  - e. Total static pressure (total external), specified and actual.
  - f. Inlet pressure.
  - g. Discharge pressure.
  - h. Fan rotations per minute.
4. Return Air/Outside Air Data:
- a. Identification/location.
  - b. Design air flow.
  - c. Actual air flow.
  - d. Design return air flow.
  - e. Actual return air flow.
  - f. Design outside air flow.
  - g. Actual outside air flow.
  - h. Return air temperature.
  - i. Outside air temperature.
  - j. Required mixed air temperature.
  - k. Actual mixed air temperature.
  - l. Design outside/return air ratio.
  - m. Actual outside/return air ratio.
5. Electric Motors:
- a. Manufacturer.
  - b. HP/BHP.
  - c. Phase, voltage, amperage; nameplate, actual, no load.
  - d. Rotations per minute.
  - e. Service factor.
  - f. Starter size, rating, heater elements.
  - g. Exercise starters through its entire operating sequence.
6. V-Belt Drive:
- a. Identification/location.
  - b. Required driven rotations per minute.
  - c. Driven sheave, diameter and rotations per minute.
  - d. Belt, size and quantity.
  - e. Motor sheave, diameter and rotations per minute.
  - f. Center-to-center distance, maximum, minimum and actual.
7. Duct Traverse:
- a. System zone/branch.
  - b. Duct size.
  - c. Area.
  - d. Design velocity.
  - e. Design air flow.
  - f. Test velocity.
  - g. Test air flow.

- h. Duct static pressure.
  - i. Air temperature.
  - j. Air correction factor.
8. Air Distribution Test Sheet:
- a. Air terminal number.
  - b. Room number/location.
  - c. Terminal type.
  - d. Terminal size.
  - e. Area factor.
  - f. Design velocity.
  - g. Design air flow.
  - h. Test (final) velocity.
  - i. Test (final) air flow.
  - j. Percent of design air flow.
9. Pump Data:
- a. Identification/number.
  - b. Manufacturer.
  - c. Size/model.
  - d. Impeller.
  - e. Service.
  - f. Design flow rate, pressure drop, BHP.
  - g. Actual flow rate, pressure drop, BHP.
  - h. Discharge pressure.
  - i. Suction pressure.
  - j. Total operating head pressure.
  - k. Shut off, discharge and suction pressure.
  - l. Shut off, total head pressure.
10. DX Cooling Coil Data:
- a. Identification/number.
  - b. Location.
  - c. Service.
  - d. Manufacturer.
  - e. Air flow, design and actual.
  - f. Entering air DB temperature, design and actual.
  - g. Entering air WB temperature, design and actual.
  - h. Leaving air DB temperature, design and actual.
  - i. Leaving air WB temperature, design and actual.
  - j. Air pressure drop, design and actual.
11. Heating Data:
- a. Identification/number.
  - b. Location.
  - c. Service.
  - d. Manufacturer.
  - e. Air flow, design and actual.
  - f. Entering air temperature, design and actual.
  - g. Leaving air temperature, design and actual.
  - h. Air pressure drop, design and actual.

12. Duct Leak Test:
  - a. Description of ductwork under test.
  - b. Duct design operating pressure.
  - c. Duct design test static pressure.
  - d. Duct capacity, air flow.
  - e. Maximum allowable leakage duct capacity times leak factor.
  - f. Test Apparatus:
    - 1) Blower.
    - 2) Orifice, tube size.
    - 3) Orifice size.
    - 4) Calibrated.
  - g. Test static pressure.
  - h. Test orifice differential pressure.
  - i. Leakage.

## 1.6 PLUMBING SYSTEM

- A. Submit plumbing system to operational tests to demonstrate satisfactory operation. Include the following information:
  1. Title Page:
    - a. Company name.
    - b. Company address.
    - c. Company telephone number.
    - d. Project name.
    - e. Project location.
    - f. Project A/E.
    - g. Project Contractor.
  2. Time date and duration of test for each system.
  3. Water pressures at the most remote and highest fixtures.
  4. Operation of each fixture and fixture trim.
  5. Operation of each valve, hydrant and faucet.
  6. Pump suction and discharge pressures.
  7. Temperature of each domestic hot water supply.
  8. Operation of each floor drain by flooding with water.
  9. Operation of each vacuum breaker and backflow preventer.
  10. Piping systems: Test results of all pressure tests.
  11. Pumps: Field check alignment of all couplings and pump vibration.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Furnish proposed test procedures, recording forms, list of personnel and test equipment for A/E review.
- B. Follow recommended procedures for testing as published by test equipment manufacturer.

- C. Provide instruments required for testing, adjusting and balancing operations. Make instruments available to A/E to facilitate spot checks during testing.
- D. Provide any additional balancing devices required for complete system balancing.

### 3.2 AIR SYSTEM BALANCING

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  - 1. Equipment is operable and in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Correct fan rotation.
  - 7. Fire and volume dampers are in place and open.
  - 8. Coil fins have been cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and operable.
  - 11. Duct system leakage has been minimized.
  - 12. Proper strainer baskets are clean and in place.
  - 13. Service and balance valves are open.
  - 14. Report any defects or deficiencies noted during performance of services to A/E.
  - 15. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
  - 16. Beginning of work means acceptance of existing conditions.
- B. Installation Tolerances:
  - 1. Adjust air handling systems except for Enthalpy Wheel unit to scheduled values plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems.
  - 2. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.
- C. Test Procedures:
  - 1. Adjust air handling and distribution systems to provide design supply, return, and exhaust air quantities.
  - 2. Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.
  - 3. Measure air quantities at air inlets and outlets.
  - 4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
  - 5. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Control volume by internal duct devices such as dampers and splitters.
  - 6. Vary total system air quantities by adjustment of sheaves. Provide drive changes required. Vary branch air quantities by damper regulation.

7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
11. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
12. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
13. Test run fan/motor combinations, volume dampers and controls. Check sequence of operation and air flow limits at factory prior to shipment and submit test reports.
14. Base performance on tests conducted in accordance with ADC 1062.
15. Check that automatic flow controller is capable of maintaining air flow to within 5 percent of set point with inlet static pressure variations up to 2 inches.
16. Maximum Casing Leakage: 2 percent of design air flow at rated inlet static pressure.
17. Maximum Damper Leakage: 2 percent of design air flow at inlet static pressure.
18. Set volume with damper operator attached to assembly allowing modulation from 100 percent of design flow to 20 percent design flow. Set units with heating coils for minimum 35 percent design flow.
19. Provide record data that represents actually measured, or observed condition.
20. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
21. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
22. Leave systems in proper working order, replace adjustable sheaves with permanent fixed position sheaves, replace belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
23. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by A/E.
24. Check and adjust systems for opposite season performance approximately six months after final acceptance and submit report.

### 3.3 MECHANICAL EQUIPMENT

#### A. Air-Cooled Condensing Units:

1. Provide initial charge of refrigerant and oil for each refrigeration system; replace losses of oil or refrigerant prior to end of guarantee period, and supply to Owner one complete charge of lubricating oil in addition to that placed in the system.
2. Charge the system with refrigerant that test the entire system for leaks after completion of installation. Repair any leaks and put the system into operation. Test the system after repair of leaks to prove performance.
3. If initial start-up and testing takes place in winter and machines are to remain inoperative, shut the system down and start-up and repeat testing at the beginning of the first cooling season.
4. Provide cooling season start-up and winter season shutdown for first year of operation.

#### B. Refrigeration System:

1. Clean lines of scale, dirt and foreign matter before making connections and purge with dry nitrogen to prevent oxidation during brazing.
2. After completion, pressure the high and low pressure sides of the piping system at the test pressures specified in ASHRAE 15 for the refrigerant type to be used. Leak test with a bubble solution followed by a Halide torch test. Repair any leaks and repeat tests until no further leaks are found and the system passes a static leak test pressure for a duration of 24 hours.
3. After the pressure tests are completed, exhaust the system including the coils by a suitable vacuum pump connected to the liquid line. After 2.5 mm of mercury absolute pressure is obtained, continue the evacuation for 72 hours. Check the vacuum by a suitable mercury column gage.
4. After the dehydration of the system is thus completed, charge the system with refrigerant and put into operation.
5. Follow the general test guidelines of ASHRAE 15 for the tests of the refrigerant piping system.
6. Test refrigeration system in accordance with ASME B31.5.
7. Provide written test report detailing methods, materials, and results.
8. Additional Tests: When deficiencies, defects or malfunctions develop during the tests required, suspend all further testing of the system until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, notify A/E when the additional work has been completed, to arrange a new inspection and test of the system. Repeat all required tests prior to final acceptance, unless directed otherwise.
9. Manufacturer's Representative: Provide the services of representatives or technicians from the manufacturers of the Enthalpy Wheel unit control system experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to facility personnel.

### 3.4 PLUMBING EQUIPMENT

- A. Natural Gas:
1. Apply pressure equal to 1-1/2 times the operating pressure with 50 pounds per square inch-gage as a minimum. Utilize oil free dry air or gaseous nitrogen and hold pressure for one hour with no drop in pressure. Repair all leaks.
  2. Record natural gas reading at entrance to building on main line with valves to equipment shutoff. Read each indicating instrument at 1/2 hour intervals for a period of four hours and a final reading at the end of 24 hours.
- B. Sanitary Waste, Vent and Storm Drainage Systems: Test systems throughout upon completion of the rough work and without fixtures connected. Test underground lines with not less than 15 feet hydrostatic head and prove leak free for one hour. After storm drainage piping is complete, plug all openings, except tops of stacks, and fill system with water and prove leak free for one hour. Plug and test sanitary system by floors and prove leak free for one hour. Flush floor drains for proper operation.
- C. Domestic Water System:
1. Test all hot and cold water piping prior to being insulated. Test in place with 125 pounds per square inch hydrostatic test at the low points and maintain pressure without pumping for one hour.
  2. Completely flush water circulating system with water with strainers removed. Fill system with water with strainer installed and circulate water for 48 hours minimum with a 1 inch open bleed valve or until bleed water is clear. After completing this operation, chemically treat system, clean strainer and open to central system.
  3. Thoroughly flush all domestic water piping and tanks and then treat and sterilize with HTH or a liquid chlorine gas and water solution, or a direct chlorine gas placed in the upstream side in amounts to give a dosage of 50 ppm chlorine calculated on the volume of water the piping will contain. A minimum residual of 5 ppm chlorine shall remain in all parts of the system for a minimum of 24 hours. After sterilizing, flush all lines thoroughly. The foregoing shall be considered minimum requirements. The sterilization shall be in accordance with local utility company requirements.
  4. Under no circumstances shall the Contractor permit the use of any portion of the domestic water system until it has been properly sterilized and certified same by the local water department.
  5. Test results of disinfection of water piping system.

END OF SECTION 15950



## SECTION 16050

### ELECTRICAL GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 16.
- B. Each section included in Division 16 is incomplete without the provisions stated herein.

##### 1.3 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Access doors.

##### 1.4 RELATED SECTIONS

- A. Section 02324 – Trenching.
- B. Section 08311 - Access Doors and Frames.
- C. Section 09910 - Paints.
- D. Section 16080 - Electrical Testing.

##### 1.5 SYSTEM DESCRIPTION

- A. Provide a complete operational electrical system. Route conduit and install equipment to avoid conflicts with other trades and to enhance maintainability of system.

##### 1.6 REFERENCES

- A. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600kN-m/cu. m.)).
- B. ASTM E 814 - Fire Tests of Through-Penetration Fire Stops.
- C. IEEE C2 - National Electrical Safety Code.
- D. 2001 CEC – California Electrical Code (NFPA 70 - National Electrical Code 1999 with California Amendments)

- E. UL 1479 - Fire Tests of Through-Penetration Firestops.

## 1.7 DEFINITIONS

- A. Provide: Where the word "provide" is used, the word is understood to mean "the Contractor shall furnish and install" the equipment, tests, inspections, etc. referenced.
- B. Related Work: The sections referenced under RELATED SECTIONS shall be understood to include provisions which directly affect the work being specified in the section where RELATED SECTIONS occurs.
- C. Concealed: Where the word "concealed" is used in conjunction with raceways, equipment, and the like, the word shall be understood to mean hidden from sight as in chases, furred spaces, or suspended ceilings.
- D. Exposed: Where the word "exposed" is used, the word shall be understood to mean open to view.
- E. Abandoned: Refers to electrical facilities which are no longer in use and are to be de-energized and left in place.
- F. Removed: Refers to electrical facilities which are to be disconnected and removed from project site by the Contractor.
- G. Salvaged: Refers to items which are disconnected, taken out of service and turned over to Owner.

## 1.8 SUBMITTALS

- A. Access Doors: Indicate detailed dimension.

## 1.9 REGULATORY REQUIREMENTS

- A. Perform work in accordance with NFPA 70 and the editions, revisions, amendments, or supplements of applicable statutes, ordinances, codes, or regulations of Federal, State, and Local Authorities having jurisdiction in effect on the date bids are received.
- B. Where approval standards have been established by OSHA, UL, ASME, AGA, AMCA, ANSI, ARI, NFPA, State Fire Insurance Regulatory Body, and IRI, FM, follow these standards whether or not indicated on the Drawings and Specifications. Include cost of work required to comply with requirements of these authorities in the original proposal. Comply with IEEE C2 where applicable.
- C. Requirements in reference specifications and standards are minimum for equipment, material, and work. In instances where capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified or scheduled capacities.
- D. Resolve code interpretations discovered in Contract Documents with A/E prior to

Contract award. After Contract award, make corrections or additions necessary for compliance with applicable codes.

- E. Arrange with local and state authorities and utility companies for permits, fees, and service connections, verifying locations and arrangement, and pay charges including inspections.

#### 1.10 CONTRACT DRAWINGS

- A. Drawings are generally diagrammatic and are intended to encompass a system that will not interfere with the structural and architectural design of the building. Coordinate work to avoid interferences between conduit, equipment, architectural, and structural work.
- B. Coordinate with architectural features, trim and millwork details, and install equipment in cabinets or other special areas as directed by A/E.
- C. Drawings are based on equipment specified. Make adjustments, modifications, or changes required, due to use of other equipment, upon approval of Substitution Request and at no additional cost to the Owner.

#### 1.11 PROJECT/SITE CONDITIONS

- A. Site Visitation: Visit the site of the proposed construction to become thoroughly familiar with details of work and working conditions, verify dimensions in the field, and advise A/E of discrepancies before performing work.
- B. Space Requirements:
  - 1. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
  - 2. Make changes in equipment location of up to 5 feet, to allow for field conditions prior to actual installation, and as directed by A/E.
  - 3. Conceal conduit in finished areas. Conduit may be exposed in mechanical rooms, electrical rooms and where specifically allowed on Drawings. Route conduit through the building without interfering with other contractors' equipment or construction.
  - 4. Provide maximum possible clear height underneath conduit. Install conduit as high as possible.
  - 5. Install equipment requiring service so that it is easily accessible.
  - 6. Compare the equipment sizes with the space allotted for installation before installation and make written notice of possible conflict. Disassemble large equipment to permit installation through normal room openings when required. Should written notice not be made in a timely manner, make adjustments and modifications necessary without additional compensation.
  - 7. Timely place equipment too large to fit through finished openings, and stairways.
- C. Site Obstructions:
  - 1. Drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed as to accuracy of location or completeness of

information.

2. Verify with A/E, utility companies, municipalities, and other interested parties that available information has been provided before cutting or trenching operations are begun. Verify locations given.
3. Alter routing of new work should obstruction be encountered, whether or not shown on Drawings. Reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
4. Assume total responsibility for and repair damage to existing utilities or construction, whether or not such existing facilities are shown. Repair the lines, if damaged.

D. Cutting and Patching:

1. Submit written request to A/E in advance of cutting or alterations.
2. Execute cutting and demolition by methods which will prevent damages to other work and will provide proper surfaces to receive installation of repairs.
3. Restore work which has been cut or removed; install new products complying with specified products, functions, tolerances and finishes as specified.
4. Escutcheon Plates:
  - a. Heavy chrome-plated or nickel-plated escutcheon plates for penetrations of finished surface.
  - b. Product: B&C No. 10 with concealed hinges.
5. Fit work airtight to conduit, sleeves, and other penetrations through surfaces. For fire-rated penetrations, provide assemblies in accordance with UL 1479 and ASTM E 814 utilizing products and materials equal to rating of surfaces penetrated.

## 1.12 DEMOLITION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Beginning of demolition means installer accepts existing conditions.
- C. Coordinate utility service outages with utility company and Owner, and schedule Utility Company to uncover feeders.
- D. Provide temporary wiring and connections to maintain existing system in service during construction. When Contractor elects to perform work on energized equipment or circuits, use personnel experienced in such operations.
- E. Existing Electrical Services to be removed: Coordinate with Utility Company to remove existing utility systems to accommodate new construction.
- F. Remove existing installations to accommodate new construction. Remove all unused conduit. Remove all disconnected circuit conductors full length from source to device.

## 1.13 MATERIALS AND WORKMANSHIP

- A. Provide new materials and equipment of a domestic manufacturer by those regularly

engaged in the production and manufacture of specified materials and equipment. Where UL or other agency has established standards for materials, provide materials which are listed and labeled accordingly. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.

- B. Work shall be performed by workmen skilled in the trade required for the work. Install materials and equipment to present a neat appearance when completed and in accordance with the approved recommendations of the manufacturer and in accordance with Contract Documents.
- C. Provide labor, materials, apparatus, and appliances essential to the complete functioning of the systems described or indicated herein, or which may be reasonably implied as essential whether mentioned in the Contract Documents or not.
- D. Make written request to A/E for supplementary instructions in cases of doubt as to Work intended or in event of need for explanation thereof.
- E. Performance and material requirements scheduled or specified are minimum standards acceptable. The right to judge the quality of equipment that deviates from the Contract Documents remains solely with A/E.

#### 1.14 DELIVERY, STORAGE AND HANDLING

- A. Follow the manufacturer's directions completely in the delivery, storage, and handling of equipment and materials.
- B. Equipment shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Store equipment in a clean, dry place, protected from other construction.
- C. While stored, maintain factory wrappings or tightly cover and protect equipment against dirt, water, construction debris, chemical, physical or weather damage, traffic and theft. Provide heat where required to prevent condensation.
- D. Adequately brace and package equipment to prevent breakage and distortion while in transit.
- E. Handle in accordance with manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

#### 1.15 COORDINATION

- A. Coordinate layout and installation with mechanical and other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate and adjust as necessary layout and installation of equipment and materials to accommodate equipment proposed in approved submittals.

## 1.16 PAINTING

- A. Comply with Section 09910 for painting.
- B. Properly prepare surfaces to receive paint. Prime prepared surfaces and finish with two coats of exterior oil base paint. Verify primer and paint are rated for application.
- C. Repair damage to factory painted finishes.
- D. Remove splattered and incidental paint from electrical equipment.

## 1.17 ACCESS DOORS

- A. Provide hinged access doors in walls, floors and ceilings to permit access to equipment requiring service or adjustment.
- B. Provide hinged access doors and frames as follows:
  - 1. Drywall Construction:
    - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel. Factory prime paint surfaces not galvanized.
    - b. Product: Milcor, Style DW.
  - 2. Visible Masonry and Ceramic Tile: Milcor, Style M.
  - 3. Gypsum and Cement Plaster: Milcor, Style K.
  - 4. Acoustic Plaster:
    - a. Reinforce panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sleeved and grommeted screwdriver operated cam locks in sufficient number for the size of the panel. Factory prime paint surfaces not galvanized.
    - b. Product: Milcor, Style AP.
  - 5. Acoustic Tile: Milcor, Style AT.
- C. Provide continuous concealed hinges and cam locks.
- D. Provide UL listed 1-1/2 hour Label "B" access doors with automatic self-closing latching mechanism where required.
- E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.
- F. Coordinate approval and location of doors with A/E.

## 1.18 NOISE AND VIBRATION

- A. Provide the entire operating system and its component items of equipment free of objectionable vibration or noises. Statically and dynamically balance rotating equipment, and mount or fasten so that no equipment vibration will be transmitted to the building. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, ballasts, or other parts of the work, rectify such condition at no additional compensation.

#### 1.19 OPERATING INSTRUCTIONS

- A. Provide services of authorized representatives of manufacturer to ensure that the equipment is installed according to the manufacturer's recommendations, is operating properly, and to instruct Owner's operating personnel during start-up and operating tests of complete electrical system. Notify A/E seven days prior to beginning equipment start-up.
- B. Certify in writing that these services have been performed.
- C. Perform tests as specified in Section 16080.

#### 1.20 SERVICE

- A. Inspect, clean, and service light fixtures; replace incandescent lamps; and replace fluorescent or HID lamps if utilized for construction lighting immediately prior to final acceptance of project.
- B. Clean and polish fixtures, equipment, and materials thoroughly, and return to "as new" condition.
- C. Remove excess material and debris. Place electrical systems in complete working order before request for final review. Broom clean areas.

#### 1.21 PROJECT RECORD DOCUMENTS

- A. Maintain a set of Contract Documents at the job site for the purpose of recording final size, location, and interrelation of work under this Division. Mark this set of drawings as the job progresses to indicate "as-built" location of equipment, including concealed conduit and equipment.
- B. Obtain mylar Drawings from A/E, at Contractor's expense, and record as-built conditions.
- C. Clearly and accurately delineate the work by dimensions on the mylar record drawings as installed, with equipment locations identified by at least two dimensions to permanent structures.
- D. Final mylar record drawings shall be marked "AS-BUILT," and signed and dated by Contractor.
- E. Provide certified record "AS-BUILT" drawings at the conclusion of project.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Circuiting.
  - 2. Equipment type and locations.
  - 3. Field changes of dimension and detail.
  - 4. Details not on original Contract drawings.

1.22 FINAL REVIEW

- A. Obtain necessary Certificates of Occupancy from local authorities.
- B. Submit final approved operation and maintenance manuals including approved submittals, test reports, and "AS-BUILT" drawings prior to requesting final payment. Delivery of operation and maintenance manuals is a condition of final acceptance.

1.23 GUARANTEE

- A. Guarantee materials, parts and labor for Work for one year from the date of issuance of occupancy permit. During that period make good faults or imperfections that may arise due to defects or omissions in materials or workmanship with no additional compensation and as directed by A/E.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 16050



## **SECTION 16051**

### **SUBMITTALS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Preparation and submission of shop drawings and product data.

##### **1.3 RELATED SECTIONS**

- A. Section 01330 – Submittal Procedures
- B. Section 16052 - Operation and Maintenance Manuals.

##### **1.4 MANUFACTURERS**

- A. Listed manufacturers will be acceptable as long as specified requirements are met.
- B. Manufacturers who are not listed as "acceptable manufacturers" bear the burden of proof to A/E that their products comply with the specifications. Furthermore, those manufacturers shall agree in writing to bear the cost of A/E time to review compliance with the specifications whether their products are approved or not.
- C. Provide power distribution and control equipment of the same manufacturer (i.e., switchboards, panelboards, transformers, motor control centers).
- D. Provide similar equipment of same manufacturer (i.e., wiring devices).

##### **1.5 CONTRACTOR'S CERTIFICATION**

- A. Submittals will be submitted only by the Contractor. Contractor shall review as indicated in Section 01330. Indicate by signed stamp that the contract documents have been checked, that the work shown in the submittals is in accordance with contract requirements and that dimensions and relationship with work of other trades have been checked. If submittals are submitted for review that have not been checked and signed by the Contractor, they will be returned for checking before being considered by A/E.

##### **1.6 PREPARATION**

- A. Include information relevant to particular equipment or materials to be furnished, where product data published by manufacturer is part of submittal.
- B. Provide documentation of compliance with manufacturer's published literature or drawings or letter signed by officer of manufacturer in cases where compliance with

UL, FM, ARI, IRI, or other similar organization standards are required.

- C. Furnish submittals to the Submittals Schedule indicated in Section 01330.
- D. Include identifying symbols and equipment numbers used in the contract documents for all equipment and material submitted.
- E. Cross reference sheet numbers on Drawings for shop drawings. Provide shop drawings consisting of plans drawn to scale, with elevations and sections, to show clearly the location of major items of equipment and clearances for maintenance and code requirements.
- F. Submit only the requested submittals complete by types of equipment (i.e., lighting fixtures, power distribution, etc.) labeled and tabbed with applicable specification section(s) included. Each submittal will be handled separately. Should any item not be acceptable, the entire submittal will be returned to the Contractor for correction and resubmittal. Partial submittals are unacceptable. The intent of this requirement is that all approved bound sets of data will be identical and will contain only acceptable information.
- G. Submit a compliance sheet for each submittal indicating the submittal is in full compliance with the drawings and specifications. Indicate by drawing number or specification section number and paragraph numbers all exceptions taken and include an explanation.
- H. The review of submittals does not relieve or modify the Contractor's responsibility for compliance with the Contract Documents or dimensions or errors contained in the submittal or quantity count. It is clearly understood that, in the review process, noting of some discrepancies but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the submittals, the Contract Documents govern the work, and are neither waived nor suspended in any way by the review of the submittals.
- I. Include in submittals sufficient plans, elevations, sections, performance data, dimensions, bolt locations, ratings, sound data, weights and schematics to clearly describe the equipment and to show compliance with these specifications. Provide Transmittal Form as identified in Section 01330. Additionally provide a cover or title sheet for the submittal containing the following:
  - 1. Name of Contractor originating the submittal.
  - 2. Name of project for which the submittal is made.
  - 3. An index of all items submitted including:
    - a. Mark of equipment on drawings.
    - b. Manufacturer.
    - c. Catalog number.
    - d. Specification section number.
  - 4. Date of submittal and date of each revision.
  - 5. Contractor's certification of review.
  - 6. Contractor's certification of compliance.
- J. Shop drawings and product data which do not comply with the requirements herein will be returned for resubmittal. Submit two paper sepias for shop drawings.

- K. A/E will retain one copy and Owner will retain one copy of submittal. Remaining copies will be returned to Contractor marked FURNISH AS SUBMITTED, FURNISH AS CORRECTED, REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM. If it is marked FURNISH AS SUBMITTED or FURNISH AS CORRECTED, no additional submittal is required. If it is marked REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, repeat submittal in accordance with this section. Submit complete and accurate shop drawings and product data at first submittal. If submittals are returned to Contractor marked REVISE AND RESUBMIT or SUBMIT SPECIFIED ITEM, only one additional submission will be permitted.
- L. If the reproducible sepia or product data marked FURNISH AS SUBMITTED or FURNISH AS CORRECTED is altered for any reason after it has been stamped, the REVIEWED stamp shall automatically be voided.
- M. Provide all work in accordance with the submittals stamped FURNISH AS SUBMITTED or FURNISH AS CORRECTED inasmuch as they are in agreement with the Contract Documents. Where differences occur between the submittals and the Contract Documents, the Contract Documents shall govern the work.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REQUIRED SUBMITTALS

- A. Furnish product data for devices, equipment, or systems as specified. Other submittals will be returned to Contractor without review. Furnish shop drawings as indicated.

### 3.2 FINAL SUBMITTAL

- A. In addition to the number of copies of shop drawings and product data required to review submittals, maintain separate file of final reviewed copies of such material. Deliver approved submittals in a hard-back binder for the Owner's use. Incorporate changes and revisions made throughout the construction period. Refer to Section 16052.

END OF SECTION 16051



## SECTION 16052

### OPERATION AND MAINTENANCE MANUALS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Preparation and submission of operation and maintenance manuals.
- B. Each section included in Division 16 - Electrical incorporates this section by reference and is incomplete without the provisions stated herein.
- C. Requirements of this section are in addition to the requirements of Section 01770 – Closeout Procedures.

##### 1.3 RELATED SECTIONS

- A. Section 01770 – Closeout Procedures
- B. Section 16050 - Electrical General Provisions.
- C. Section 16051 - Submittals.
- D. Section 16080 - Electrical Testing.

##### 1.4 PREPARATION

- A. Furnish four copies of complete operation and maintenance instructions, service manuals and parts list applicable to each manufactured item of equipment furnished. Bind operation and maintenance information in four separate looseleaf binders and deliver to A/E at least four weeks prior to final review of the project.
- B. Organize binders to contain like equipment in separate divisions. Provide a complete double index for each binder to include:
  - 1. An alphabetized list of the products by name.
  - 2. An alphabetized list of manufacturers whose products have been incorporated in the work together with their addresses and the name, addresses and telephone numbers of the local sales representative or supplier.
- C. For each section of product, equipment or system, organize the data as follows:
  - 1. Furnish a general description of the equipment or system listing the major components, intended service and other general data.
  - 2. Furnish technical data including nameplate data, design parameters, ratings, capacity, performance data, operating curves, characteristics, and the like. Clearly distinguish between information which does and does not apply.

3. List warnings and cautions to be observed during both installation and operations.
4. Fully detailed installation and operation instructions including special tools required, alignment instructions, start-up, and shut-down sequences.
5. Furnish maintenance, service and repair instructions including maintenance and service schedules, materials, and methods for performing routine and annual service.
6. Furnish a troubleshooting guide and check list indicating common failures, test methods and procedures for determining component fault or failure.
7. Furnish a spare parts list indicating part and order number with name, address, and telephone number of supplier. Include current prices of replacement parts and supplies.
8. Furnish diagrams including controls, wiring, installation or operation of the equipment or system.
9. Furnish copies of all approved submittals. Refer to Section 16051.
10. Furnish copies of all test reports. Refer to Section 16080.
11. Print copies of the "AS-BUILT" drawings. Refer to Section 16050.
12. Furnish all warranties and guarantees.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 16052

## SECTION 16053

### ELECTRICAL SYSTEM COORDINATION STUDY

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SECTION INCLUDES

- A. Work included: Services necessary to complete the system analysis studies required for the item specified under this Division, including but not limited to:
  - 1. Short circuit study.
  - 2. Protective device evaluation study.
  - 3. Protective device coordination study.
  - 4. Arc flash hazard analysis

##### 1.03 SUBMITTALS

- A. Submit six copies of protection coordination studies bound in 8-1/2 inch by 11-inch hard cover volumes with drawings and diagrams folded to fit the 8-1/2 inch by 11-inch format. Securely retain documents in pockets or compartments of rigid binder. Submittals, Re-submittals and Final submittals shall be provided as required by Section 16051. Final submittals shall incorporate all data that may have been altered during project construction and include calculations reflecting "As Built" Conditions.
- B. Include complete low voltage distribution system. Provide identification and description of industry testing standards on which study is based, for each section of study.
- C. The study shall be performed with the aid of a computer program and shall be in accordance with the latest applicable IEEE, ANSI and NFPA 70E standards.
- D. Provide calculations, conclusions, and recommendations as part of study general content.
- E. Provide all field investigation and coordinate with equipment vendors to obtain all data required for completion of the study. Coordinate with utility company and generator vendor to determine source characteristics.
- F. The study shall be submitted prior to final review of the distribution equipment shop drawings and prior to release of equipment for manufacture. If formal completion of the study may cause delay in equipment manufacture, approval may be obtained for a preliminary submittal of sufficient data to ensure that the selection of device ratings and characteristics will be satisfactory. Then the formal study will be provided to verify the preliminary findings.
- G. Provide each study with following:
  - 1. Description, purpose, basis and scope of the study and a single line diagram of that

- portion of the power system, which is included within the scope of the study.
2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding it.
  3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding it.
  4. Coordination plots which graphically indicate coordination proposed for several systems. Provide plots centered on full scale log-log-forms.
  5. Coordination plots with complete titles, representative one-line diagrams and legends, associated power company's system characteristics, significant motor starting characteristics, complete parameters for power, fuses, if applicable, and associated system load protective devices.
  6. Coordination plots which define types of protective devices selected, with proposed coil taps, time dial settings, and pick-up settings required.
  7. Long time region of coordination plots shall indicate complete tap scale for each relay and full load current transformer parameters and designate pick-ups required for low voltage circuit breakers.
  8. Short time region shall indicate low voltage circuit breaker, short time and instantaneous trip devices, fuse manufacturing tolerance bands, when applicable, and significant symmetrical and asymmetrical fault currents.
  9. Tabulated results of Arc flash analysis calculations to determine Arc Flash Boundary, working distance, Incident energy, and PPE requirements for each protective device in the system.
  10. Provide transformer, motor and cable damage curves on plots to verify proper protective device settings.

H. Coordinate each item of equipment as follows:

1. Separate low voltage power circuit breakers from each other by 16 percent current margin for coordination and protection in event of secondary line-to-line faults.
2. Terminate protective device characteristics or operating band to reflect actual symmetrical and asymmetrical fault currents sensed by device.
3. Prepare study with network analyzer, computer, or by written calculations. Include complete fault calculations as specified for each proposed and ultimate source combination.
4. Source combinations include proposed and future large motors or generators.
5. Provide ground fault setting criteria to minimize equipment damage.

I. Provide manufacturer-prepared system studies of switchgear or equipment for incoming service to building.

J. An arc flash hazard analysis study shall be performed with the necessary calculations to provide equipment marking to meet the requirements of NEC. The studies shall be in accordance with the latest edition of NFPA 70E.

1. The study shall be for all normal power and generator backup modes of operation. The study shall include all medium and low voltage classes of equipment from the transformer serving the building and generator service protective devices down to and including the largest rated device in the low voltage panelboards.
2. Tabulate all the data used in the calculations to determine Arc Flash (AF) Boundary, Incident energy, and personal protective equipment (PPE) requirements for each protective device in the system. Working distance shall be assumed to be 18”.



- K. Drawings and specifications indicate general requirements for motors, motor starter equipment, and low voltage equipment. Determine additional specific characteristics of equipment furnished in accordance with results of short circuit and protective device coordination study.
  - 1. Submit equipment design discrepancies and proposed corrective modifications, if required, with short circuit and protective device coordination study. Identify variations clearly on shop drawings.
  - 2. Provide equipment, overcurrent devices, field settings, adjustments and minor modifications for conformance with approved short circuit and protective device coordination study.
  - 3. Do not submit equipment shop drawings until short circuit and protective device coordination study has been approved.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.01 FIELD MARKING OF FLASH PROTECTION

- A. The equipment manufacturer shall provide field marking of equipment indicating arc flash and shock hazard warnings. Marking shall include values, units of measurement and description for the following:
  - 1. Flash hazard boundary.
  - 2. Incident energy and working distance.
  - 3. Personal protective equipment (PPE) category level with requirement.

3.02 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

- A. The equipment manufacturer shall provide the services of a qualified field engineer and necessary tools and equipment to test and calibrate the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Study.

END OF SECTION 16053



## **SECTION 16054**

### **ELECTRICAL DEMOLITION**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Remove, relocate, extend, and abandon electrical circuits, equipment, and systems.

##### **1.3 DEFINITIONS**

- A. Abandoned: Refers to electrical facilities which are no longer in use and are to be de-energized and left in place.
- B. Removed: Refers to electrical facilities which are to be disconnected and removed from project site.
- C. Salvaged: Refers to items which are disconnected, taken out of service and turned over to Owner.

##### **1.4 RELATED SECTIONS**

- A. Section 01732 – Selective Demolition
- B. Section 16091 - Work In Existing Building
- C. Section 16120 - Wire and Cable.
- D. Section 16130 - Boxes.
- E. Section 16132 - Conduit.

#### **PART 2 - PRODUCTS**

##### **2.1 MATERIALS AND EQUIPMENT**

- A. Provide all materials and equipment for patching and extending work as specified in individual sections.
- B. Provide all materials necessary for work.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on field observation and existing record documents. Contractor shall verify existing conditions. Discrepancies between plans and actual conditions shall be brought to the attention of owner prior to commencement of work.
- D. Beginning of demolition means installer accepts existing conditions.

### 3.2 PREPARATION

- A. Coordinate utility service outages with utility company and owner, and schedule utility to uncover feeders.
- B. Provide temporary wiring and connections to maintain existing system in service during construction. When Contractor elects to perform work on energized equipment or circuits, use personnel experienced in such operations.
- C. Existing Electrical Service: Maintain existing utility system in service until new diverted utility service is installed, inspected, and ready to be energized.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work indicated on drawings.
- B. Remove, relocate, and extend existing installations to accommodate new construction. Remove all unused conduit. Remove all disconnected circuit conductors full length from source to device.
- C. Repair adjacent construction and finishes damaged during demolition and extension work.
- D. Maintain access to existing electrical installations which remain active. Modify installation or provide access as appropriate.
- E. Extend existing installations using materials and methods compatible with existing electrical installations or as specified.
- F. Remove with care all equipment to be relocated. Repair or replace damaged equipment as required.
- G. Where equipment is to be relocated and re-installed, thoroughly examine and document (As-Built) all power control, and telecom wiring connections to the equipment prior to any disconnecting or demolition.

### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and dry before reinstallation on bases. Air dry or wipe dry glass lenses and metal parts. Air dry plastic lenses to prevent static electrical charge. Coordinate baseplate mounting hole pattern of reused and new bases since these may be different.

### 3.5 INSTALLATION

- A. Install relocated materials and equipment as indicated. Upgrade wiring and installation method to meet current applicable codes.

END OF SECTION 16054



## SECTION 16060

### GROUNDING AND BONDING SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SECTION INCLUDES

- A. Grounding electrodes and conductors; equipment grounding conductors; bonding methods and materials, including:
  - 1. Power system grounding.
  - 2. Communication system grounding.
  - 3. Electrical equipment and raceway grounding and bonding.
  - 4. Structural steel grounding.
  - 5. Miscellaneous system grounding.

##### 1.03 RELATED SECTIONS

- A. Section 03200 - Concrete Reinforcement.
- B. Section 16080 - Electrical Testing.
- C. Section 16120 - Wire and Cable.
- D. Section 16132 - Conduit.
- E. Section 16210 - Service Entrance.

##### 1.04 REFERENCES

- A. NECA - Standard of Installation.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. CEC – California Electrical Code (NFPA 70 - National Electrical Code with California Amendments)

##### 1.05 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
  - 1. Existing metal underground water pipe.
  - 2. Metal frame of the building.
  - 3. Concrete-encased electrode.
  - 4. Rod electrode.

- B. Grounding System Resistance: 5 ohms.

#### 1.06 SUBMITTALS

- A. Product Data: Submit grounding electrodes and connections; for fastening components; and nameplates, labels, and markers.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- C. Project Record Documents: Record actual locations of components and grounding electrodes.

#### 1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years documented experience, and with service facilities within 100 miles of project.

#### 1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Rod Electrodes: Copper-encased steel, 3/4-inch diameter, minimum length 10 feet.
- B. Mechanical Connectors:
  - 1. Manufacturers:
    - a. Burndy.
    - b. O.Z. Gedney.
  - 2. Heavy-duty, bolt-type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.
- C. Exothermic Connections:
  - 1. Type for underground and structural steel; Cadweld.
  - 2. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- D. Wire: Stranded, copper cable:
  - 1. Foundation Electrodes: 2/0 AWG.
  - 2. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- E. Grounding Well Components:



1. Well Pipe: 8-inch NPS by 24-inch long concrete pipe with belled end.
  2. Well Cover: Cast iron with legend "GROUND" embossed on cover.
- F. Insulated Grounding Bushings:
1. Plated malleable iron or steel body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.
- G. Connections To Pipe:
1. For cable to pipe: UL listed bolted connection complying with NEC requirements.
- H. Connections To Structural Steel, Ground Rods, Or Splices:
1. Where required by the Drawings or Specifications, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds or high pressure compression type connectors.
  2. Exothermic welds shall be used for cable-to-cable and cable-to-ground rod and for cable to structural steel surfaces. Exothermic weld kits shall be as manufactured by Cadweld, Thermoweld or equal. Each particular type of weld shall use a kit unique to that type of weld.
  3. High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections. Connections shall be as manufactured by Thomas & Betts #53000 series, Burndy "Hy-Ground" or equal.
- I. Main Building Reference Ground Bus:
1. Provide copper bus bar, of size as noted on drawings. Mount on walls in locations shown, on insulating standoffs, 18" AFF. Furnish complete with cast copper alloy body lugs for connecting grounding system cables. Attach lugs to bus with appropriate size cadmium bronze bolt, flat washer and Belleville washer. All connections shall be torqued. All holes shall be drilled and tapped for single hole lugs. Provide 6 spare lugs and lug spaces.

## PART 3 - EXECUTION

### 3.01 EXISTING WORK

- A. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors. Patch surfaces damaged by removal of existing components.

### 3.02 GROUNDING AND BONDING INSTALLATION

- A. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- B. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

- C. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond steel together.
- D. Bond structural steel together where electrically discontinuous.
- E. Provide bonding to meet Regulatory Requirements.
- F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- G. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- H. Do not use spring steel clips and clamps.
- I. Do not use powder-actuated anchors.
- J. Do not drill or cut structural members.
- K. Protect all above grade grounding and bonding conductors within conduit.

### 3.03 ELECTRIC SERVICE GROUND

- A. Ground the electrical service system neutral at service entrance equipment to grounding electrodes.
- B. Bond together system neutrals, service equipment enclosures, and equipment grounding conductor at service entrance.
- C. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to ground rod, ground loop, or other supplemental electrode.
- D. Provide grounding and bonding at the power company's metering equipment.

### 3.04 EQUIPMENT GROUND

- A. Provide a complete ground system for the building consisting of copper cable, ground rods and exothermic connections to serve the service entrance, building structural steel, metallic enclosures and conduit systems.
- B. Provide a separate, insulated equipment-grounding conductor from the main service ground to each main switchboard and in all feeders and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Do not use conduit as grounding conductor.
- C. Provide OZ Type "BJ" bonding jumper or equal at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- D. Ground each lighting and power panelboard by connecting the grounding conductor to the grounding stud.

- E. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground loop if a ground loop is installed or the nearest structural steel member.
- F. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes switchboards, panelboards, disconnect switches, receptacles, controls, fans, air handling units, pumps, and flexible duct connections.
- G. Conduit terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
- H. Provide bonding jumpers across expansion and deflection couplings in conduit runs, pipe connections to water meters, dielectric couplings in metallic cold water piping system.
- I. Provide #2 AWG conductor bond between cold water service pipework and hot water service pipework at each water heater. Bond to gas pipework if heater is gas fired.
- J. Provide internal ground wire in flexible conduit connected at each end via grounding bushing.

### 3.05 COMMUNICATIONS GROUND

- A. Provide communications system-grounding conductor at point of service entrance and connect to service entrance ground bus.
- B. Use minimum No. 3/0 AWG copper conductor to communications service grounding bus.
- C. Refer to Section 16051 for Telecommunications Grounding Backbone.

### 3.06 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION 16060



## SECTION 16061

### TELECOMMUNICATIONS GROUNDING BACKBONE

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Labor, materials and equipment necessary to complete the installation required for the item specified within this Section, including but not limited to:
  - 1. Telecommunication Grounding Backbone System.
  - 2. Commissioning/testing of the Telecommunication Grounding Backbone System.
- B. Related Sections:
  - 1. 16010 Basic Electrical Requirements
  - 2. 16706 Telecommunications Bonding

##### 1.03 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. NFPA 70, National Electric Code:
    - a. Chapter 8: Communications Systems
    - b. Article 250: Grounding
  - 2. ANSI-J-STD-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
  - 3. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
  - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. IEEE 467: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
    - b. IEEE P1100:IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

##### 1.04 DEFINITIONS

- A. Definitions as described in Division 1 and Section 16010 shall apply to this section.
- B. In addition, the following list of terms as used in this specification shall be defined as follows:
  - 1. "ACEG": Alternating Current Equipment Ground.

2. "BCT": Bonding Conductor for Telecommunications.
3. "CM": Circular Mil.
4. "MBRGB": Main Building Reference Grounding Busbar.
5. "TBB": Telecommunications Bonding Backbone.
6. "TBC": Telecommunications Bonding Conductor.
7. "TGB": Telecommunication Grounding Busbar.
8. "TMGB": Telecommunication Main Grounding Busbar.

#### 1.05 SYSTEM DESCRIPTION

A. Overview: The Telecommunications Grounding Backbone System contains grounding bus bars, grounding conductors, bonding conductors, and connecting devices (including but not limited to pressure connectors, lugs, clamps, or exothermic welds). These components, upon completion of installation & testing, shall provide the means of a low impedance path to ground for stray voltages or spurious signals present on telecommunications media and equipment.

B. Base Bid Work:

1. BCT – bonding conductor from electrical service ground to TMGB; origination & destination locations as shown on the Drawings.
2. TMGB – main telecommunications system grounding busbar; location as shown on the Drawings with the connections as shown on the Drawings.
3. TBB – Use the TBB(s) as the main bonding conductor between the TMGB and other TGBs provided throughout a single building. The length of TBB's shall not exceed 500 feet. The TBB shall route from the MDF through each of the IDFs bonding each of the TGBs to the TMGB. Maintain TBB continuity and do not break continuity in order to bond to a TGB. Refer to Drawings for more information.
4. TGB – telecommunications room grounding busbar; locations as shown on the Drawings with the connections as shown on the Drawings.

C. System Performance:

1. Resistance: Resistance from the telecommunication system ground bus to the ground electrode and to earth shall not exceed 25 Ohms.

#### 1.06 SUBMITTALS

A. General: Submittal requirements as described in Section 16051 shall apply to this section.

B. Quantity: Furnish quantities of each submittal as noted in Section 16051.

C. Product Data Submittal:

1. Format: As described in Section 16051.
2. Content: In addition to requirements of Section 16051, include the following:
  - a. Product Data: "catalog cuts", data sheets, specifications, and block wiring

diagrams (if necessary) of bonding devices and installation accessories. This data shall clearly describe the physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, and material finish.

- b. Clearly indicate by arrows or brackets precisely the model and accessories submitted on.

#### 1.07 QUALITY ASSURANCE

- A. Install new, unused, and of current manufacturer for materials, equipment and parts comprising the units specified herein.
- B. Only use products and applications listed in this Section on the project unless otherwise submitted.
- C. Contractor Qualifications:
  1. A current, active, and valid C10 California State Contractors License.
  2. At least five years of experience, and a minimum of five completed projects similar to scope and cost.
  3. Evidence of technicians qualified for the work.
  4. CWA and IBEW union affiliation.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 16050 for minimum delivery, storage, and handling requirements.

#### 1.09 WARRANTY

- A. The warranty period for the telecommunications grounding system shall be 1 year from the date of acceptance.
- B. Contractor Warranty:
  1. Warrant installed hardware to be, under normal use and service, free from defects and faulty workmanship during the warranty period. The entire system shall be kept in operating condition at no additional material or labor costs to the Owner during the warranty period.
- C. Manufacturer Warranty:
  1. Warrant that all installed system components will, under normal use and service, comply with the performance of this specification for the entire warranty period. Any replacements required to comply shall be provided at no additional material or labor costs to the Owner. The Contractor shall be held responsible for making up any deficiencies in the manufacturers warranty and may be required by the Owner to post a performance bond for the entire warranty period in order to comply with these specifications.
  2. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. A complete parts department shall be located close enough to the job site area to supply replacement parts within a 4 hour period.

3. The manufacturer(s) of all components shall demonstrate that a quality assurance program is in place to assure that all of the specifications are met. The program shall include, as a minimum, provisions for:
  - a. Incoming inspection of raw materials.
  - b. In-process inspection and final inspection of the product.
  - c. Calibration procedures of all test equipment to be used in the qualifications of the product.
4. Recall procedures in the event that out of calibration equipment is identified.

## PART 2 - PRODUCTS

### 2.01 GROUNDING AND BONDING CONDUCTORS

#### A. BCT:

1. Wire: Type THHN, per UL 83.
2. Conductor: Bare soft annealed copper (per ASTM B3), Class B stranded (per ASTM B8).
3. Size BCT same as or larger than TBB.
4. Insulation: Thermoplastic (such as PVC), or similar. Jacket shall be nylon, or similar.
5. Outer Color: Green.
6. Wire shall meet or exceed IEEE 383, and shall be listed as UL VW-1.
7. Wire shall have printed on the outside of the jacket the insulation grade, the conductor gauge, applicable UL jacket listings, and foot markings.

#### B. TBB:

1. Wire: Type THHN, per UL 83.
2. Conductor: Bare soft annealed copper (per ASTM B3), Class B stranded (per ASTM B8).
3. Size each TBB conductor as 2,000 circular-mils per linear foot from the TMGB to the furthest TGB.
  - a. Minimum Size: 6 AWG;
  - b. Maximum Size: 3/0 AWG.
4. Insulation: Thermoplastic (such as PVC), or similar. Jacket shall be nylon, or similar.
5. Outer Color: Green.
6. Wire shall meet or exceed IEEE 383, and shall be listed as UL VW-1.
7. Wire shall have printed on the outside of the jacket the insulation grade, the conductor gauge, applicable UL jacket listings, and foot markings.



C. TBC:

1. Wire: Type THHN, per UL 83.
2. Conductor: Bare soft annealed copper, Class B stranded (per ASTM B8).
3. TBC size: 6 AWG.
4. Insulation: Thermoplastic (such as PVC), or similar. Jacket shall be nylon, or similar.
5. Outer Color: Green.
6. Wire shall meet or exceed IEEE 383, and shall be listed as UL VW-1.
7. Wire shall have printed on the outside of the jacket the insulation grade, the conductor gauge, applicable UL jacket listings, and foot markings.

2.02 GROUNDING BUSBARS

A. Material: Solid copper.

B. Size:

1. TMGB Type Busbar: 20 inches long by 4 inches high (minimum) by ¼ inch thick (minimum).
2. TGB Type Busbar: 10 inches long by 2 inches high (minimum) by ¼ inch thick (minimum).

C. Holes: Predrilled, with standard NEMA bolt hole sizing & spacing for the type of connectors used.

D. Mounting: Standoff/support shall be insulated from the busbar.

E. Busbars shall comply with J-STD-607-A requirements for (at a minimum) size, material, and hole pattern.

F. Manufacturer: Chatsworth Products Inc, or equal:

1. #40153-020; TMGB type busbar with standoffs
2. #13622-010; TGB type busbar with standoffs

2.03 CONNECTORS

A. Provide UL listed connectors.

B. TBB-to-TBC "H" Tap, at Busbar:

1. Manufacturers, or equal:
  - a. Panduit #HTCT250-2-Q; "H" type compression tap, main = #2-250MCM, tap = #2-#6.

C. Lugs, for TBCs:

1. Manufacturer: Panduit, or equal:
  - a. #LCD6-14A-L; two hole (1/4" dia. x 5/8" on center) standard barrel lug for #6 AWG conductor.
  - b. #LCD4-14A-L; two hole (1/4" dia. x 5/8" on center) standard barrel lug for #4

AWG conductor.

- c. #LCD2-14A-Q; two hole (1/4" dia. x 5/8" on center) standard barrel lug for #2 AWG conductor.
- d. #LCD1-14A-E; two hole (1/4" dia. x 5/8" on center) standard barrel lug for #1 AWG conductor.
- e. #LCD1/0-38D-X; two hole (3/8" dia. x 1" on center) standard barrel lug for #1/0 AWG cond.
- f. #LCD2/0-38D-X; two hole (3/8" dia. x 1" on center) standard barrel lug for #2/0 AWG cond.
- g. #LCD3/0-38D-X; two hole (3/8" dia. x 1" on center) standard barrel lug for #3/0 AWG cond.

D. TBC-to-Conduit:

- 1. Thomas & Betts #3864 threaded insulated throat grounding bushings for 4" rigid steel entrance conduits.
- 2. Thomas & Betts threaded insulated throat grounding bushings for conduits longer than 3' used to protect the telecommunication grounding conductor.

E. TBC-to-TBB "H" (In-Line) Tap, at Conduit Bushings:

- 1. Manufacturers, or equal:
  - a. Panduit #HTCT250-2-Q; "H-type" compression tap, main = #2-250MCM, tap = #2-#6.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Work shall comply with the National Electrical Code, UL 467, and ANSI/TIA/EIA 607 standard, as well as local codes that may specify additional grounding and/or bonding requirements. If discrepancies between codes and/or standards arise, the more stringent code or specification shall prevail.
- B. Install components to manufacturer's instructions and recommendations.
- C. Identify grounding and bonding conductors according to local codes.
- D. Terminations must be accessible for inspection and maintenance during the life of the system.

### 3.02 INSTALLATION

- A. Pathways:
  - 1. When routing a TBB conductor through conduit, bond both ends of metallic conduit longer than 3 feet to the grounding conductor using a #6 AWG bonding conductor.
  - 2. Bond telecommunication conduit, cable tray, cable runway, equipment racks, and other metallic telecommunication infrastructure components to the nearest TMGB

using a TBC and appropriate grounding hardware.

3. Install grounding conductors in conduit to protect them from physical damage.

B. BCT and TBB:

1. Wire insulation used as BCT and TBB conductors shall be green. .
2. Install TBB(s) and/or BCT in a manner that will protect them from physical and mechanical damage.
3. Route TBBs and/or BCT in the shortest possible path and parallel to building lines.
4. Install the TBB and/or BCT without splices. If this is not possible, contact the Engineer for direction.
5. Enclose all conductors within metallic conduit.

C. TMGB and TGB Busbars:

1. Mount on wall in location shown on Drawings, on insulating standoffs.
2. Install TMGB and TGBs such that the bar is 2 inches from the wall.
3. Thoroughly clean non electrotin-plated bus bars prior to fastening the conductors, bolts, or connectors to the bus bar.
4. Attach lugs to bus with appropriate size cadmium bronze bolt, flat washer and Belleville washer.
5. Torque connections.

D. TBC:

1. Provide TBC conductors as bonding jumpers for bonding equipment and other metallic components within a Telecommunications Room to the grounding busbar. Use #6 up to 25 feet long; refer to drawings for sizing longer than 25 feet.
2. Bonding conductors shall be continuous. Splices are not allowed in TBCs.
3. Route TBCs in the shortest possible path.
4. Use right-angles for turns utilizing a 1-foot (minimum) bend radius.

E. Metallic Raceways:

1. If TBB and/or BCT routes through conduit longer than 1 meter, bond metallic conduit to conductor at both ends.
2. Bond metallic raceways for telecommunications cabling (conduit, cable tray, and other metallic telecommunication infrastructure components) located within the same room or space as the TMGB or TGB to the nearest telecommunication grounding busbar.

F. Panelboards:

1. Bond the panelboard's Alternating Current Equipment Ground (ACEG) bus (where equipped) or the enclosure, when dedicated to serving a Telecommunication space, to a busbar (either TMGB or TGB).

### 3.03 LABELING

#### A. General Requirements:

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner's Representative before installation.
2. Scope Of Labeling: Label the following components:
  - a. BCT: Affix label as close as practical to each connection point (at the electrical service ground and TMGB).
  - b. TBB: Affix label as close as practical to each connection point (at the TMGB and to bonding connections at TGBs).
  - c. TMGB and TGBs: Affix label as shown on Drawings or, if not shown, on front-top of busbar.
  - d. TBCs: Affix label as close as practical to each end of the conductor.
3. Labels shall be permanent.

#### B. Label Format:

1. Labels shall be permanent with machine-generated text; hand written labels will not be accepted.
2. Labels on conductors (e.g., TBB and TBCs) shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

#### C. Identifier Assignment:

1. General:
  - a. Separate label fields by a hyphen, unless otherwise noted.
  - b. Assign identifiers according to current practice and as approved by Owner before installation.
2. BCT:
  - a. First field: "BCT" (the conductor type).
  - b. Example: "BCT"
3. TBB:
  - a. First field: "TBB" (the conductor type).
  - b. Second field: a unique sequential number, for example, "01".
  - c. Example: "TBB-01"
4. TMGB/TGB (Ground Busbars):
  - a. First field: the busbar type, for example, "TMGB" or "TGB"
  - b. Second field: the IDF's identity (IDF identifier's suffix) where the conductor is installed; for example, "MDF-G.1".
  - c. Example: "TGB-MDF-G.1"
5. TBC (Bonding Conductors):
  - a. First field: the conductor type, for example., "BC"
  - b. Second field: the IDF's identity (IDF identifier's suffix) where the conductor is installed; for example, "MDF-G.1".

- c. Third field: a unique two-digit number
- d. Fourth field: describe the device, equipment, component, or raceway being bonded.
- e. Example: "BC-MDF-G.1-01 (CABLE TRAY)"

#### 3.04 RECORDS

- A. Telecommunication Grounding System records shall fully conform to TIA/EIA-606-A Administration Standards. Each component shall have as a minimum, the information as outlined in Table 4.7-1 of TIA/EIA-606-A.

#### 3.05 CERTIFICATION

- A. Obtain and record ground resistance measurements from the ground bus to earth. Provide additional bonding and add grounding electrodes as required to comply with resistance limits specified under this Section.
- B. Include computer-generated records of measured resistance values with the Operation and Maintenance Manual furnished to the Owner at the time of project closeout.

END OF SECTION 16061



## SECTION 16070

### SUPPORTING DEVICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Supporting devices, including:
  - 1. Conduit and equipment supports.
  - 2. Fastening hardware.

##### 1.3 COORDINATION

- A. Coordinate size, shape and location of concrete pads with section on cast-in-place concrete.
- B. Coordinate size, shape and requirements for utility company equipment with local utility company.

##### 1.4 QUALITY ASSURANCE

- A. Provide support systems adequate for weight of equipment and conduit, including wiring which they carry.

##### 1.5 SUBMITTALS

- A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of component used.
- B. Anchor Bolts and Studs: Submit drawings indicating locations and dimensioned where proposed to be used in structural steel.
- C. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and provide design drawings.
- D. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. B-Line.

- B. Kindorf.
- C. Unistrut.

## 2.2 MATERIAL

- A. Support Channel: Galvanized or painted steel.
- B. Hardware: Galvanized or painted steel.
- C. Provide epoxy or PVC coated materials for corrosive environments.
- D. Spring steel clips.

## 2.3 CONCRETE FASTENERS

- A. Provide expansion-shield type concrete anchors.
- B. Provide powder driven concrete fasteners with washers.

## 2.4 CONCRETE INSERTS

- A. Provide pressed galvanized steel, concrete spot insert, with oval slot capable of accepting square or rectangular support nuts of 1/4 inch to 1/2 inch diameter thread for rod support.

## 2.5 THREADED ROD

- A. Provide steel threaded rod, sized for the load unless otherwise noted on the Drawings or in the Specifications.

## 2.6 CONSTRUCTION CHANNEL

- A. Provide 1-1/2 inch by 1-1/2 inch, 12 gauge galvanized steel channel with 17/32-inch diameter bolt holes, and 1-1/2 inch on center in the base of the channel.

## 2.7 CONSTRUCTION CHANNEL END CAPS

- A. Provide white PVC end caps that total enclose the end of construction channel.

## 2.8 CONDUIT STRAPS

- A. One hole strap, steel or malleable iron, with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.
  - 1. Use malleable strap with spacers for exterior and wet locations.
  - 2. Use steel strap without spacers for interior locations.
- B. Steel channel conduit strap for support from construction channel.



- C. Steel conduit hanger for pendant support with threaded rod
- D. Steel wire conduit support strap for support from independent #12 gauge hanger wires.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps or bolts.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; sheet metal screws in sheet metal studs and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors on new concrete structure.
- E. Do not drill structural steel members.
- F. Where attachment is required to be made to structural members, provide steel mounting plates rigidly welded to the steel members of sufficient size and thickness for application. Plates shall be provided with mounting studs to accommodate the equipment to be supported.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Provide steel reinforced concrete pads and equipment bases for all outdoor equipment on grade, floor mounted equipment, and where shown on Drawings.
- I. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not support conduit from ceiling wire supports.
- L. Do not use spring steel clips and clamps or support conduits by individual hanger wires.
- M. Where multiple runs of conduit can be run grouped together, run conduit in racks supported from the building structure. Provide for future use of rack by properly planning routing of conduits in and through restricted areas such as through walls and around mechanical and electrical equipment.
- N. Use spring steel clips with EMT for individual branch circuits and device boxes in

drywall construction.

- O. Install PVC end caps on all construction channel.
- P. Provide additional support backing in stud walls prior to sheet rocking or installation of exterior wall panels as required to adequately support wall mounted interior and exterior lighting fixtures and outlet boxes.

### 3.2 ANCHORAGE

- A. All floor mounted, free standing electrical equipment such as transformers, switchboards, distribution boards, motor control centers, etc. shall be securely fastened to the floor structure.
- B. Anchorage of electrical equipment shall comply with the seismic requirements as outlined in Section 16010: Basic Electrical Requirements.

END OF SECTION 16070

## SECTION 16071

### SEISMIC CONTROLS FOR ELECTRICAL WORK

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

##### 1.03 DEFINITIONS

- A. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- B. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

##### 1.04 SUBMITTALS

- A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.
  - 1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.
- B. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.
  - 1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
  - 2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
  - 3. Preapproval and Evaluation Documentation: By an agency approved by

authorities having jurisdiction, showing maximum ratings of restraints and the basis for approval tests or calculations.

- C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

#### 1.05 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in UBC, unless requirements in this Section are more stringent.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

#### 1.06 PROJECT CONDITIONS

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: F.
  - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: Occupancy = IV, Seismic Design Category = D.
    - a. Component Importance Factor: 1.5.
    - b. Component Response Modification Factor: Per ASCE 7 Table 13.6-1.
    - c. Component Amplification Factor: Per ASCE 7 Table 13.6-1.
  - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 1.05g.
  - 4. Design Spectral Response Acceleration at 1.0-Second Period: 0.52g.

#### 1.07 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. B-Line Systems, Inc.
  2. Erico, Inc.
  3. GS Metals Corp.
  4. Loos & Company, Inc.
  5. Mason Industries, Inc,
  6. Powerstrut.
  7. Thomas & Betts Corp.
  8. Unistrut Corporation.

### 2.02 MATERIALS

- A. Use the following materials for restraints:
1. Indoor Dry Locations: Steel, zinc plated.
  2. Outdoors and Damp Locations: Galvanized steel.
  3. Corrosive Locations: Stainless steel.

### 2.03 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

## 2.04 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
  - 1. Materials for Channel: ASTM A 570, GR 33.
  - 2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
  - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
  - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
  - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
  - 2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

## PART 3 - EXECUTION

### 3.01 APPLICATION

- A. Generator Sets: Comply with Division 15 Section 15070 Vibration Isolation.

### 3.02 INSTALLATION

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

### 3.03 STRUCTURAL ATTACHMENTS

- A. Use bolted connections with steel brackets, slotted channel, and slotted-channel

fittings to spread structural loads and reduce stresses.

- B. Attachments to New Concrete: Bolt or weld to channel-type concrete inserts or use expansion anchors.
- C. Attachments to Existing Concrete: Use expansion anchors.
- D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
- E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
- F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
- G. Attachments to Wood Structural Members: Install bolts through members.
- H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

### 3.04 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
- B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
  - 1. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
  - 2. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
  - 3. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

### 3.05 SEISMIC BRACING INSTALLATION

- A. Install bracing according to spacings and strengths indicated by approved analysis.
- B. Expansion and Contraction: Install to allow for thermal movement of braced components.
- C. Cable Braces: Install with maximum cable slack recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete

members.

### 3.06 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

END OF SECTION 16071



## SECTION 16075

### ELECTRICAL IDENTIFICATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Items for identification of electrical products installed under Division 16.

##### 1.3 SUBMITTALS

- A. Submit product data.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. W.H. Brady Co.
- B. Carlton Industries, Inc.
- C. Seton Nameplate Co.

##### 2.2 MATERIALS

- A. Nameplates: Provide engraved three-layer laminated plastic nameplates with lettering etched through the outer covering. Character and background colors shall conform to the following system color code:

Background.	Char.	System
Black	White	Normal Power & Lighting
Orange	White	Isolated Ground
Green	White	Security
Red	White	Fire Alarm
Yellow	White	Emergency Circuit

- B. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type.
- C. Underground Warning Tape:
  1. Manufactured polyethylene material and unaffected by acids and alkalies.
  2. 3.5 mils thick and 6 inches wide.
  3. Tensile strength of 1,750 pounds per square inch lengthwise.
  4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background conforming

to APWA recommendations.

- D. Panelboard Directories: Provide typed circuit directory for each panelboard. Mount circuit directory in a permanent, clear Lexan card holder located on inside of door on panelboard.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be acceptable.
- E. Provide underground tape at electrical installations.

### 3.2 WIRE AND CABLE LABELING

- A. Provide wire markers on each conductor in splice boxes, pull boxes, and at first load connection on homerun. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- B. Identify branch circuit or feeder number for power and lighting circuits on cover of pull and junction boxes with indelible marker.

### 3.3 EQUIPMENT LABELING

- A. Provide nameplates to identify all electrical distribution and control equipment.
- B. Engraved, Laminated Plastic Nameplates: 1/4-inch letters, equipment designation; 1/8-inch letters, source circuit number. Provide for:
  - 1. Meters.
  - 2. Panelboards.
  - 3. Switchboards including each individual device or piece of equipment within a switchboard.
  - 4. Motor control center including each individual device with a motor control center.
  - 5. Enclosed switches, starters, circuit breakers and contactors. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, design letter, service factor, and voltage/phase rating. Provide phenolic nameplate on cover exterior to indicate motor served.
  - 6. Transformers.
  - 7. Generator.

- C. Identify junction boxes by circuit number with legible permanent ink marker.
- D. Identify Emergency Circuit junction boxes by circuit number with Engraved, Laminated Plastic Nameplates, sized to suit box cover. Secure with adhesive suitable for exterior use.

#### 3.4 BOX AND COVER COLOR CODING

- A. Fire Alarm Wiring: Red.

#### 3.5 ELECTRICAL SCHEMATICS

- A. Provide copy of electrical schematic single line diagram complete with feeder sizes and equipment ratings at each electrical room. Diagram shall reflect As Built conditions and shall be reproduced on bond paper at a minimum half-size of the Contract Drawings.
- B. Electrical schematic shall be installed within a hinged frame with transparent shatter-free cover to provide protection and allow updates to be made.
- C. Install diagram within main electrical room, or as directed by the Owner.

END OF SECTION 16075



## **SECTION 16080**

### **ELECTRICAL TESTING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Test electrical systems and equipment.
- B. These tests are required to determine that the equipment involved may be safely energized and operated.
- C. Perform tests by and under the supervision of fully experienced and qualified personnel. Advise each respective manufacturer's representative of tests on their equipment.
- D. Record all test data.
- E. Each section of Division 16 that has products or systems listed herein incorporate this section by reference and is incomplete without the required tests stated herein.

##### **1.3 REFERENCES**

- A. ANSI/IEEE C37.20 - Circuit Breakers, Switchgear, Substations, and Fuses.
- B. NETA - National Electrical Testing Association
- C. NFPA 70 - National Electrical Code.

##### **1.4 SUBMITTALS**

- A. Submit test report forms for review a minimum of 90 days prior to requesting a final review by A/E.
- B. Furnish six individually bound copies of test data. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.
- C. A/E will retain one copy. Remaining copies will be returned to Contractor for inclusion in the operation and maintenance manuals.

#### **PART 2 - PRODUCTS (Not Used)**

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Furnish proposed test procedures, recording forms, list of personnel and test equipment for A/E review.
- B. Follow recommended procedures for testing as published by test equipment manufacturer.

### 3.2 GENERAL TESTS

- A. Circuit continuity: Test all feeder and branch circuits for continuity. Test all neutrals for improper grounds.
- B. Equipment operations: Test motors for correct operation and rotation.
- C. Lighting control circuits: Test lighting circuits for correct operation through their control devices.
- D. Alarm and interlock systems: Produce malfunction symptoms in operating systems to test alarm and interlock systems. In addition, all specific tests described in the fire alarm system shall be performed.

### 3.3 CIRCUIT BREAKERS

- A. Insulated Case/Molded Case
  - 1. Visual and Mechanical Inspection
    - a. Compare nameplate data with drawings and specifications.
    - b. Inspect circuit breaker for correct mounting.
    - c. Operate circuit breaker to insure smooth operation.
    - d. Inspect case for cracks or other defects.
    - e. Verify tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method in accordance with manufacturer's published data. Perform thermographic survey.
    - f. Inspect mechanism contacts and arc chutes in unsealed units.
  - 2. Electrical Tests (for all circuit breakers 100A and above)
    - a. Perform a contact-resistance test.
    - b. Perform an insulation-resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
    - c. Perform insulation resistance test at 1000 volts dc on all control wiring. Do not perform the test on wiring connected to solid state components.
    - d. Perform adjustments for final settings in accordance with coordination study supplied by owner.
    - e. Perform long-time delay time-current characteristic tests by passing 300 percent rated current through each pole separately unless series testing is required to defeat ground fault functions.
    - f. Determine short-time pickup and delay by primary current injection.

- g. Determine ground-fault pickup and time delay by primary current injection.
- h. Determine instantaneous pickup current by primary injection using run-up or pulse method.
- i. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
- j. Verify the calibration of all functions of the trip unit by means of secondary injection.

### 3. Test Values

- a. Bolt-torque levels shall be in accordance with Table 10.12 unless otherwise specified by manufacturer.
- b. Compare microhm or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than 25 percent. Investigate any value exceeding manufacturer's recommendations.
- c. Insulation resistance shall not be less than 100 megohms.
- d. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- e. For molded-case circuit breakers all trip times shall fall within Table 10.7. Circuit breakers exceeding specified trip time at 300 percent of pickup shall be tagged defective.
- f. For molded-case circuit breakers instantaneous pickup values shall be within values shown on Table 10.8.

## 3.4 WIRE AND CABLE

- A. Test insulation resistance of each main feeder and service after the installation is complete but before the connection is made to its source and point of termination.
- B. Test insulation resistance using Biddle Megger or equivalent test instrument at a voltage not less than 1,000 volts DC. Measure resistance from phase-to-phase and phase-to-ground. In circuits where insulation test value is lower than 1 megohm, remove and replace conductor and retest.
- C. Visually inspect connections of every branch circuit for tightness.
- D. Ensure that grounding conductor is electrically continuous.
- E. Test branch circuits against grounds, shorts or other faults.
- F. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- G. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment.
- H. Test system for stray currents and ground shorts. If stray currents and shorts are detected, eliminate or correct as required.

## 3.5 WIRING DEVICES

- A. Operate switches at least twice.
- B. Test every convenience outlet with plug-in device for proper phasing and grounding.
- C. Demonstrate operation of lighting circuits and lighting control systems.

### 3.6 ELECTRICAL SWITCHGEAR AND PANELS

- A. Before Energization:
  - 1. Visually inspect connections for tightness and correctness.
  - 2. Verify proper fusing.
- B. After Energization:
  - 1. Verify proper voltage with system operating at load conditions.
  - 2. Verify proper operation.
  - 3. Operate every circuit breaker, switch and contactor.
  - 4. Measure line amperes with system operating at load conditions.
  - 5. Modify circuit breaker and relay settings as required.
  - 6. Megger meter centers for opens, shorts and grounds.
  - 7. Thermographic Tests:
    - a. With system operating at load conditions, perform thermographic test on switchgear, bus duct, control centers, distribution panelboards, lighting panelboards and equipment feeders using an infrared temperature scanning unit. Provide thermograph tests performed by Independent Contractor.
    - b. Tighten or correct connections with higher temperatures than acceptable. After corrections have been made, perform thermograph test to confirm that problems have been corrected.

### 3.7 GROUND FAULT

- A. Factory test switchboards at the manufacturer's factory prior to shipment as specified herein:
  - 1. Furnish a ground fault protection system test for circuit testing and verification of the tripping of the ground fault relays at the factory location. Pass predetermined values of current through the relay sensors and measure the relay tripping time for each phase and the neutral sensor (if one is required). Compare the measured time-current relationships to the tri-characteristic curves for each relay. If the relay trips outside the range of values indicated on the curve, replace or recalibrate the relays. Include a polarity verification of the interconnection of the ground sensor circuits as a part of the test.
  - 2. Have the proper voltages applied to their circuits and satisfactory operation demonstrated for additional auxiliary, pilot, control relays, electrically operated breakers, shunt-trip operated breakers, switches, etc.
  - 3. Furnish in accordance with NFPA 70 Section 230-95(c), test results certified by the switchboard manufacturer. One reviewed copy to be available at the job site for review by the authorities having jurisdiction.
  - 4. Upon completion of the factory ground fault protection system tests, the current and time adjustment on each relay are to be set on their minimum values.



- B. After construction work is complete and prior to energizing switchboards, field test ground fault protection system; provide reset to manufacturer's recommended setting for both current and time by Independent Contractor.
  - 1. The test procedure is to be similar to that specified for the factory test.
  - 2. Notify A/E in writing at least two weeks prior to the day of the field test. A/E may witness the field test if he so desires.
  - 3. Furnish all field test results certified by the testing company listed hereinbefore.

### 3.8 SECONDARY GROUNDING

- A. Test service entrance ground resistance.
- B. Provide additional made-electrodes if resistance is more than 5 ohms.
- C. Test grounding system resistance within building at a minimum of ten locations.

### 3.9 PACKAGED ENGINE GENERATOR SYSTEM

- A. Refer to Specification Section 16231: Engine Generator.
- B. Demonstrate operation of standby system with voltage check while the entire electrical system is operating at system full load condition to assure proper operation of generator, transfer switches, etc.
- C. Where building load is unavailable for testing or is less than full rated load of generator, provide resistive load bank connected into system to bring load up to full rating of generator.
- D. Simulate standby power conditions by operating main overcurrent devices to simulate a loss of main electrical power to each building.
- E. Prove ability to operate generator from multiple automatic transfer switches. Verify operation of all transfer switches and operation of all equipment on standby power. Check and adjust all delays and timing sequences. Verify operation when transferring from normal to emergency source and re-transfer from emergency to normal. Simulate failure of normal source during generator cool-down period to verify ability of generator to provide power to the load.
- F. Perform a full load test of the generator by applying a resistive load bank to system equal to full load rating of generator for four hours. Perform stepped load tests. Record generator voltage under the following step load conditions.
  - 1. 0% - 50%
  - 2. 50% - 100%
  - 3. 100% - 50%
  - 4. 50% - 0%
  - 5. 0% - 75%
  - 6. 75% - 0%
- G. During test, record the following at 20-minute intervals:
  - 1. Kilowatts.
  - 2. Amperes.

3. Voltage.
  4. Coolant temperature.
  5. Room temperature.
  6. Frequency.
  7. Oil pressure.
- H. Test alarm and shutdown circuits by simulating conditions.
- I. Test insulation resistance of generator field and exciter windings.
- J. Test sound level at 20 linear feet from engine within parking structure and at property line adjacent to public street.
- K. Based on vibration analysis, select vibration isolators and other dampening devices required to provide a smooth running installation.

END OF SECTION 16080

## **SECTION 16120**

### **WIRE AND CABLE**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Wire and cable, including:
  - 1. Building wire.
  - 2. Cable.
  - 3. Wiring connections and terminations.

##### **1.03 RELATED SECTIONS**

- A. Section 16060 - Grounding and Bonding Systems.
- B. Section 16080 - Electrical Testing.
- C. Section 16130 - Boxes.
- D. Section 16132 - Conduit.
- E. Section 16140 - Wiring Devices.
- F. Section 16150 - Wire Connections and Devices.

##### **1.04 REFERENCES**

- A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

##### **1.05 SUBMITTALS**

- A. Furnish samples upon request of Architect/Engineer.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Wire and Cable:
  - 1. Carol.
  - 2. Southwire.
  - 3. Triangle PWC, Inc.
  
- B. Connectors:
  - 1. Burndy.
  - 2. T & B.
  - 3. 3M.
  
- C. Power Distribution Blocks:
  - 1. IlSCO.
  - 2. Square D.

### 2.02 BUILDING WIRE

- A. Thermoplastic-Insulated Building Wire: NEMA WC 5.
- B. Rubber-Insulated Building Wire: NEMA WC 3.
- C. Feeders and Branch Circuits Larger Than No. 6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN, XHHW, RHW.
- D. Feeders and Branch Circuits No. 6 AWG and Smaller: Copper conductor, 600 volt insulation, THW, THHN/THWN; smaller than No. 8 AWG, solid conductor.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THW, THHN/THWN.
- F. Plenum Rated Cable: Provide plenum rated cable where cable is installed exposed in plenums.
- G. Wiring types BX and MC will not be acceptable for use on this project.

### 2.03 WIRING CONNECTIONS AND SPLICES

- A. Connect and splice wire No. 8 AWG and smaller with self-insulating, wire nut connectors.
- B. Terminate and splice all No. 6 AWG and larger copper conductors, except for load side lugs on Class I and II switchboards, panelboards, motor control centers, fusible switches, circuit breakers, transformers and individual motor controllers with high conductivity, wrought copper, color-keyed compression connector similar to T & B Series 54100 for terminal connection; Series 54500 for two-way copper-to-copper splices; and Series 54700 for tapping and pigtailling copper conductors.
- C. Motor Connections: 3M Series 5300-5304.

- D. Set screw type connectors are only acceptable on the load side lugs of Class I and II switchboards, panelboards, circuit breakers, fusible switches and on individual motor controllers.
- E. Where three or more conductors larger than No. 8 AWG are installed in wiring gutter, utilize a screw-type power distribution block. Utilize split-bolt mechanical connector, filled and taped for smooth joint, only where specifically requested by Contractor and approved by A/E.
- F. Taps and splices of wire within in-grade handholes grade shall be made by means of Burndy Type YC-C compression connectors. Each joint, tap and splice in conductor of #8 and larger shall have the connector voids filled with electrical insulation putty and be taped with rubber covered with plastic tape providing insulation not less than one and a half times the thickness of the original insulation with two half-lapped layers each, Scotch #33.

## PART 3 - EXECUTION

### 3.01 GENERAL WIRING METHODS

- A. Use no wire smaller than No. 12 AWG for power and lighting circuits, and no smaller than No. 14 AWG for control wiring. Provide minimum of No. 12 AWG for all switch legs. Provide neutral conductor of the same size as the phase conductors to which it is associated.
- B. Use No. 10 AWG conductor minimum for 20 ampere, 120 volt branch circuits longer than 100 feet.
- C. Provide homerun conductors of continuous length without joint or splice from overcurrent device to first outlet.
- D. Provide main service and feeder conductors of continuous length without joint or splice for their entire length.
- E. Install wiring in conduit, unless indicated otherwise.
- F. Neatly train and lace wiring inside boxes, panelboards, switchgear, motor control centers, wiring gutters, and other equipment using Thomas & Betts "Ty-Wraps."
- G. Provide equal conductor lengths for all parallel circuits.
- H. Provide individual neutral for branch circuits. Multi-wire 120V branch circuits from 3-phase panelboards shall utilize one neutral conductor for MAXIMUM of three ungrounded conductors derived from different phases.
- I. Drawings indicate proposed circuiting only, and do not indicate every conductor unless intent is unclear and further clarification is required. Provide the necessary travelers for all three-way and four-way switches.
- J. Tag each circuit in an outlet box where two or more circuits run to a single outlet as a

guide for the fixture hanger in making connections.

### 3.02 WIRING INSTALLATION IN RACEWAYS

- A. Pull conductors into raceway at the same time. Use UL listed wire pulling lubricant. Do not exceed manufacturer's recommended tension.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Remove and discard conductors cut too short or installed in wrong raceway. Do not install conductors which have been removed from a raceway.
- E. Do not install conductors in conduit which contains wires already in place.

### 3.03 WIRING CONNECTIONS AND TERMINATIONS

- A. Make taps and splices in accessible junction or outlet boxes only.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- D. Provide joints in branch circuits only where such circuits divide. Where circuits divide, provide one through circuit to which the branch is spliced from the circuit. Do not leave joints in branch circuits for fixture hanger to make. Make all taps and splices with approved type compression connector.
- E. Terminate spare conductors with electrical tape.
- F. Identify and label all conductor terminations as specified in electrical identification.
- G. Properly terminate indicated conductors in equipment furnished and provide properly sized lugs.

### 3.04 COLOR CODING

- A. Color code distribution systems as follows:

- 1. 120/208V System:

Phase	Color
A	Black
B	Red
C	Blue
N	White
G	Green

2. 277/480V System:

Phase	Color
A	Brown
B	Orange
C	Yellow
N	Gray/White
G	Green

3. For areas where local authority color coding differs from that specified, contact A/E for instructions.

B. Provide color coding throughout the full length of all wire No. 6 and smaller. Identification by permanent paint bands or tags at the outlets will be acceptable for wire sizes larger than No. 6. Provide the same color and shade of color throughout the project.

3.05 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Torque test conductor connections and terminations to manufacturer's recommended values.

END OF SECTION 16120





## **SECTION 16130**

### **BOXES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Wall and ceiling outlet boxes, floor boxes, and pull and junction boxes.

##### **1.3 RELATED SECTIONS**

- A. Section 16070 - Supporting Devices.
- B. Section 16075 - Electrical Identification.
- C. Section 16120 - Wire and Cable.
- D. Section 16132 - Conduit.
- E. Section 16140 - Wiring Devices.

##### **1.4 REFERENCES**

- A. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
- C. 2001 CEC – California Electrical Code (NFPA 70 - National Electrical Code with California Amendments)

##### **1.5 SUBMITTALS**

- A. Furnish samples upon request of Architect/Engineer.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
- D. Record Documents:
  - 1. Provide as-built plan and profile drawings of all high voltage and medium and low voltage duct banks and pull boxes. Show all utilities encountered.
  - 2. Utilize sheets for plan and profile drawings of same size as Drawings. Coordinate scale of drawings with A/E.

## PART 2 - PRODUCTS

### 2.1 OUTLET BOXES

- A. Provide galvanized or cadmium-plated pressed steel outlet boxes suitable for the conditions of each outlet. Provide multi-gang outlets of single box design; sectional boxes will not be acceptable.
- B. Provide deep type cast metal outlet boxes located in damp locations exposed to weather or exposed areas subject to damage, complete with gasketed cover and threaded hubs.
- C. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of CEC, and not less than 1-1/2 inch deep unless shallower boxes are required by structural conditions and are especially approved by A/E.
- D. Provide PVC type outlet boxes only in corrosive areas rated as NEMA 13X.
- E. Provide 4-inch octagonal ceiling outlet boxes.

### 2.2 FLOOR BOXES

- A. Provide fully adjustable, cast iron, or formed steel floor boxes for installation in cast-in-place concrete floors. Refer to Section 16140: Wiring Devices for floor mounted service boxes.

### 2.3 TILE BOX

- A. Provide outlet boxes for installation in tile walls.
- B. Standard outlet boxes with raised, square corners and device covers are acceptable.
- C. ANSI/NEMA OS 1.

### 2.4 PULL AND JUNCTION BOXES

- A. Provide galvanized sheet metal boxes conforming to NEMA OS 1. Provide hinged enclosures for any box larger than 12 inches in any dimension.
- B. Provide cast metal boxes for outdoor and wet locations conforming to NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight with cover and ground flange, neoprene gasket, and stainless steel cover screws.
- C. Provide separate pull boxes and junction boxes for electric power, control, and communication systems.

## PART 3 - EXECUTION

### 3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Drawings are approximate unless dimensioned. Verify with A/E the location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Provide access doors where installation is inaccessible. Coordinate locations and sizes of required access doors with those specified in Division 15 - Mechanical.
- D. Locate and install to maintain headroom and to present a neat appearance.

### 3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings. Provide blank plates for all junction boxes.
- D. Securely fasten boxes to the building structure, independent of the conduit, except for splice boxes that are connected to two metal conduits, both supported within 12 inches of box.
- E. Provide access to all boxes.
- F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate with A/E for mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- I. Set boxes installed in concealed locations flush with the finish surfaces, and provide with the proper type extension rings and/or covers where required.
- J. Position outlets to locate luminaires as shown on reflected ceiling plans.
- K. In inaccessible ceiling areas, do not install junction boxes which are accessible only through luminaire ceiling opening.
- L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use adjustable steel channel fasteners for flush ceiling outlet boxes.

- M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Install all grouped device locations neat and symmetrical. Coordinate with A/E before rough-in.

### 3.3 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material.
- B. Seal as recommended by manufacturer.

### 3.4 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Provide pull boxes in feeder circuits as required but at least every 150 feet in straight runs.
- D. Identify all junction boxes by circuit number on cover with legible permanent ink marker.
- E. Provide weatherproof pull boxes or junction boxes where installed outdoors with watertight gasketed covers fastened by means of corrosion resistant screws.

END OF SECTION 16130

## SECTION 16132

### CONDUIT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SECTION INCLUDES

- A. Raceway systems, including:
  - 1. Rigid Galvanized Steel (RGS) conduit and fittings.
  - 2. PVC coated Rigid Galvanized Steel conduit and fittings.
  - 3. Electrical Metallic Tubing (EMT) and fittings.
  - 4. Flexible metal conduit and fittings.
  - 5. Liquid tight flexible metal conduit and fittings.
  - 6. Rigid nonmetallic conduit and fittings.

##### 1.03 RELATED SECTIONS

- A. Section 02581 -Underground Ducts And Manholes
- B. Section 03300 - Cast-in-Place Concrete.
- C. Section 16070 - Supporting Devices.
- D. Section 16120 - Wire and Cable.
- E. Section 16130 - Boxes.

##### 1.04 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
- C. 2001 CBC - California Building Code (1997 Uniform Building Code with California Amendments)
- D. 2001 CEC - California Electrical Code (NFPA 70 - National Electrical Code with California Amendments)
- E. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- F. NEMA RN 1 - PVC Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
- G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

- H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- I. UL 1 - Flexible Metal Conduit
- J. UL 6 - Rigid Metal Conduit
- K. UL 360 - Liquid-Tight Flexible Steel Conduit
- L. UL 651 - Schedule 40 and 80 Rigid PVC Conduit

#### 1.05 SUBMITTALS

- A. Furnish samples upon request of Architect/Engineer.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Rigid Galvanized Steel (RGS) conduit, Electrical Metallic Tubing (EMT) and Fittings:
  - 1. Allied Tube and Conduit Corporation.
  - 2. Western Tube and Conduit
  - 3. Wheatland Tube Co.
- B. Flexible Conduit and Fittings:
  - 1. Anamet, Inc.
  - 2. Electri-Flex Co.
  - 3. Eastern Wire and Cable
- C. Nonmetallic Conduit and Fittings:
  - 1. Can-Tex Industries.
  - 2. Carlon.
  - 3. Certain-Teed.

#### 2.02 MATERIALS

- A. Rigid Galvanized Steel (RGS) Conduit and Fittings:
  - 1. Rigid Steel Conduit and fittings shall be threaded, hot dipped galvanized with zinc coated threads and shall be in compliance with ANSI C80.1, NEMA FB 1, and UL 6.
    - a. Connectors shall have insulated throats.

- b. Polyvinyl chloride (PVC) externally coated RGS conduit and fittings shall be covered with a 40 mil PVC coating, and shall be in compliance with NEMA RN 1.
- B. Electrical Metallic Tubing (EMT) and Fittings:
  1. Electrical Metallic Tubing shall be hot-dipped galvanized tubing and shall meet the requirements of ANSI C80.3.
  2. Fittings shall be set steel screw type and shall meet the requirements of NEMA FB 1.
- C. Flexible Metal Conduit (FMC) and Fittings:
  1. Flexible metallic conduit shall be of continuously spirally wound galvanized steel or aluminum strip and shall be in compliance with UL 1.
  2. Fittings and conduit bodies shall be malleable iron or steel squeeze types and shall be in compliance with NEMA FB 1.
    - a. Connectors shall have insulated throats.
- D. Liquid-tight Flexible Conduit (LFMC) and Fittings:
  1. Liquid-Tight flexible metallic conduit shall be polyvinyl chloride (PVC) covered continuously spirally wound galvanized steel or aluminum strip with integral grounding conductor and shall be in compliance with UL 360.
  2. Fittings and conduit bodies shall be liquid-tight, zinc coated steel and shall be in compliance with NEMA FB 1.
    - a. Connectors shall have insulated throats.
- E. Rigid Nonmetallic Conduit (RNC) and Fittings:
  1. Rigid nonmetallic conduit shall be schedule 40, polyvinyl chloride (PVC), 90 degrees C rated and shall be in compliance with UL 651, NEMA TC-2, and TC-3.
  2. Fittings and conduit bodies shall be in compliance with NEMA TC 3.
  3. Conduit, fittings, and cement shall be products of same manufacturer.
- F. Miscellaneous Conduit Fittings And Products
  1. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.
  2. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.
  3. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL listed for wet or dry locations.
  4. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible,

corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.

5. Fire rated penetration seals:
  - a. UL classified.
  - b. Conduit penetrations in fire rated separation shall be sealed with a UL classified assembly consisting of fill, void or cavity materials.
  - c. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.
  - d. Penetrations of rated floors shall be sealed with an assembly having both F and T ratings at least equal to rating of the floor.
6. Penetrations of rated walls shall be sealed with an assembly having an F rating at least equal to the rating of the wall.
7. Hazardous area fittings: UL listed for the application

## PART 3 - EXECUTION

### 3.01 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

- A. Minimum size of conduit is 3/4-inch. Indicated sizes are minimum based on THW copper wire and larger sizes may be used for convenience of wire pulling.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Conceal conduit in ceiling of all finished areas and in metal stud walls of all areas of the building. In unfinished areas without ceilings, conduit may be run exposed overhead. Install all conduit, including conduit above accessible ceiling, parallel or perpendicular to walls and adjacent piping. Neatly route conduit in a common rack where possible.
- D. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit securely to building structure using clamps, hangers and threaded rod.
- F. Refer to Section 16070 for support of conduit.

### 3.02 CONDUIT INSTALLATION SCHEDULE

- A. Raceway Application
  1. Outdoors: Apply raceway products as specified below unless otherwise indicated:
    - a. \Exposed Conduit: GRC.
    - b. Concealed Conduit, Aboveground: EMT.
    - c. Underground Conduit: RNC, Type EPC-40 -PVC, direct buried. HDPE where indicated for utility conduits. Concrete encased where indicated.
    - d. Connection to Vibrating Equipment (Including Transformers and Hydraulic,



- Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- e. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- f. Lighting Poles, communications conduit: ENT

2. Indoors: Apply raceway products as specified below unless otherwise indicated:

- a. Exposed, Not Subject to Physical Damage: EMT.
- b. Exposed, Not Subject to Severe Physical Damage: EMT.
- c. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
  - 1) Mechanical rooms.
  - 2) Maintenance Bay
- d. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- e. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
- f. Damp or Wet Locations: GRC.
- g. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.

B. Rigid Galvanized Steel Conduit

- 1. RGS shall be permitted under all conditions subject to the restrictions of the National Electric Code; except areas identified as a corrosive environment.

C. PVC Coated Rigid Galvanized Steel Conduit

- 1. PVC coated galvanized rigid steel conduit shall be used in the following applications:
  - a. Use 40-mil coating for feeders and branch circuits in damp or wet locations.
  - b. Use 20 or 40 mil for feeders and branch circuits concealed in concrete walls or slabs in contact with earth.
  - c. Use 20 or 40-mil for runs beneath floor slabs on grade.
  - d. Use 40-mil for all below grade penetrations through floor slabs on grade or exterior walls.

D. Electrical Metallic Tubing

- 1. EMT shall be permitted for both exposed and concealed work
- 2. EMT shall not be permitted:
  - a. Where subject to physical damage, including mechanical equipment rooms below 8'-0" AFF.
  - b. In corrosive areas
  - c. In cinder block construction
  - d. In hazardous or classified aseptic locations

E. Flexible Metallic Conduit

- 1. Flexible metallic conduit shall be permitted for final connections to, suspended light

fixtures, between J-boxes and recessed/surface - mounted light fixtures, to overcome building obstructions, for connections to vibrating, hydraulic, or pneumatic equipment, motors, transformers and solenoids in dry locations.

2. Maximum lengths shall be 4'-0" unless otherwise approved by the A/E.

F. Liquid-Tight Flexible Metallic Conduit

1. Liquid-Tight flexible metallic conduit shall be permitted for final connections to vibrating, hydraulic, or pneumatic equipment, motors, transformers, and solenoids in outdoor areas, mechanical areas, and where exposed to moisture.
2. Maximum lengths shall be 4'-0" unless otherwise approved by the A/E

G. Rigid Nonmetallic Conduit.

1. Rigid nonmetallic conduit may be used underground (direct buried or concrete encased).

H. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing will not be acceptable for use on this project. BX and MC cable will not be acceptable for use on this project.

### 3.03 GENERAL CONDUIT INSTALLATION

- A. Installations shall comply with California Electrical Code as required for type of conduit.
- B. Cut conduit square using a saw or pipe cutter; de-burr cut ends before joining.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Install no more than the equivalent of three 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point. Seal conduit which crosses a boundary between areas of extreme temperature difference.
- G. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- H. Drawings indicate intended circuiting and are not intended to be scaled for exact conduit location.
- I. Install conduit such that it does not interfere with fireproofing of steel.
- J. In all empty conduits or ducts, install a polyethylene pulling rope.
- K. An installation of concealed conduit and recessed outlets and connections shall be provided within all finished areas. Conduits shall be concealed within any areas with suspended ceilings.
- L. Except in electrical and mechanical rooms, conduit connections to motors and surface cabinets shall be concealed unless exposed work is clearly called for on the Drawings.

- M. Install conduits in complete runs before pulling in cables or wires.
- N. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
- O. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.

### 3.04 PENETRATIONS

- A. Penetrations of walls and wall membranes required to have a fire-resistance rating shall be protected with through-penetration fire stops suitable for the method of penetration.
- B. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, wall, etc.
- C. Cutting or holes:
  - 1. Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed.
  - 2. Provide sleeves or "can outs" for cast-in-place concrete floors and walls. Following conduit installation, seal all penetrations using non-iron bearing, chloride free, non-shrinking, dry-pack grouting compounds; or fire rated penetration-sealing materials.
  - 3. Cut holes for conduit penetrations through non-concrete and non-masonry walls, partitions, or floors with a hole saw. The hole shall be only as large as required to accommodate the size of the conduit.
  - 4. Provide single piece escutcheon plates around all exposed conduit penetrations in public places.
- D. Sealing:
  - 1. Non-rated penetrations: Pack opening around conduits with non-flammable insulating material and seal with gypsum wallboard taping compound.
  - 2. Fire stop: Where conduits, wireways, and other electrical raceways pass through fire rated partitions, walls, smoke partitions, or floor; install a UL classified fire stop material to provide an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.
- E. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Division 7.
  - 1. Install specified watertight conduit entrance seals at all below grade wall and floor penetrations. Conduits penetrating exterior building walls and building floor slab shall be PVC coated rigid galvanized steel.
  - 2. For roof penetrations furnish and install roof flashing, counter flashing and pitch-pockets as specified under Roofing and Sheet Metal Sections of the Specifications.
  - 3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
  - 4. Conduits that horizontally penetrate a waterproof membrane shall fall away from and

below the penetration on the exterior side a minimum of two times the conduit diameters.

### 3.05 CONCEALED IN CONCRETE:

- A. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the conduits.
- B. Installation of conduit in structural concrete that is less than three inches thick is prohibited. Topping slabs, maintenance pads, and curbs are exempted.
- C. Tie conduits to reinforcing rods or otherwise secure them to prevent sagging or shifting during concrete placement. Run conduit larger than 1-inch trade size, parallel with or at right angles to the main reinforcement; where at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.
- D. Where nonmetallic conduit or tubing is used, raceways must be converted to PVC coated rigid steel conduit before rising above floor.
- E. Make couplings and connections watertight.
- F. Protect stub-ups from damage where conduits rise from floor slabs.
- G. Arrange so curved portion of bends is not visible above the finished slab.

### 3.06 TERMINATIONS AND JOINTS

- A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.
- B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.
- C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
- D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
- E. Stub-up connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver operated threaded flush plugs with floor.

- F. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating in switchgear, cabinets or gutters inside the building. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
- G. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times it's original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms; water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects, and rodents. Install raceway sealing foam at the following points:
  - 1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air-conditioned spaces, etc.).
  - 2. Where conduits enter buildings from below grade.
- H. Install expansion couplings where any conduit crosses a building separation or expansion joint as follows:
  - 1. Conduits three inches and larger, shall be rigidly secured to the building structure on opposite sides of a building expansion joint, and provided with expansion or deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
  - 2. Conduits smaller than three inches shall be rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground-bonding jumper installed. For concrete embedded conduit, use expansion and deflection couplings as specified above for three inches and larger conduits.
  - 3. Use short length (maximum of 6ft) of the appropriate FMC or LFMC conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquidtight flexible metal conduit for installation in exterior locations, moisture or humidity-laden atmosphere, corrosive atmosphere, water hose or spray wash-down operations, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with FMC or LFMC conduit.

### 3.07 NONMETALLIC CONDUIT INSTALLATION

- A. Wipe nonmetallic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

### 3.08 METALLIC CONDUIT INSTALLATION

- A. Make joints mechanically tight and all conduits electrically continuous.
- B. Use conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations. Use sealing locknuts and other approved techniques for moisture proofing raceway in wet areas.
- C. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than

2 inch size.

- D. Install expansion joints where conduit crosses building expansion joints and at 150 foot intervals in straight runs.

END OF SECTION 16132

## **SECTION 16133**

### **WIREWAYS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 REFERENCES**

- A. California Electrical Code (NFPA 70 - National Electrical Code with California Amendments)

##### **1.03 SUBMITTALS**

- A. Furnish samples upon request of Architect/Engineer.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

#### **PART 2 - PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. B-Line.
- B. General Electric.
- C. Hoffman.
- D. Keystone.
- E. Square D.
- F. Wiremold

##### **2.02 MATERIALS**

- A. General Purpose Wireway: Square D Square Duct, Series LD.
- B. Oiltight, Dust-Tight Wireway: Square D Type JIC, Series LL.
- C. Raintight Wireway: Square D lay-in raintight, Series LDR.
- D. Raintight Troughs: Square D, Series RD.

E. Wireway End Closures, Supports and Associated Fittings: Square D, of best forms and dimensions for applications.

F. Multi-channel Surface metal raceway: Wiremold ALA4800.

1. The aluminum surface metal raceway system specified herein for branch circuit wiring and/or data network, voice, video, and other low-voltage wiring shall be the ALA4800 System as manufactured by The Wiremold Company.
2. The raceway and all system components must be UL Listed in full compliance with their standard for surface metal raceways and fittings (UL-5). All extrusions are to be 6063-T5 aluminum alloy, with nominal wall thickness of 0.078" throughout. The surface finish is to be satin, anodized #204 Type clear, Class R1 Mil-Spec with minimum anodized finish of 0.004" .
3. The raceway shall be a two-piece design with a base and snap-on cover. The base shall be furnished in 10'-0" lengths and the cover sections shall be furnished in 5'-0" lengths. The overall dimensions of assembled raceway shall be 6" wide by 2.25" deep with a cross sectional area of 8.5 square inches.
4. The ALA4800B-10 base shall have an extruded divider separating the 6" raceway into two equal compartments.
5. The ALAC-5 cover shall fit onto both compartments to allow access to only one compartment at a time.
6. The two compartment and separate covers must be available to handle both power and communications wiring.
7. A full compliment of fittings for the raceway shall be available. The available fittings should include, but not be limited to the following: flat, internal and external elbows, tee and cross fittings, wire clips, couplings for joining sections of raceway, grounding adapters as an NEC approved secondary grounding method, and transition connectors to 1/2" and 3/4" trade size conduit.
8. The fittings shall have a satin anodized finish to match the raceway.
9. Device cover plates for mounting the following commercially available devices must be available: duplex devices, single 1.40" and 1.59" dia. receptacles, GFCI, Sentrex® surge receptacles and other rectangular faced devices and modular voice and data jacks. All devices must be mounted to the cover plates, which are securely held in place by extruded protrusions. Cover plates are to be removable by use of a standard screwdriver without marring the extrusion finish.
10. The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP, STP (150 ohm), Fiber Optic, Coaxial and other cabling types with faceplates and bezels to facilitate mounting.
11. A complete line of preprinted station and port identification labels, snap-in icon buttons as well as write-on station identification labels shall be available.

G. Pre-wired Surface metal raceway.

1. The surface metal raceway system specified herein for branch circuit wiring shall be the aluminum AL2000 System as manufactured by The Wiremold Company.
2. The raceway and all system components must be UL Listed in full compliance with their standard for surface metal raceways and fittings (UL-5).
3. The raceway shall be a two-piece design with a base and snap-on cover. The overall dimensions of assembled raceway shall be 1-7/16" wide by 1-1/8" deep.
4. A full compliment of fittings for the raceway shall be available. The available fittings should include, but not be limited to the following: flat, internal and external elbows,



- tee and cross fittings, wire clips, couplings for joining sections of raceway, grounding adapters as an NEC approved secondary grounding method, and transition connectors to 1/2" trade size conduit.
5. The fittings shall have a finish to match the raceway.
  6. All devices must be mounted to the cover plates, which are securely held in place by extruded protrusions. Cover plates are to be removable by use of a standard screwdriver without marring the extrusion finish.
  7. Device color to match other wiring devices.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Provide systems of wireway of sufficient size where shown, on equipment racks, and at other locations with two or more starters, disconnect switches, and cabinets mounted in close proximity.
- B. Size wireway cross-sectional area and length based upon conductor fill and equipment served as required by CEC and local codes.
- C. Install types based on environmental conditions to which exposed.
- D. Provide covers for wiring gutters of the same construction as the wiring gutter. Secure cover with captive type screws located in accordance with manufacturer's recommendation. Hinged covers will not be acceptable.

### 3.02 PAINTING

- A. In finished spaces where wireway is visible, provide prime coat after wireway installation is complete. Refer to Section 09912 "Interior Painting" for finish painting.

END OF SECTION 16133



## **SECTION 16140**

### **WIRING DEVICES**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Specification grade wiring devices, including:
  - 1. Wall switches.
  - 2. Wall dimmers.
  - 3. Receptacles.
  - 4. Floor mounted service fittings.
  - 5. Occupant sensors.
  - 6. Device plates and box covers.

##### **1.03 RELATED SECTIONS**

- A. Section 16130 - Boxes.

##### **1.04 REFERENCES**

- A. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.
- B. California Energy Code, Title 24, Part 6

##### **1.05 SUBMITTALS**

- A. Furnish samples upon request of A/E.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

#### **PART 2 - PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. Switches and Receptacles:
  - 1. Hubbell, Bryant.
  - 2. Leviton.
  - 3. Pass & Seymour/Legrand

- B. Dimmers:
  - 1. Leviton.
  - 2. Lutron.
  - 3. Pass & Seymour/Legrand
- C. Cover Plates: Match device manufacturer.
- D. Floor Mounted Service Fittings:
  - 1. Hubbell, Bryant.
  - 2. RCI.
  - 3. Square D.
  - 4. Walker.
- E. Occupant Sensors:
  - 1. Hubbell, Bryant.
  - 2. Leviton.
  - 3. Pass & Seymour.
  - 4. Lighting Control and Design Inc.

## 2.02 DEVICE COLOR

- A. Provide gray colored switches, dimmers, and receptacles in all areas except where not available for Industrial heavy duty special receptacles, or where NEMA 3R, NEMA 4 or NEMA 12 rating is required.
- B. NEMA 4 and NEMA 12 switches will be self-finished metallic.
- C. Provide orange receptacles for circuits with an isolated ground.

## 2.03 COVER PLATES

- A. Provide one piece cover plates for all group mounted devices.
- B. Provide stainless steel metal plates for all areas except where not available for Industrial heavy duty special receptacles, or where NEMA 4 or NEMA 12 rating is required.
- C. Duplex receptacles on generator fed circuit shall be provided with the word "GENERATOR" in red color engraved on the plate and with wires inside the box tagged with panel and circuit numbers.
- D. Weatherproof Cover Plate: Gasketed self-closing hinged While-In-Use cover. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
- E. Wet-Location, Weatherproof Receptacle Cover Plate: Gasketed self-closing hinged While-In-Use cover, gray impact resistant thermoplastic.
- F. Exposed Box Cover Plate: Stamped steel box covers.

## 2.04 SWITCHES

- A. Snap Switches: Heavy-duty, quiet type, 20A, 120-277V.
- B. Provide Leviton "Commercial grade" or equal.

## 2.05 DIMMERS

- A. NEMA WD 2; slide type, solid-state, positive off, Lutron "Nova" series.
- B. 1,500-watt minimum rating; larger size as necessary to accommodate load shown on contract drawings. Fully rated, gangable without breaking off cooling fins.
- C. Rated for incandescent or fluorescent as shown.

## 2.06 RECEPTACLES

- A. Provide receptacle style NEMA 5-20R, Leviton "Commercial grade" Catalog number range "CR20" or equal, unless noted otherwise, in simplex, duplex, double duplex configuration as indicated on the drawings.
- B. Provide NEMA straight blade, locking style, pin and sleeve or specialty straight blade as indicated on the drawings.
- C. Provide receptacle style NEMA 5-20R with integral GFCI protection, Leviton "Commercial grade" catalog number range "6599" or equal, unless noted otherwise, in duplex configuration with black TEST and red RESET switches. Compliant with UL 943 CLASS A and UL 498.
- D. Provide receptacle style NEMA 5-20R with isolated ground, Leviton "Industrial grade" catalog number range "8300-IG" or equal, unless noted otherwise, in duplex configuration.

## 2.07 OCCUPANT SENSORS

- A. Self-Contained:
  - 1. Single gang, gangable device designed to fit behind a standard decorator switch plate.
  - 2. Infrared detector behind a fresnel lens.
  - 3. Detection Range:
    - a. 1,000 square foot field of view.
    - b. 180-degree sensing field.
    - c. 40-foot sensing distance.
  - 4. Adjustable Time-Out Delay: 30 seconds to 30 minutes.
  - 5. Adjustable Ambient Override: 4 footcandles to full daylight.
  - 6. Product: Leviton "ODS15-ID" and "ODS0D-ID"
  - 7. Certified by California Energy Commission

B. Network:

1. Sensor:

- a. Self-mounting, ceiling bracket.
- b. Infrared detector behind a fresnel lens.
- c. Detection Range:
  - 1) 8 to 14 micrometer frequency spectrum of bodily emitted infrared radiation.
  - 2) 110-degree sensing field over 400 gross square feet.
- d. Time-Out Delay: 30 seconds to 30 minutes.
- e. Product: Leviton, "6778".

2. Control Unit:

- a. Rated 120 volts or 277 volts.
- b. Enclosure: Galvanized, heavy duty for mounting to a 4-inch or 4-11/16 inch square box.
- c. Control up to five sensors.
- d. Power Rating:
  - 1) 2,400 watts incandescent at 120 volts.
  - 2) 2,400 watts fluorescent at 120 volts.
  - 3) 4,800 watts fluorescent at 277 volts.
- e. Product: Leviton, "6779".

3. Auxiliary Relays for Additional Load:

- a. 120 Volt: Leviton, "6783-120".

4. Certified by California Energy Commission.

## 2.08 FLOOR MOUNTED SERVICE FITTINGS

A. Poke-Thru Devices

1. Poke-thru device shall have been examined and tested by Underwriters Laboratories Inc. to Standard UL514A and/or UL514C and bear the U.S. UL Listing Mark. The poke-thru device shall also have been tested by Underwriters Laboratories Inc. and Classified for fire resistance and bear the U.S. UL Classification Mark. Devices shall be classified for use in 1-, 1 1/2-, or 2-hour rated, unprotected reinforced concrete floors and 1-, 1 1/2-, or 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the poke-thru fittings. This device shall also conform to the standards set in the National Electric Code, Section 300-21. These devices meet all UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. This poke-thru device shall also have been evaluated by UL to meet the applicable U.S. safety standards for scrub water exclusion when used on tile,

terrazzo, wood, and carpet covered floors. Suitable for use in air handling spaces in accordance with Sec 300-22 (C) of the National Electrical Code.

2. The poke-thru devices shall be Walker RC7 devices manufactured by The Wiremold Company. The poke-thru device shall be compatible to accept a complete line of Ortronics® workstation connectivity outlets and modular inserts, or the Pass & Seymour Network Wiring System.
3. This assembly consists of an insert and an activation cover. Overall poke-thru assembly length shall be 16 1/4".
4. The insert body shall have the necessary channels to provide complete separation of power and communication services. There shall be one 3/4" trade size channel for power and two 1/2" trade size channels for communication cabling. The channels shall be arranged such that communication cables can be conduit protected and connected to the insert body using a die-cast zinc conduit connector with two 1/2" trade size threaded openings to accept both rigid and flexible conduit connections.
5. The body will consist of an intumescent fire stop material to maintain the fire rating of the floor slab. The intumescent material will be held securely in place in the insert body and shall not have to be adjusted to maintain fire rating of the unit and the floor slab. The insert shall have a spring steel-retaining ring that will hold the poke-thru device in the floor slab without additional fasteners. The poke-thru insert shall also consist of a 3/4" trade size conduit stub that is connected to the insert body and a 24.5 cu. in. stamped steel junction box for wire splices and connections. The stamped steel junction box shall also contain the necessary means to electrically ground the poke-thru device to the system ground.
6. The trim flange shall be manufactured of die-cast aluminum alloy and be capable of being powder-coated or plated. Coated finish is to be textured, two-stage epoxy paint in gray, black, or ivory (to be selected by A/E). A gasket shall be attached to the underside of the trim flange to maintain scrub water tightness. Trim flange shall also be available in a solid brass forging and a die cast brushed aluminum finish. Brass and aluminum finish shall be a brushed finish with a lacquer sealant. Final finish to be selected by the A/E). The activation cover shall be 7" in diameter. The activation slide cover shall be 5" in diameter. The activation shall also be supplied with a 20 amp duplex receptacle prewired with three #12 AWG THHN conductors for power applications. The power receptacle shall be capable of being wired as a standard receptacle or for isolated ground.
7. The poke-thru activation cover shall be manufactured from textured Polycarbonate or PVC, final color to be selected by the architect. The slide holder assembly shall be flush with the floor and provide "Dead-front" protection that allows the receptacle covers to snap back into place when receptacle is not in use. A gasket is attached to the underside of the cover assembly to maintain scrub water tightness by preventing water, dirt, and debris from entering the power and communication compartments. The device shall also have accommodations for up to two communication connectors. The cover shall have individual slides that allow access to the communication connectors and will close over the connectors when not in use. Each activation cover shall also provide locations to adhere labels to identify both power and communication circuits.
8. The activation shall have two locations to mount communication connectors. Connectors shall be mounted using a mounting bracket. Mounting brackets shall be provided to mount up to two Ortronics TracJack Category 6 insert modules or Pass & Seymour Category 6 discrete keystone connectors. Type of communication activation to be verified with the A/E prior to product submittal). Communication connectors shall be installed flush. The unit shall also be supplied with two dual Category 5e keystone connectors and two Lucent keystone connectors with the Pass & Seymour

version. The unit shall also accommodate a mechanism to permit protection of communication cabling. This mechanism shall be zinc die-cast with two openings to accept both flexible and rigid conduit. Openings shall accept 1/2" trade size conduit.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install receptacles and switches only in electrical boxes which are clean and free from excess building materials, debris, etc.
- B. Install wall switches with OFF position down.
- C. Where switches and other devices are mounted at one location, provide single coverplate to cover all devices. Where switches are located with dimmers, switches shall match dimmers.
- D. Align the tops of all group mounted devices. Install plumb and aligned in the plane of the wall.
- E. Derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- F. Install convenience receptacles in vertical position with grounding pole on bottom unless otherwise noted.
- G. Provide ground fault circuit interrupting type devices in all locations requiring weatherproof devices.
- H. Do not use feed through feature for ground fault interrupting devices. Install GFI device at each location. GFI circuit breaker will not be acceptable.
- I. Install plates on all devices and blank outlets in finished areas. Use jumbo size plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlets in unfinished areas.
- K. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings.
- L. Mounting Heights:
  - 1. Refer to drawing sheet or contact A/E.
  - 2. Convenience Receptacles Above Counter or Backsplash: 6 inches above counter or backsplash in horizontal position.
  - 3. Receptacles for Water Coolers: Mount directly behind water cooler to eliminate visibility of cord and attachment plug. Coordinate elevation with the cooler to be installed prior to installation of box.
  - 4. Install devices in mill work as shown in details and elevations or as directed by A/E.
- M. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.



N. Network Occupant Sensors:

1. Coordinate the sensors and the control units for compatibility. Provide auxiliary relays as necessary.
2. Verify the sensor coverage of the approved manufacturer and provide the necessary sensors, control units and auxiliary relays required to adequately cover and control the indicated area. Where corridors are covered, install ceiling mounted back-to-back sensors.

3.02 FIELD QUALITY CONTROL

A. Electrical testing:

1. Test proper polarity of all receptacles.
2. Test ground continuity of all wiring devices.
3. Test ground fault interrupting device operation.

B. Visual and mechanical inspection:

1. Check proper operation of all switches.
2. Visually inspect and replace damaged or defective devices.

3.03 CLEANING

- A. Clean interior of all boxes from dirt and paint prior to installation of devices.
- B. Clean wiring devices and coverplates from dirt and paint over spray.

END OF SECTION 16140



## SECTION 16150

### WIRE CONNECTIONS AND DEVICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Splicing and terminating devices.

##### 1.3 RELATED SECTIONS

- A. Section 16120 - Wire and Cable.

##### 1.4 SUBMITTALS

- A. Furnish samples upon request of Architect/Engineer.
- B. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- C. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Burndy Corp.
- B. Dossert Manufacturing Corp.
- C. Ideal Industries, Inc.
- D. Ilsco Corp.
- E. Minnesota Mining and Manufacturing Co.
- F. Thomas & Betts Co., Inc.

##### 2.2 MATERIALS

- A. Joints, taps, and splices of wire #10 and smaller shall be made by means of "Ideal-Nut" connectors or "3M Scotchklok" spring connectors which are resistant to vibration.

- B. Cable and wire connections for splicing or terminating wires #8 and larger shall be made with compression deforming type connectors with heat or cold shrink jacket. Connectors for cable sizes 250 kcmil and larger shall be the long barrel type for double indentation. Soldered connections will not be permitted.
- C. Provide terminal connectors with hole sizes and spacing in accordance with NEMA standards. Provide terminal connectors with two holes in tongue for use on conductor sizes 250 kcmil and larger. Terminal connectors will not be required for connections to the circuit breakers in the lighting and/or receptacle panels.
- D. Provide connections made with non-insulated connectors insulated with three layers of plastic tape, each layer being half-lapped.
- E. Provide connectors/ lugs as required for oversized feeders.
- F. Taps and splices of wire within in-grade handholes grade shall be made by means of Burndy Type YC-C compression connectors. Each joint, tap and splice in conductor of #8 and larger shall have the connector voids filled with electrical insulation putty and be taped with rubber covered with plastic tape providing insulation not less than one and a half times the thickness of the original insulation with two half-lapped layers each, Scotch #33.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Connectors shall be large enough to enclose and securely fasten all strands of the conductor.
- B. Each joint, tap and splice in conductor of #8 and larger shall have the connector voids filled with electrical insulation putty and be taped with rubber covered with plastic tape providing insulation not less than two half-lapped layers each, "Scotch #33", "Scotch #88", "Slipnot Grey", or equal.
- C. Provide electrical connections to equipment furnished under other contracts and furnish wiring, conduit, outlet boxes, and safety switches, as required. Verify locations, horsepower, and voltages of equipment prior to installation of feeders. If apparent conflict arises in power wiring, advise A/E immediately for clarification.
- D. Provide switches as required by national or local codes.
- E. If the motor is integral to the equipment, isolate the entire piece of equipment with a short section of flexible metal conduit to prevent vibration and/or noise amplification to be transferred to the building structure.
- F. If the motor is adjustable, install an additional length of flexible metal conduit at the motor.
- G. Connect a ground wire from the conduit termination to the motor frame on the inside of flexible conduit. Use approved grounding lugs or clamps or the conduit connection.

- H. Major equipment furnished under mechanical and other sections of specifications may require different rough-in requirements than those indicated on Drawings. Secure detailed drawings from source furnishing equipment to determine actual rough-in locations, conduit and conductor requirements to assure proper installation.
- I. Before connecting any piece of equipment, verify the name plate data corresponds with information shown on Drawings. Discrepancies shall be called to attention of A/E.
- J. Change any feeders installed incorrectly as a result of not verifying equipment requirements, of equipment provided by others, prior to feeder installation.

END OF SECTION 16150



**SECTION 16210**  
**SERVICE ENTRANCE**

**PART 1 - GENERAL**

**1.1 RELATED REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

**1.2 SECTION INCLUDES**

- A. Electrical service entrance, including:
  - 1. Arrangement with power company for permanent electric service.
  - 2. Secondary service entrance from power company.
- B. Scope Of Work: It is the intent of this specification to secure electrical service to the facility and the removal of existing abandoned facilities. The general requirements of the electrical utility company are indicated on the drawings. Coordinate work with the Utility Company based on Construction Schedule.

**1.3 RELATED SECTIONS**

- A. Section 02581 – Underground Ducts and Manholes
- B. Section 16054 - Demolition
- C. Section 16060 - Grounding and Bonding Systems.
- D. Section 16132 - Conduit.
- E. Section 16441 - Switchboards.

**1.4 SYSTEM DESCRIPTION**

- A. System Voltage: 480/277 volts, three-phase, four-wire, 60 hertz.
- B. Service Entrance: Underground.

**1.5 SUBMITTALS**

- A. Submit product data.
- B. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around where equipment, pipe and ducts are prohibited. Show equipment layout and relationships between electrical components and adjacent structural and mechanical elements.
- C. Provide submittals of all junction boxes, concrete pads, grounding systems, secondary service entrance conduits, service entrance conductors, service entrance

switchboard, service entrance panelboards, terminations and meter sockets.

- D. Submit product data as required by Pacific Gas and Electric (PG&E) for review and approval.
- E. Submit documentation indicating products and materials have been approved by PG&E and meet PG&E standards.

#### 1.6 QUALITY ASSURANCE

- A. Install service entrance in accordance with power company's rules and regulations.
- B. Install secondary distribution raceway system, trenching and concrete structures and service entrance in accordance with utility company's rules and regulations.
- C. Verify all requirements indicated on the drawings and in the specifications with the utility company during pre-construction meetings.

### PART 2 - PRODUCTS

#### 2.1 UTILITY

- A. Utility Company: Pacific Gas & Electric (PG&E).

#### 2.2 EQUIPMENT

- A. Coordinate with the power company and provide conduits, grounding system and equipment pads in accordance with power company directives.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. The contractor shall contact, schedule meetings and make arrangements with the utility company (PG&E) to obtain permanent electric service to the project based on construction schedule requirements. The Contractor shall hold a pre-construction meeting with the utility company to establish the schedule requirements of the project. The Contractor shall agree with the utility company the frequency and notice period required for utility company inspections of installations provided by the Contractor. The Contractor shall confirm trenching requirements, conduit routing, transformer pad, junction box locations, sizes and appurtenances with the utility company prior to providing submittals on products.
- B. Provide submittals of all junction boxes, concrete pads, grounding systems, secondary service entrance conduits, service entrance conductors, service entrance switchboard, service entrance load centers, bus terminations and meter socket for review and approval by Utility Company.
- C. The Utility Company (PG&E) will be responsible for providing primary service entrance conduits from utility company terminations. Final conduit connections into



existing live power manholes will be provided by PG&E.

- D. Provide continuous length of ¼” polypropylene pull rope in all spare conduits.
- E. Utility Company will provide primary cables and connect conductors to service transformer.
- F. The Utility Company will be responsible for providing pad-mounted service transformer.
- G. Provide grading and site preparation for Utility Company transformer pad.
- H. Provide concrete pad with conduit windows for Utility Company transformer. Pad may be cast in place or pre-cast subject to approval by the Utility Company.
- I. The Contractor shall be responsible for providing transformer grounding as indicated on the drawings. Provide two ground rods installed a minimum of 6'-0” apart. Rods shall be interconnected by a continuous #2 AWG bare copper stranded conductor.
- J. Provide secondary service entrance conduits from the Utility Company transformer secondary to the building service entrance equipment.
- K. Provide secondary conductors between utility transformer secondary vault and service entrance equipment. Identify conductors and seal.
- L. Provide all trenching and backfilling for primary and secondary raceways.
- M. Coordinate location and spacing of all utilities to be installed in joint utility trenches with owners of each utility service and obtain required inspections and approvals.
- N. Contact, schedule meetings and make arrangements with the power company to remove existing abandoned electric service to the project based on construction schedule requirements.

END OF SECTION 16210



## **SECTION 16231**

### **ENGINE GENERATOR**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Standby generator system.
- B. Scope Of Work: It is the intent of this specification to secure a standby generator system that has been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. The equipment supplied and installed shall meet the requirements of the local Air Pollution Control District, NFPA, the California Electric Code and all applicable local codes and regulations. All equipment shall be new, of current production by a national firm which manufactures the generator and controls, transfer switch, and assembles the standby generator sets as a matched unit so that there is one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

##### **1.03 RELATED SECTIONS**

- A. Section 16070 - Supporting Devices.
- B. Section 16071 – Seismic Controls For Electrical Installations
- C. Section 16075 - Electrical Identification.
- D. Section 16080 - Electrical Testing.
- E. Section 16120 - Wire and Cable.
- F. Section 16132 - Conduit

##### **1.04 SUBMITTAL**

- A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around where equipment, pipe and ducts are prohibited. Show generator layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support.
- B. Submittal shall include specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included

elsewhere in these specifications. Identical package shall be submitted to the Air Pollution Control District for approval.

- C. Submittal shall include details of minimum concrete base anchorage and seismic support structure requirements.
- D. Submittal shall include details of generator enclosure access stairs and support structure requirements.
- E. Provide submittal drawings and calculations signed and sealed by licensed Structural engineer to A/E for approval of anchorage and support.
- F. Indicate on submittal location or area served and equipment identification tag for each generator and automatic transfer switch.
- G. Wiring diagrams including a system diagram distinguishing between factory wiring and field wiring.

#### 1.05 TESTING

- A. To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer shall be responsible for design prototype tests as described herein: Components of the emergency system, such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and reliability preproduction models, which will not be sold, shall be used for these tests. Upon request, the following certified test records shall be made available:
  - 1. Maximum power (kw).
  - 2. Maximum starting (kva) at 30 percent instantaneous voltage dip.
  - 3. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40 and 16.40.
  - 4. Governor speed regulation under steady-state and transient conditions.
  - 5. Voltage regulation and generator transient response.
  - 6. Fuel consumption at no load, 1/4, 1/2, 3/4, and full load.
  - 7. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
  - 8. Three-phase line-to-line short circuit test.
  - 9. Alternator cooling air flow
  - 10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
  - 11. Endurance testing.

#### 1.06 WARRANTY

- A. In addition to the Guarantee of Work required under the General Conditions, the emergency generator system shall be warranted by the manufacturer for five years from the date of substantial completion.

#### 1.07 PROJECT CONDITIONS

- A. Generator shall be installed in an open area but below grade, exposed to weather as indicated on the drawings. The physical size of the generator shall account for the space restrictions of the location for delivery, installation and operation. Where necessary the

equipment shall be shipped in pieces for on-site assembly.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. The standby generator set shall be by Kohler, rated continuous standby (defined as continuous for the duration of any power outage) 277/480 volts, 3 phase, 4 wire, .8 powerfactor, 85 degrees Fahrenheit. Vibration isolators shall be provided between the engine-generator and welded steel base. Entire unit shall be housed in a weatherproof sound attenuating enclosure on a 4-inch high concrete base with access to the maintenance service doors.
  
- B. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
  - 1. Single-step load pickup.
  - 2. Transient and steady-state governing.
  - 3. Safety shutdown device testing.
  - 4. Voltage regulation.
  - 5. Rated Power.
  - 6. Maximum Power.
  - 7. Sequencing Elevator Release and Single Cab Operation.
  
- C. Upon request, arrangements to witness this test will be made or a certified test record will be sent prior to shipment.

### 2.02 ENGINE

- A. The engine shall deliver the required HP at a governed speed of 1,800 rpm. The engine shall be equipped with the following:
  - 1. Fuel filters and electric solenoid fuel shut-off valve.
  - 2. Positive engagement solenoid shift-starting motor.
  - 3. Automatic solid state battery charging alternator with solid-state voltage regulation.
  - 4. Electronic governor with electric actuator capable of regulating no load to full load frequency to a 5 percent maximum and capable of 0.66 percent steady state frequency regulation.
  - 5. Computerized air fuel ratio controller and catalytic converter when required to meet Air Pollution Control District requirement.
  - 6. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
  - 7. Dry-type replaceable air cleaner elements.
  
- B. The turbocharged engine shall be fueled with diesel, 4-cycle, and liquid cooled. The radiator blower fan, water pump, thermostat and radiator duct flange shall properly cool the engine with up to 0.5 inches water static pressure on the fan.

### 2.03 GENERATOR

- A. The alternator shall be 4-pole, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed stator for smooth voltage waveform. The insulation shall meet the NEMA standard for Class F and be vacuum impregnated with epoxy varnish to be fungus resistant. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage with in plus-or-minus 2 percent at any constant load from 0 to 100 percent of rating. The regulator must be protected from the environment by conformal coating.
- B. On application of any load up to the rated load, the instantaneous voltage dip shall not exceed 20 percent and shall recover to plus-or-minus 2 percent of rated voltage within one second.
- C. A resettable line current sensing circuit breaker with inverse time versus current response shall be furnished and shall not automatically reset preventing restoration of voltage if maintenance is being performed. This breaker shall protect the generator from damage due to its own high current capability and shall not trip within the 10 seconds specified above to allow selective tripping of down-stream fuses or circuit breakers under a fault condition.
  - 1. Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
  - 2. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  - 3. Trip Settings: Matched to generator thermal damage curve as closely as possible.
  - 4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
  - 5. Mounting: Adjacent to or integrated with control and monitoring panel.
- D. The generator, having a single maintenance free bearing, shall be directly connected to the flywheel housing with a semiflexible coupling between the rotor and the flywheel.

#### 2.04 GENERATOR CONTROLLER

- A. Set-mounted controller capable of facing right, left, or rear shall be vibration isolated on the generator enclosure. The microprocessor control board shall be conformal coated. Relays will only be acceptable in high current circuits.
- B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:
  - 1. Fused DC circuits.
  - 2. Complete two-wire start/stop control which shall operate on closure of a remote contact.
  - 3. Speed sensing and a second independent starter motor disengagement systems shall protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.
  - 4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then reengage the starter.
  - 5. Cranking cyler with ten-second ON and OFF cranking periods.
  - 6. Overcrank protection designed to open the cranking circuit after 60 seconds if the engine fails to start.
  - 7. Circuitry to shut down the engine when signal for high coolant temperature, low oil

- pressure, or overspeed are received.
8. Engine cool down timer factory set at five minutes to permit unloaded running of the standby set after transfer of the load to normal.
  9. Three-position (Automatic - OFF - TEST) selector switch. IN the test position, the engine shall start and run regardless of the position of the remote starting contacts. In the automatic position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the off position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault lamp shall also be accomplished by putting the switch to the off position.
  10. "Lockout" contact for generator lockout by emergency power off (EPO).
- C. A 16 light engine and generator instrument panel shall be installed on the unit with vibration isolators, the control panel shall have provisions to be rotated 90 degrees facing left, right or the back of the generator set and include the following:
1. Indicator lamps and alarm contacts:
    - a. "Not in auto" (flashing red)
    - b. Overcrank (red)
    - c. Emergency stop (red)
    - d. High engine temperature (red)
    - e. Overspeed (red)
    - f. Low oil pressure (red)
    - g. High battery voltage (red)
    - h. Low battery voltage (red)
    - i. System ready (green)
    - j. Anticipatory low oil pressure (yellow)
    - k. Battery carrier fault (green)
    - l. Low fuel (red)
    - m. Low water temperature (yellow)
    - n. Anticipatory high water temperature (yellow)
  2. Instrument:
    - a. Dual range voltmeter plus-or-minus 2 percent accuracy.
    - b. Dual range ammeter plus-or-minus 2 percent accuracy.
    - c. Lights to indicate high or low meter scale.
    - d. Direct reading pointer-type frequency meter plus-or-minus 5 percent accuracy, 45 to 65 Hz scale.
    - e. Panel illuminating lights.
    - f. Battery charging meter.
    - g. Oil pressure gauge.
    - h. Running time meter
    - i. Voltage adjust rheostat
    - j. Engine water temperature
    - k. D.C. voltmeter
  3. Controls:
    - a. Lamp test switch
    - b. Voltage adjusting rheostat +/- 5% range

- c. Panel lamp (2)
  - d. Voltmeter-ammeter phase selector switch
4. Alarm horn, with silence switch, to meet the requirements of NFPA 110. Note: Silencing this horn after one fault, i.e., low fuel, shall not prevent it from sounding again should a different condition occur.
- D. Complete control panel shall be "rodent proof" to prevent damage to components by small rodents.

## 2.05 FUEL STORAGE SYSTEM SUB-BASE TANK

- A. Provide a U.L. listed dual wall sub-base mounted fuel storage tank with a minimum capacity to support the generator at full load for minimum 32 hours. Tank design shall provide stub up area for electrical conduit from below.
- B. Tank features shall include:
- 1. 2" filler spout.
  - 2. Engine supply and return openings and drain tubes.
  - 3. Vent for both primary and secondary containment.
  - 4. Fuel level indicator gauge.
  - 5. Low fuel level alarm switch, set at 2 remaining hours.
  - 6. Secondary containment, totally enclosed with double wall tank construction.
  - 7. Provide leak detection alarm contact in secondary tank.
- C. Provide flexible fuel lines rated for duty at 300 degrees F and 100 PSI.

## 2.06 EXHAUST SYSTEM

- A. Exhaust Muffler: Provide a Critical Muffler, including flexible exhaust fitting, properly sized and installed according to the manufacturer's recommendation. Mounting shall be provided by the installer. The muffler shall be mounted so that its weight is not supported by the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer.
- B. Insulation: The muffler and all indoor exhaust piping shall be lagged by the installer to maintain a surface temperature not to exceed 150 degrees F (65.5 degrees C). The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.
- C. Extend exhaust piping beyond building structure.

## 2.07 COOLING SYSTEM

- A. A radiator shall be provided with all necessary piping for proper cooling of the engine running at 100 percent load @ 55 degrees C.

## 2.08 AUTOMATIC STARTING SYSTEM

- A. Starting Motor: A DC electric starting system with positive engagement drive shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.



- B. Automatic Controls: Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and one auxiliary contact for activating accessory items. Controls shall include a 30-second, single-cranking cycle limit with lockout.
- C. Jacket Water Heater: A unit-mounted thermal circulation-type water heater(s) incorporating a thermostatic switch shall be furnished to maintain engine jacket water to 90 degrees F (32.2 degrees C) in ambient temperature of 30 degrees F (minus 1.1 degrees C).

## 2.09 BATTERY

- A. A lead/acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537 and of sufficient capacity to provide for 1 1/2 minutes total cranking time without recharging. A battery rack and necessary cables and clamps shall be provided.

## 2.10 BATTERY CHARGER

- A. A solid state regulated battery charger shall be furnished to automatically recharge batteries. It shall include overload protection, silicon diode-full wave rectifiers, voltage surge suppressors, DC ammeter, and fused AC input. AC input voltage shall be 120V. Amperage output shall be no less than 10 amperes.

## 2.11 AUTOMATIC TRANSFER SWITCH

- A. Type: Automatic transfer switches, 3-phase, 60 Hz, and 3 poles with switched neutral, for voltage specified herein and for the current rating indicated on the drawings shall be provided. Each switch shall conform with the provisions of Underwriters' laboratory 1008 Standards for Automatic Transfer Switches.
- B. Accessories: The transfer switch shall be equipped with the following accessories:
  - 1. Time Delay - Nominal 0.5 to 7.5 seconds on signal to start.
  - 2. Time Delay - Nominal 0.5 to 7.5 seconds on transfer to emergency.
  - 3. Time Delay - Adjustable 2 to 25 minutes on re-transfer with 5 minutes unloaded running time.
  - 4. Voltage and frequency lockout relay.
  - 5. Differential protection, 3-phase, dropout at 70 percent and pickup at 90 percent voltage.
  - 6. Test switch.
  - 7. Engine starting contact.
  - 8. Two auxiliary contacts - close on emergency, close on normal.
  - 9. Three sets auxiliary contacts (3 N/O and 3 N/C).
  - 10. Generator Exerciser.

## 2.12 ACCESSORIES

- A. Overvoltage protection will shut down the unit after one second of 15 percent or more overvoltage.
- B. Two flexible fuel lines.
- C. "SNMP" Communications Module capable of communicating all status and alarms.

#### 2.13 WEATHER/SOUND PROTECTIVE ENCLOSURE

- A. Provide a steel 14 to 16 gauge weather and sound protective enclosure with removable or hinged side panels to allow inspection and maintenance. The enclosure shall be coated with ASA gray primer and two coats of high-gloss, weather-proof, and resistant vinylac in the bonding process. Color shall be to manufacturers standard colors.
- B. Doors shall have a common keyed latch. Provide 2 sets of keys.
- C. Enclosure shall be louvered as required to ensure proper air flow.
- D. Vertical up-flow outlet hood with 90 degree angle to redirect air.
- E. Acoustic insulation meeting UL94 HF1 flame resistance standards.
- F. Doors shall be located in the enclosure so that service points are directly accessible.
- G. Generators that are mounted where the service door opening is greater than 30" above surrounding finished grade shall have platforms installed with handrails and steps that facilitate maintenance and servicing of the generator. Materials of construction shall be hot dipped galvanized steel, stainless steel or aluminum. Service platforms shall be a minimum of 48" wide.
- H. Acoustic attenuation at full load of 83dBA at 1m, 73dBA at 7m and 67dBA at 15m.

#### 2.14 REMOTE ANNUNCIATOR

- A. Provide and install a recessed 16 light remote alarm/status panel as shown on the drawings. Panel shall include the following features:
  - 1. Alarm indicators for:
    - a. Pre-alarm high engine temperature
    - b. Pre-alarm low oil pressure
    - c. Low water temperature
    - d. Low fuel
    - e. Battery charger fault
    - f. Low battery voltage
    - g. Auxiliary fault
  - 2. Shutdown indicators for:
    - a. High engine temperature
    - b. Low oil pressure
    - c. Emergency stop

- d. Overspeed
  - e. Overcrank
3. Status indicator for:
- a. Line power
  - b. Generator power
  - c. System ready
  - d. Lamp test switch
4. Alarm horn, with "Silence/Normal" Switch.

## PART 3 - EXECUTION

### 3.01 GENERAL REQUIREMENT

- A. The equipment shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.
- B. Refer to section 16080 for additional testing requirements.
- C. Location and dimensions of generator set with fuel tank and acoustic enclosure shown on the plans are indicative and may vary from manufacturer's shop drawings. Contractor shall coordinate placement of generator enclosure with surrounding equipment and structures. Contractor shall submit a dimensioned layout drawing for the generator enclosure in relation to surrounding equipment and structures, in addition to submittal requirements indicated within the project specifications. Service stub-up locations are indicative and final locations and requirements shall be coordinated with the approved generator set submittal shop drawings.
- D. Coordinate size and location of conduit stub-up locations and wiring connections.
- E. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- F. Upon completion, provide delivery and cost of fuel to fill base tank.
- G. Coordinate size and location of vendor designed equipment access stairs and landing.

### 3.02 INSTALLATION

- A. Install in locations shown on Drawings, in accordance with manufacturer's written instructions and maintaining clearances in accordance with applicable codes.
- B. Tighten accessible connections and mechanical fasteners after placing equipment.
- C. Provide a minimum 4-inch steel reinforced concrete housekeeping pad with anchor bolts. Bolt equipment to pad plumb and square.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

- B. Measure insulation resistance of each feeder conductor phase-to-phase and phase-to-ground for one minute each.
- C. Check tightness of accessible joints using a calibrated torque wrench in accordance with manufacturer's recommended values.
- D. Provide on-site testing of the system under load prior to final acceptance. Perform infrared testing of installation during the test. Remake any connection showing abnormally high temperature variations.

#### 3.04 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to return to "as new" condition.
- C. Adjust trip and time delay settings to values shown on Drawings or as required.

#### 3.05 SITE TEST

- A. An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The A/E, regular operators, and the maintenance staff shall be notified of the time and date of the site test. Provide fuel and load bank for all site tests. All tests shall be recorded. The tests shall include:
  - 1. Fuel, lubricating oil, and antifreeze (liquid cooled models) shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.
  - 2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.
  - 3. Start-up under test mode to check for exhaust leaks, path of exhaust gases, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
  - 4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.
- B. Refer to Specification Section 16080: Electrical Testing.
- C. Test sound level at points north, south, east and west from engine. Test sound level at 20 linear feet from engine. Record data in accordance with section 16080.
- D. Provide all fuel for testing. Upon completion of testing fill generator fuel tank with a complete tank of fuel.

#### 3.06 PERMIT

- A. Provide a framed copy of Air Pollution Control District permit located near the generator.

### 3.07 AUXILIARY CIRCUITS

- A. Provide 120 V and 208V AC circuits to generator auxiliaries as required to operate the generator.
- B. Provide conduit and cable as required between remote annunciator and controller as shown on plans.

### 3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators and transfer switches.
- B. Coordinate this training with that for transfer switches.
- C. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
- D. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout.
- E. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
- F. Schedule training with Owner, with at least seven days' advance notice.
- G. Minimum Instruction Period: Eight hours.

END OF SECTION 16231



## SECTION 16276

### DRY TYPE TRANSFORMERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Dry-type two-winding and non-linear transformers.

##### 1.3 RELATED SECTIONS

- A. Section 16075 - Electrical Identification.

##### 1.4 REFERENCES

- A. IEEE C57.12.91 - Dry-Type Distribution and Power Transformers.
- B. NEMA ST 20 - Dry-Type Transformers for General Applications.
- C. UL 1561 - Dry-Type General Purpose and Power Transformers.

##### 1.5 SUBMITTALS

- A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, no load core loss, full load winding conductor loss, full load losses, efficiency at 25 percent, 50 percent, 75 percent and 100 percent rated loads, percent regulation with 80 percent and 100 percent power factor loads, sound level, tap configurations, insulation system type and rated temperature rise.
- B. Indicate K-factor where applicable.
- C. Submit proposed mounting and support details for wall mounted and ceiling hung transformers.
- D. Base data for electrical characteristics on actual laboratory tests of typical transformers.
- E. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
- F. Provide operation and maintenance manual.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Dry-Type Two-Winding Transformers:
  - 1. Cutler-Hammer.
  - 2. General Electric.
  - 3. Hevi-Duty.
  - 4. Sorgel.
  - 5. Square D.
- B. Dry-Type Non-Linear Transformers:
  - 1. General Electric.
  - 2. Hevi-Duty.
  - 3. Topaz/Square D.

### 2.2 DRY-TYPE TWO-WINDING TRANSFORMERS

- A. Factory-assembled, air cooled dry type transformers; ratings as scheduled; capable of operating at 100 percent load continuously at an ambient temperature of 40 degrees C.
- B. Insulation system and average winding temperature rise for rated kVA as follows:

kVA Rating	Insulation Class	Temperature Rise degrees C
1-15	185	115
16-500	220	150

### 2.3 DRY-TYPE NON-LINEAR TRANSFORMERS

- A. Factory assembled, air cooled, dry-type, shielded isolation transformers; ratings as scheduled; capable of operating at 100 percent load continuously at an ambient temperature of 40 degrees C.
- B. Insulation system and average winding temperatures rise for rated kVA as follows:
  - 1. kVA Rating: 15 to 300.
  - 2. Insulation Class: 220.
  - 3. Temperature Rise degrees C: 150.



- C. Provide electrostatic winding shield with separate insulated grounding connection.
- D. Provide neutral sized for 200 percent of secondary phase conductors.
- E. Manufactured and tested in accordance with IEEE C57.12.91, UL 1561, and NEMA ST 20 at K factor rating of 13.

2.4 GENERAL

- A. Enclosures: Unless indicated otherwise, provide general purpose, NEMA 1 for indoor locations; and weatherproof, NEMA 3R for outdoor locations.
- B. Provide NEMA TP-1 Energy Star labeled transformers.
- C. Maximum Case Temperature: 50 degrees C rise above ambient at its warmest point.
- D. Winding Taps, Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
- E. Winding Taps, Transformers 15 kVA and Larger: Two 2-1/2 percent below and two 2-1/2 percent above rated voltage, full capacity taps on primary winding.
- F. Sound Levels: Maximum noise level as follows:

kVA Rating	Noise Level Decibels
0 - 9	40
10 - 50	45
51 - 150	50
151 - 300	55

- G. Basic Impulse Level: 10 kV for transformers less than 300 kVA; 30 kV for transformers 300 kVA and larger.
- H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- I. Mounting: Provide transformers 112.5 kVA and below suitable for wall, floor or trapeze mounting; transformers larger than 112.5kVA suitable for floor mounting.
- J. Coil Conductors: Continuous copper windings with terminations welded or brazed to ends of the windings.
- K. Core: High grade, non-aging silicon steel with high magnetic permeability.
- L. Isolate core and coil from enclosure using vibration absorbing mounts.

- M. Nameplate: Include transformer connection data.
- N. Impedance: Transformer impedance shall conform to NEMA standards.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Set transformer plumb and level. Mount enclosure on vibration isolators to minimize noise transmission from the enclosure to supporting structure. Set floor mounted transformers at 10-degree angle to wall on a neoprene pad on housekeeping pads.
- B. Install transformer so that enclosure does not make contact with wall surface.
- C. Provide steel channel support structure for wall mounted equipment.
- D. Provide floor and wall mounted steel channel support structure for transformers that are stacked vertically.
- E. Use flexible conduit indoors in dry locations or liquidtight flexible conduit in damp/wet locations, two-foot minimum in length, for primary and secondary connections to transformer case. Make connections to side panels of enclosure, except for floor mounted transformers fed from directly below enclosure.
- F. Ground neutral connection to service ground per codes.
- G. Provide all transformers with lugs for both primary and secondary conductor sizes for conductors shown on Drawing. Connect lug to termination point with appropriate size bolt, nut flat and Belleville washers.
- H. Provide high-pressure compression lugs, for primary and secondary phase and neutral terminations for transformers 45 KVA and larger. Utilize only the tool and dies designed for uses in installing the lugs provided.

### 3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.
- C. Prior to energizing of transformer the contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's approved methods and materials.
- D. Upon completion of project prior to final acceptance the contractor shall thoroughly clean both the interior and exterior of transformer per manufacturers recommended materials and methods. Remove paint splatters and other spots, dirt, and debris.

- E. Touch-up paint any marks, blemishes, or other finish damage suffered during installation.

### 3.3 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments. Adjust primary taps so that secondary voltage is above and within 2 percent of rated voltage.

END OF SECTION 16276



## SECTION 16336

### TRANSIENT VOLTAGE SURGE SUPPRESSORS

#### PART 1 General

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Work included: Labor, materials and equipment necessary to complete the installation required for the item specified under this Division, including but not limited to:

- 1. Transient voltage surge suppressors (TVSS).

- B. Related work: Consult all other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

##### 1.3 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified.

- 1. American National Standards Institute, Inc. (ANSI)/Institute of Electrical and Electronics Engineers (IEEE):

- a. ANSI/IEEE C62.1; Standard for Surge Arresters for Alternating Current Power Circuits.

- b. ANSI/IEEE C62.11; Standard for MOV Surge Arrestors in Low-Voltage AC Power Circuits.

- c. ANSI/IEEE C62.41; IEEE Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.

- d. ANSI/IEEE C62.45; Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.

- 2. Underwriters Laboratory, Inc. (UL):

- a. UL 50; Cabinets and Boxes.

- b. UL 1283 EMI/RFI Facility Filters.

- c. UL 1449; Standard for Transient Voltage Surge Suppressor.

- 3. National Electrical Manufacturers Association (NEMA):

- a. NEMA LS1; Low Voltage Surge Protective Devices.

- b. NEMA PB1.1; Instructions for Safety Instruction Operation and

#### 1.4 SYSTEM DESCRIPTION

- A. All specification noted herein apply to both the panelboard and switchboard units unless otherwise noted.
- B. The TVSS shall be a parallel design transient voltage surge suppression system. The system shall utilize diversion modules to suppress and divert transient voltage and surge currents. The system shall be designed to provide protection for sensitive electronic devices against the effects of surges, transients and electrical line noise.
- C. Environmental requirements:
  - 1. Operating temperature: -40c to 60c.
  - 2. Relative humidity: 0 - 95%.
  - 3. Operating altitude: 0 - 12,000 feet.
  - 4. Audible noise: Less than 35 dB.
- D. Electrical requirements:
  - 1. The TVSS shall have unlimited nominal current handling when installed in a parallel configuration.
  - 2. The TVSS system voltage shall be as shown on the Drawings.
  - 3. Protection modes: For a WYE configured system; the device shall have directly connected suppression elements between line-to-neutral (L-N), line-to-ground (L-G), and neutral-to-ground (N-G). For a Delta configured system, the device shall have suppression elements between line-to-line (L-L) and line-to-ground (L-G).
  - 4. Each unit's mode of operation shall protect against surges and transients from line-to-ground and line-to-line or line-to-ground, line-to-neutral, and neutral-to-ground if a neutral wire is present.
  - 5. The TVSS shall be a hybrid device capable of suppressing the following amperage per mode:
    - a. Main switchboard 100,000 amps minimum.
    - b. 120/208-volt branch panelboards: 50,000 amps minimum.
- E. Operating parameters:
  - 1. The maximum response time shall not exceed 1 nanosecond.
  - 2. Electrical noise filter: Each unit shall include a high performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be no less than 55 dB at 100 kHz.
  - 3. The TVSS system shall operate over a frequency range of 47 hertz to 63 hertz.

4. The TVSS system shall limit total harmonic distortion produced to less than one percent.
5. The system's filtering mode shall provide sine wave tracking to within +/-20 percent.
6. The maximum surge voltage rating for devices must not exceed the following:

MODES	120/208V	277/480V	347/600V
a. WYE: L-N; L-G; N-G	400V	800V	1200V
b. Delta: L-L; L-G	800V	1500V	2000V

7. The let through voltage for Category C3 surges (20 kV, 10 kA) shall be less than:

MODES	120/208V	277/480V	347/600V
a. L-N	500V	900V	1300V

8. The let through voltage for Category B3 surges (6 kV, 500 amps) shall be less than:

MODES	120/208V	277/480V	347/600V
b. L-N	170V	300V	470V

9. All devices shall be tested to the specified surge voltage ratings to ensure the devices achieve the required life expectancy and reliability. Testing to full ratings also verifies internal construction quality of the suppressors.

## 1.5 SUBMITTALS

- A. Submit in accordance with the requirements of Section 16010: Basic Electrical Requirements, the following items:
  1. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
  2. Describe system operation, equipment, and dimensions and indicate features of each component.
  3. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
  4. Shop drawings: Include elevations, cabinet dimensions, complete component listing and layout within cabinet, amperage ratings and capacities, system characteristics, and wiring diagrams.
  5. Submit manufacturer's installation instructions.
  6. Complete bill of material listing all components.
  7. Warranty.

## 1.6 OPERATION AND MAINTENANCE MANUAL

- A. Supply operation and maintenance manuals in accordance with the requirements of Section 16010: Basic Electrical Requirements, to include the following.
  - 1. A detailed explanation of the operation of the system.
  - 2. Instruments for routine maintenance.
  - 3. Pictorial parts list and parts number.
  - 4. Telephone numbers for authorized parts and service distributors.

#### 1.7 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the units specified herein shall be new and unused, and of current manufacturer.
- B. Only products and applications listed in this Section may be used on the project unless otherwise submitted.

#### 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: TVSS components shall not be delivered to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.
- B. Storage: Store in a clean, dry, ventilated space free from temperature extremes. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation.
- C. Handling: Handle in accordance with the manufacturer's written instructions. Be careful to prevent internal component damage, breakage, denting and scoring. Damaged units shall not be installed. Replace damaged units and return equipment to manufacturer.

#### 1.9 WARRANTY

- A. Units and components offered under this Section shall be covered by a 5 year parts and labor warranty for malfunctions resulting from defects in materials and workmanship.

### PART 2 Products

#### 2.1 MANUFACTURERS

- A. Equal products by the following manufacturers will be considered providing that all features of the specified product are provided:
  - 1. Current Technology.
  - 2. EFI Electronics.
  - 3. Clipper Power System (Cutler-Hammer).
  - 4. Liebert.



5. General Electric.

6. Or equal.

B. Substitutions: Under provisions of Section 16010: Basic Electrical Requirements.

## 2.2 PROTECTION AND FILTERING ELEMENTS

A. The TVSS system shall consist of protection modules designed to suppress and divert transient voltage and surge currents. Each protection module shall be rated to suppress the per phase surge current, as noted above, for the application. Each protection module shall contain multiple individually fused metal oxide varistor(s) capable of withstanding over 1000 surges of current rated at 10,000 amperes and 20,000 volts per ANSI C62.41-1991, Category C with less than 10% degradation.

B. The protection for the switchboard units shall be of the plug-in type for ease in installation and/or replacement. No special tools should be required to replace the module. Modules in the panelboard units do not have to be the plug-in type.

C. The line-to-neutral mode shall contain filtering elements capable of providing noise attenuation as specified above.

## 2.3 ENCLOSURES

A. Switchboards : A NEMA 1 or 12 enclosure shall be designed for mounting totally within the switchboard enclosure. The switchboard manufacturer shall provide a separate section dedicated and compartmentalized from all power bus bars. The units shall be completely installed in the switchboard factory.

B. Panelboard units mounted internally:

1. Unit shall have minimal conflict with branch circuit wiring and conduit terminations. The unit shall be mounted in the bottom of the panelboard where the majority of branch circuits exit from the top of the panel. Conversely, units shall be mounted on the top of the panelboard where the majority of branch circuits exit from the bottom of the panel. Coordinate with the Construction Drawings.

2. Viewing of the unit's monitoring/status indicator lights shall be possible without opening the panelboard. This may be accomplished by providing remote cover mounted indicating lights or by a cutout in the outer door metal cover directly over the indicating lights. The cutout shall be as small as possible and not void any U.L. or NEC ratings or requirements. It is advisable that the unit be factory installed in the panelboard. Provide black engraved nameplate, with white letters, denoting the purpose and meaning of the indicating lights directly over the lights.

3. Access to the units mounted inside panelboards shall be via the same standard one piece, door-in-door trim, using the outer door.

## 2.4 OVERCURRENT PROTECTION

A. Switchboards : The units shall be provided with a minimum 60 ampere switching duty rated, non-fused safety disconnect switch or circuit breaker. The phase conductors from the power source shall be terminated at the disconnect switch or circuit breaker line terminals. The neutral (where available), and ground conductor shall be terminated at line terminals in the unit and all subsequent phase wiring internal to the

system shall be factory wired. The front cabinet door shall be mechanically interlocked requiring the power to the system be interrupted in order to gain access to current carrying parts.

- B. Panelboards: The units provided for branch panelboards shall be a direct bus connection. Each unit shall contain it's own internal overcurrent protection.
- C. All internal devices shall be fused in such a manner as to prevent violent failures or propelling of particles under any failure condition up to the full AIC rating listed for the associated switchboard or panelboard. Main power fuses do not meet this requirement.

## 2.5 MONITORING FEATURES

A. Switchboard : Provide the following features:

1. Each protection module shall contain a pulsing green light and solid red light for easy viewing. The normal operation of the protection module shall provide positive indication utilizing the pulsing green light. Failure of the protection module shall provide negative indication utilizing the solid red light. Indication of module failure shall be duplicated remotely on the outside front door of the switchboard enclosure providing a summary visual alarm utilizing the pulsing green and solid red lights.
2. An audible local alarm shall sound in the event a protection module has failed. Pushing an alarm silence button can silence the audible alarm.
3. TVSS counter capable of counting individual transient events as they occur. The counter consists of a six-digit readout calibrated to count all relevant surges. The counter shall be provided battery back up capable of storing the number of events in memory when input power is not available.
4. The status/surge counter, indicator panel and audible alarm shall be remote to the front of the switchboard.
5. Provide auxiliary form-C dry contacts for remote monitoring of status.

B. Panelboards: Provide the following features:

1. Each unit shall contain a pulsing green light and solid red light for easy viewing. The normal operation of the protection module shall provide positive indication utilizing the pulsing green light. Failure of the protection module shall provide negative indication utilizing the solid red light.
2. Auxiliary form-C dry contacts for remote monitoring of status.

## 2.6 SOURCE QUALITY CONTROL

- A. System shall be thoroughly factory-tested before shipment. Testing of each system shall include but shall not be limited to "HI-POT" tests at two times rated voltage plus 1000 volts per UL listing, ANSI C62.41, Category B surge test, UL ground leakage tests, and operational and calibration tests.
- B. Provide factory test report to verify the operational integrity of each unit's suppression system.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of TVSS installation to verify conformance with manufacturer and specification tolerances. Do not commence with installation until all conditions are made satisfactory.

### 3.2 INSTALLATION

- A. Install TVSS in accordance with manufacturer's written instructions, as shown on the drawings and as specified herein.
- B. Set cabinets plumb and symmetrical with building lines in conformance with PB1.2. Furnish and install all construction channel bolts, angles, etc., required to mount the equipment furnished under this Section.
- C. Conductors from the power source to the surge suppressor shall be #4 AWG copper in switchboards and #8 AWG copper in panelboards. Conductors shall be routed without sharp bends and straight and short as possible. The absolute maximum of 7'-0" long for units in switchboards and 1'-0" long for units in panelboards.
- D. Switchboards: Conductors originating from direct bus bar connections shall be individually wrapped with electric tape in half-lapped increments for added protection of the un-protected conductors. Tie-wrap the conductors away from the bus bars without any sharp bends. All holes that the conductors pass through shall be grommets.
- E. Cabinets shall be anchored and braced to withstand seismic forces as calculated per Section 16010: Basic Electrical Requirements.
- F. Provide TVSS protection for electrical equipment where indicated on the drawings. Refer to power one line diagram(s).

### 3.3 FIELD QUALITY CONTROL

- A. Prefunctional testing:
  - 1. Visual and mechanical inspection:
    - a. Inspect for physical damage, defects, alignment and fit.
    - b. Compare nameplate information and connections to contract documents.
    - c. Check tightness of all control and power connections.

END OF SECTION 16280



## **SECTION 16411**

### **DISCONNECT SWITCHES**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Disconnect switches, including:
  - 1. Fuses.
  - 2. Enclosures.

##### **1.03 RELATED SECTIONS**

- A. Section 16070 - Supporting Devices.
- B. Section 16075 - Electrical Identification.

##### **1.04 REFERENCES**

- A. California Electrical Code (NFPA 70 - National Electrical Code with California Amendments)
- B. UL 198E - Class R Fuses.

##### **1.05 SUBMITTALS**

- A. Furnish dimensions and ratings for voltage, ampacity, horsepower and short circuit.
- B. Indicate enclosure material finish and NEMA classification type.
- C. Furnish samples upon request of Architect/Engineer.
- D. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- E. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

#### **PART 2 - PRODUCTS**

##### **2.01 MANUFACTURERS**

- A. Disconnect Switches:

1. Cutler-Hammer.
2. General Electric.
3. Siemens.
4. Square D.

B. Fuses:

1. Bussman.
2. Gould-Shawmut.
3. Littelfuse.

## 2.02 ENCLOSURE DESIGN REQUIREMENTS

- A. Provide disconnect switches of the type suitable for the application and environment.
- B. Provide NEMA 1 (general purpose) enclosure for interior use unless noted otherwise.
- C. Provide NEMA 12 (industrial) enclosure for interior use in garage and where shown on Drawings or required by the interior environment.
- D. Provide NEMA 3R (water resistant) enclosure for exterior use unless noted otherwise.
- E. Provide NEMA 4 enclosure where indicated on the drawings.

## 2.03 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: Heavy duty; quick-make, quick-break, load interrupter enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class J.
- B. Nonfusible Switch Assemblies: Heavy duty; quick-make, quick-break, load interrupter enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. General-Use Snap Switch: Motors of one horsepower or less as allowed by code.
- D. Construct all current carrying parts of high conductivity copper with silver-plated switch contacts.
- E. Provide solid copper neutral bar where a neutral is present in the circuit.

## 2.04 FUSES

- A. Fuses 600 Amperes and Less: UL 198E, Class J; as indicated on drawings; time delay, dual element, current limiting, 600 volt.
- B. Fuses Over 600 Amperes: Class L, bolt-on type with time delay and capability to hold 500 percent rated fuse current for a minimum of four seconds and clear 20 times rated fuse current in .01-second or less. Provide fuses with 'O' ring seals between end bells and glass melamine barrel similar to Bussman time delay KRP-C.

- C. Interrupting Rating: 200,000 rms symmetrical amperes.
- D. Provide all fuses of the same manufacturer.
- E. Install fuses in motor circuits in accordance with motor manufacturer's recommendations.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Provide disconnect switches, where required by NEC, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on each switch and adjacent equipment.
- B. Provide fused disconnect switches when required to maintain equipment manufacturer's warranty. Coordinate with Division 15 for warranty requirements of equipment approved by submittal.
- C. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.
- D. Wall mount switches, where possible, or mount on Uni-Strut supports.
- E. Provide spare fuse cabinet in main electrical room complete with three spare fuses for each rating installed for fuse sizes over 600 amperes, and ten percent spare fuses (minimum of three) of each type and rating installed for 600 amperes or less.
- F. Provide fuse identification label showing type and size inside door of each switch.
- G. Mount with operating handle at 5'-6" above finished floor. Align the tops of all grouped starters/disconnects. Install plumb and aligned in the plane of the wall in which they are installed.
- H. Provide supports of galvanized angle or other suitable material where mounting on wall or other rigid surface is impractical. Do not support from conduit alone. Locate disconnects that are mounted on equipment served so that the disconnect will not inhibit the removal of any service panel or interfere with required access.
- I. Mount in accessible location to allow sufficient room for maintenance on itself and adjacent items.
- J. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- K. Check tightness of accessible bolted bus joints using a calibrated torque wrench in accordance with manufacturer's recommended values.
- L. Identify with arc flash data based on recommendations of Section 16053 Electrical System Coordination Study.

### 3.02 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.
- B. Provide on-site testing of the system under load prior to final acceptance. Perform infrared testing of installation during the test. Remake any connection showing abnormally high temperature variations.

### 3.03 TESTING

- A. Refer to Specification Section 16080: Electrical Testing.

### 3.04 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to return to "as new" condition.
- C. Provide fuses based on recommendations of Section 16053 Electrical System Coordination Study.

END OF SECTION 16411



## **SECTION 16423**

### **CONTACTORS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 RELATED SECTIONS**

- A. Section 16075 - Electrical Identification.
- B. Section 16080 - Electrical Testing.
- C. Section 16442 - Panelboards.
- D. Section 16510 - Lighting Fixtures - Building.

##### **1.3 SUBMITTALS**

- A. Furnish written verification that contactor type is compatible with all controlling devices.
- B. Indicate enclosure material finish and NEMA classification type.
- C. Provide operation and maintenance manual.
- D. Furnish samples upon request of Architect/Engineer.
- E. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- F. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

#### **PART 2 - PRODUCTS**

##### **2.1 MANUFACTURERS**

- A. Allen-Bradley.
- B. ASCO.
- C. General Electric.
- D. Square D.

## 2.2 ELECTRICALLY HELD CONTACTORS

- A. Electrically held for two-wire control.
- B. Encapsulate coils and rate for continuous duty.

## 2.3 GENERAL

- A. Coil Operating Voltage: 120 volts, 60 hertz.
- B. Contacts: Provide the number of contacts for the control functions indicated plus two additional contacts, field convertible to normally open or normally closed contacts.
- C. Provide solderless pressure wire terminals.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate controlling devices such as time clocks and photocells with contactor furnished for compatible system.
- C. Identify with nameplate. Label each circuit controlled.

END OF SECTION 16423

## **SECTION 16424**

### **INDIVIDUAL MOTOR STARTERS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Starters, contactors, and switches for motor control.
- B. Controller for each motor and piece of equipment where controller is not furnished as an integral part of the equipment and as indicated or specified to provide the Owner a complete and operating system.

##### **1.3 RELATED SECTIONS**

- A. Section 15130 - Pumps.
- B. Section 15832 - Axial Fans.
- C. Section 15834 - Centrifugal Fans.
- D. Section 15900 - Controls.
- E. Section 16070 - Supporting Devices.
- F. Section 16075 - Electrical Identification.
- G. Section 16080 - Electrical Testing.

##### **1.4 REFERENCES**

- A. IEEE Std. 519 - Harmonic Control in Electric Power Systems.
- B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC.

##### **1.5 DESIGN REQUIREMENTS**

- A. Provide starters of the type suitable for the application and environment.
- B. Provide NEMA 1 (general purpose) enclosure for interior use starters unless noted otherwise.
- C. Provide NEMA 12 (industrial) enclosure for interior and exterior use in production

areas and where shown on Drawings or required by the interior environment.

- D. Provide NEMA 3R (water resistant) enclosure for exterior use starters unless noted otherwise.

## 1.6 SUBMITTALS

- A. Include data on relays, pilot devices, switching and overcurrent protection. Include trip ratings, size and UL listing.
- B. Indicate enclosure material finish and NEMA classification type.
- C. Provide operation and maintenance manuals for variable frequency motor controllers and motor starters.
- D. Furnish samples upon request of Architect/Engineer.
- E. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- F. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Allen Bradley.
- B. Cutler-Hammer.
- C. General Electric.
- D. Square D.

### 2.2 MANUAL MOTOR STARTERS

- A. Fractional Horsepower Manual Starter: AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, pilot light, and toggle operator.
- B. Motor Starting Switch: AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, red pilot light, NO auxiliary contact, and toggle operator.

### 2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: AC general-purpose, Class A, magnetic controller for induction motors rated in horsepower as indicated.

- B. Provide accessible terminals for wiring directly from the front of the starter.
- C. Contacts: Provide silver, cadmium oxide alloy, double break, non-welding contacts which will not require filing, dressing or cleaning throughout the life of the control equipment.
- D. Provide starter types as scheduled:
  1. Full Voltage Starting: Non-reversing type.
  2. Two Speed Starting: Two speed, two winding, variable torque type. Include integral time delay transition between FAST and SLOW speeds. Must be compatible with motor installed.
- E. Coils: Pressure molded, 120 volts, 60 hertz. Provide integral control transformer.
- F. Overload Relay: Provide bimetal overload relays in all three phases for three-phase full voltage starters, in ungrounded phases for single-phase full voltage starters and in all six legs for two-speed full voltage starters. Provide overload relays of the hand reset, trip-free variety so that blocking the reset mechanism in the reset position will not prevent the motor controller from dropping out if the motor is overloaded. Capability to field convert overload relays from hand to automatic reset is unacceptable.
- G. Auxiliary Contacts: Provide each starter with the required auxiliary contacts for the control functions indicated and required, including the holding interlock and pilot light interlocks plus two additional contacts, field convertible to normally closed or normally open NEMA ICS 2 controls. Provide capability to add auxiliary contacts without removing existing wiring or removing the controller from its enclosure.
- H. Selector Switches: HAND/OFF/AUTO for single-speed motors; HAND/OFF/AUTO with FAST/SLOW selector switch for two-speed motors; in front cover.
- I. Indicating Lights: RUN; red for single-speed motors; FAST/SLOW; red/amber for two-speed motors (push to test type) in front cover. Operate pilot lights by separate interlock not placed across the holding coil.
- J. Control Power Transformers: Provide integral 120 volt secondary control transformer with both primary and secondary fuses for each controller.

## 2.4 COMBINATION MOTOR STARTER

- A. Combine magnetic motor starter with disconnect in common enclosure as scheduled with adjustable trip, magnetic-only molded case, motor circuit protector.
- B. Provide combination starters with an IER of at least 100,000A (RMS) when used with feeder protective device indicated.

## 2.5 VARIABLE FREQUENCY MOTOR CONTROLLERS

- A. Manufacturers:
  - 1. Allen-Bradley.
  - 2. Century.
  - 3. Emerson.
  - 4. General Electric.
  - 5. Reliance.
  - 6. Robicon.
  - 7. Square D.
  - 8. York.
- B. Provide variable frequency drive (VFD) motor controllers to vary the speed of standard AC induction motor used on fans and/or pumps. Controllers may be VVI or PWM Type if they comply with this specification. Provide isolation bypass contactors on all VFD motor controllers in order to operate the equipment while the VFD is inoperative or being maintained. Conform to IEEE Std. 519.
- C. Provide VFD controllers that are specially designed for varying the speed of both standard and high efficiency three-phase, squirrel cage induction motors and capable of momentary overloads of 110 percent.
- D. Provide VFD controllers with a continuous current rating of no less than the full load current indicated on the driven motor nameplate. Provide with continuous speed adjustment with corresponding constant volts/hertz excitation.
- E. Provide VFD controllers with an AC to DC converter, DC link filter and an inverter section.
  - 1. Provide inverter section with power transistors. SCRs or gate turn-off devices are unacceptable.
  - 2. Factory mount and wire all components on a dead-front, grounded, free-standing or wall mounted minimum NEMA-1 enclosure arranged for top and bottom conduit entry. Provide free-standing enclosure suitable for mounting on a steel platform or on a concrete housekeeping pad, except where VFD controllers are indicated on plan to be installed group mounted or motor control center, provide controller capable of being mounted in motor control centers.
  - 3. Provide front accessible connections and easily removable assemblies. Provide capability to interchange all printed circuit boards in regulator section with other units.
- F. Incorporate the following features on the VFD controller:
  - 1. Input Power: 480 volts plus 5 percent, minus 10 percent, 3-phase, 60 hertz.
  - 2. AC input fuses.
  - 3. Input line filters capable of protecting the electronics against transient voltage spikes or notches. Isolation transformers are unacceptable.
  - 4. Output motor contactor rated at the full amperage of the VFD. Interlock this contactor with the bypass magnetic starter to provide a mechanical disconnect from the motor when the VFD is off or at zero speed.

5. Make all control adjustments without the necessity of extender boards on special meters. Provide front access for all adjustable potentiometers.
  6. Electrically isolate logic and control circuits from the power circuits. Ground signal circuit common point.
  7. LEDs for signal tracing and status indication.
  8. Independently adjustable acceleration and deceleration potentiometers; 0.5 to 25 seconds.
  9. Power dip ride-through to allow continuous operation for up to a three cycle line loss.
  10. Local and remote automatic switch.
  11. Motor slip dependent speed regulation.
  12. Frequency stability of 0.5 percent for 24 hours with voltage regulation of plus 2 percent of rated output.
  13. Unidirectional coast to rest upon stop.
  14. Before restoration of power after momentary outage or transfer of power, provide ability to pick up and supply power to driven motor at any speed without damage or provide time delay for motor decay.
- G. Limit the harmonic distortion on the incoming 480V bus to 5 percent or less with a source impedance of 1 percent or less.
- H. Provide the VFD with instantaneous overcurrent trip. Maximum allowable current is 160 percent of nameplate current rating under this specification.
- I. Phase sensitive VFDs will not be acceptable.
- J. Provide electronic I<sup>2</sup>t motor protection. Bimetallic overloads are unacceptable.
- K. Provide the VFD with a full load, full speed efficiency of 95 percent or better.
- L. Provide the VFD with a full function current limit, adjustable from 10 percent to 110 percent which is independent of the instantaneous overcurrent trip, basically works as follows: In the event of a motor overload, current is unable to exceed the adjustable preset limit. When the current reaches that limit, it will hold that level for one minute. If the current is not reduced during the one-minute time interval, the motor speed is automatically reduced until the overcurrent condition is removed. The motor may then return to the required speed after the overcurrent condition is removed.
- M. Provide an integral fault diagnostic center indicating the following conditions:
1. External fault.
  2. Processor line fault.
  3. Low AC line voltage.
  4. High AC line voltage.
  5. Current overload.
  6. High DC bus voltage.
  7. VFD output fault.
- N. Provide VFD with convection cooling.
- O. Provide VFD with controlled regenerative override to apply a decelerating torque

to motor without tripping off the line when the speed command is reduced.

- P. Protection against:
1. Input line over/under voltage.
  2. AC line transient voltage.
  3. Phase loss.
  4. Output ground fault. Prevent the VFD from blowing fuses in this condition. Isolation transformers will not be used to prevent this condition.
  5. Output line-to-line short circuit.
  6. Motor overload.
  7. DC over voltage.
  8. Over frequency.
  9. Over temperature.
  10. Electrical isolation between power and logic circuits.
  11. DI/DT and DI/DV for semiconductors.
- Q. Provide VFD with 0.5 percent speed regulation.
- R. Mount following on door of VFD:
1. Hand-off automatic selector switch with indicator lights.
  2. Manual speed potentiometer.
  3. Speed meter 0 to 100 percent.
  4. Non-fused disconnect switch.
- S. Provide the VFD with a three-position HOA switch to accept a 4 to 20 ma signal for the automatic operation as described in Division 15 - Controls and required by the sequence of operation.
- T. Specifically select VFD to provide quiet operation with standard motor. Select controller so sound level in spaces adjacent to mechanical room do not exceed a N.C. of 35. After installation, if adjacent spaces do exceed N.C. of 35, replace controller at no additional cost.
- U. Provide portable service analyzer, one total for project, capable of being plugged into controller without modification. Portable service analyzer to have capability to run, stop and control unit, and indicate satisfactory operation or isolate the source of malfunction to the smallest replaceable unit.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Mount with operating handle at 5'-6" above finished floor. Align the tops of all grouped starters. Install plumb and aligned in the plane of the wall in which they



are installed.

- D. Provide supports of galvanized angle or other suitable material where mounting motor starters on wall or other rigid surface is impractical. Do not support starters from conduit alone. Locate motor starters that are mounted on equipment served so that the starter will not inhibit the removal of any service panel or interfere with required access.
- E. Mount in accessible location to allow sufficient room for maintenance on itself and adjacent items.
- F. Securely mount all starters indicated.
- G. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- H. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each.
- I. Check tightness of accessible bolted bus joints using a calibrated torque wrench in accordance with manufacturer's recommended values.
- J. Provide spare printed circuit board for each size variable speed drive.
- K. Coordinate with other trades as required for control and interconnections with motors provided under other Divisions.
- L. Identify with arc flash data based on recommendations of Section 16053 Electrical System Coordination Study.

### 3.2 TESTING

Refer to Specification Section 16080: Electrical Testing.

### 3.3 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to return to "as new" condition.
- C. Adjust circuit breaker trip settings based on recommendations of Section 16053 Electrical System Coordination Study.
- D. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.
- E. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

END OF SECTION 16424



## **SECTION 16441**

### **SWITCHBOARDS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Main and distribution switchboards.

##### **1.3 RELATED SECTIONS**

- A. Section 16053 - Electrical System Coordination Study
- B. Section 16070 - Supporting Devices.
- C. Section 16075 - Electrical Identification.
- D. Section 16080 - Electrical Testing.
- E. Section 16120 - Wire and Cable.
- F. Section 16132 - Conduit.
- G. Section 16336 - Transient Voltage Surge Suppressors

##### **1.4 REFERENCES**

- A. NEMA PB 2 - Dead Front Distribution Switchboards.
- B. NEMA PB 2.1 - General Instruction for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- C. UL 891 - Dead-Front Switchboards.

##### **1.5 SUBMITTALS**

- A. Utility company metering and termination provisions with indication of approval by utility company.
- B. Indicate detailed dimensions for the front and side views.
- C. Indicate conduit entrance locations and requirements.
- D. Indicate enclosure material finish and NEMA classification type.
- E. Indicate nameplate legends.

- F. Indicate size and number of bus bars and ground; switchboard instrument details.
- G. Furnish instructions for handling and installation of switchboard.
- H. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- I. Provide operation and maintenance manual.
- J. Provide one-line diagram.
- K. Indicate cable terminal sizes.
- L. Provide copy of approved submittals to Utility Company.
- M. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- N. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
- O. Do not submit equipment shop drawings until short circuit and protective device coordination study has been approved.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site with shipping splits and subassemblies sized for passing through openings.
- B. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

#### 1.7 SPARE PARTS

- A. Keys: Furnish two each to the Owner for each lock.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Cutler-Hammer.
- B. General Electric.
- C. Siemens.
- D. Square D.

E. I.E.M.

## 2.2 SWITCHBOARD CONSTRUCTION AND RATINGS

- A. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB 2, and UL 891, and complete from incoming line terminals to load-side terminations.
- B. Provide Utility pull section compartment as indicated. Underground pull section, terminations and metering compartment to meet requirements of the utility company.
- C. Enclosure for Utility metering section and main distribution. UL listed and labeled for service entrance application.
- D. Provide Utility Metering Compartment where indicated: Fabricated compartment and section meeting utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- E. Switchboard electrical ratings and configurations as shown on Drawings. Integrated equipment rating as shown, but not less than 65,000 amperes RMS (sym).
- F. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and number of conductors used.
- G. Main Section Devices: Individually mounted.
- H. Distribution Section Devices: Panel mounted.
- I. Bus Material: Copper with tin plating, sized in accordance with NEMA PB 2.
- J. Bus Connections: Bolted, accessible from front for maintenance. Provide Belleville washers for and properly torque all connections.
- K. Provide with main lugs and breakers or fuses as scheduled on the drawings. Provide main lug connection to accommodate two-hole long barrel T & B compression connector on end of cable. Attach connector to panel bus with two bolts per lug. Provide captive type bolts or studs to facilitate reinstallation of the lugs with the wire attached.
- L. Provide fully rated copper neutral bus.
- M. Provide front panel mounted TVSS equipment integral to switchboard enclosure.
- N. Provide properly sized copper ground bus through the length of the switchboard.
- O. Enclosure: NEMA PB 2 Type 1 for interior use and Type 3R for exterior use. Align sections at front and rear.
- P. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

- Q. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating as indicated on Drawings. Extend and drill main bus for future addition by means of splice plate.

## 2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers (1,600 amps or smaller):
1. Provide bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles.
  2. Provide circuit breakers UL listed as Type SWD for lighting circuits.
  3. Provide UL Class A ground fault interrupter circuit breakers where scheduled.
- B. Circuit breakers with trip ratings 401 amps through 1200 amps shall have electronic trips with the following characteristics:
1. Electronic true RMS sensing trip, adjustable via current plug.
  2. Adjustable long time setting and delay.
  3. Adjustable short time pick-up and delay.
  4. Adjustable instantaneous pick-up.
  5. Mechanical targets on overload, ground fault, and short circuit.
- C. Circuit breakers with trip ratings 101 amps through 400 amps shall have solid state electronic trips with true RMS reading through the 13th harmonic with 1% accuracy, interchangeable trip via front accessible current plug, adjustable instantaneous and short time be rated as shown on drawings at the voltage indicated.
- D. Circuit breakers with trip ratings 100 amp and smaller shall be ambient temperature compensated, thermal magnetic type unless otherwise noted. Breakers shall be of full size, 1 inch per pole type. Panels with more than one branch breaker larger than 100 amps shall be installed in distribution type panels.
- E. Provide ground fault protection on each main device, rated 480/277 volts, 1,000 amps or larger, and as indicated on the drawings, as follows:
1. UL listed ground sensor relay system, General Electric GSR, with ground break components for each system with coordinated ground sensor (CR) with integral test winding, solid state relay to operate with shunt trip circuit on the switch and monitor panel.
  2. Use time delay type relay with the following features:
    - a. Continuously adjustable current pick-up settings of 100 to 1,200 amperes.
    - b. Continuously adjustable time delay setting from instantaneous (0.03 second) to one second.
    - c. Memory function to recognize and initiate tripping on intermittent ground faults.
  3. Install panel which indicates relay operation and provides means for testing the system with or without interruption of electrical service and does not permit the ground fault system to be inadvertently left in an inactive or 'off' state.
  4. Use ground sensor for zero sequence arrangement on the main service entrance devices.

## 2.4 INSTRUMENTATION

- A. Provide solid state circuit monitor with digital output display rated for 120 volts, 60 hertz. Cutler Hammer IQ 320.
- B. Provide six-digit LED readout which will allow local display of the following electrical parameters:
  - 1. Voltmeter, phase to phase and phase to neutral.
  - 2. Current, per phase RMS and 3 phase average.
  - 3. Demand current, per phase.
  - 4. Power factor, per phase and 3 phase total.
  - 5. Real power, 3 phase total.
  - 6. Reactive power, 3 phase total.
  - 7. Apparent power, 3 phase total.
  - 8. Energy (MWH).
  - 9. Reactive energy (MVARH).
  - 10. Frequency.
  - 11. Average demand real power.
- C. Provide the circuit monitor with the following characteristics:
  - 1. Built-in communications capability which will allow multipoint communication at a 9,600 minimum baud rate to a remote computer workstation, programmable controller or other host device.
  - 2. Adjustable demand interval (5 to 60 minutes).
  - 3. Nonvolatile memory for storing all historical data.
- D. Set-up of the monitor shall be accomplished from the front of the device. It shall not be necessary to open the front of the enclosure to reach rear mounted dip-switches. Include set-up parameters for CT ratio, PT ratio, System type 3 or 4 wire, and demand interval.
- E. Provide keyswitch protection for all set-up and reset functions to prevent unauthorized/accidental change of value.
- F. Provide the following monitor accuracy in percent of full scale for:
  - 1. Current Voltage Measurements: Plus or minus 1 percent.
  - 2. Power and Energy: Plus or minus 2 percent.
  - 3. Frequency: Plus or minus 0.5 percent.
  - 4. Power Factor: Plus or minus 4 percent.
  - 5. Data Update Time: 0.817 S (4 wire).
- G. Provide three potential transformers (PT) rated 480/120 volt with metering class accuracy.
- H. Provide three current transformers (CT) having a primary to match the size of the bus and a 5 ampere secondary with metering class accuracy.

## 2.5 TVSS

- A. Provide front panel mounted TVSS equipment integral to switchboard enclosure where indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Provide a 6-inch steel reinforced concrete housekeeping pad with anchor bolts for exterior equipment. Provide a 4-inch steel reinforced concrete housekeeping pad with anchor bolts for interior equipment.. Bolt equipment to pad plumb and square.
- D. Provide filler plates for unused spaces.
- E. Provide typewritten circuit directory mounted in permanent, clear Lexan card holder located on inside of door or front of switchboard.
- F. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors. Where manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.
- G. Install overcurrent protective devices and accessories in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable NEC and NEMA standards for installation.
- H. Identify with arc flash data based on recommendations of Section 16053 Electrical System Coordination Study.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each.
- C. Check tightness of accessible bolted bus joints using a calibrated torque wrench in accordance with manufacturer's recommended values.

### 3.3 TESTING

Refer to Specification Section 16080: Electrical Testing.

### 3.4 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.



- B. Touch-up scratched or marred surfaces to return to "as new" condition.
- C. Adjust circuit breaker trip settings based on recommendations of Section 16053 Electrical System Coordination Study.
- D. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.
- E. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

END OF SECTION 16441



## **SECTION 16442**

### **PANELBOARDS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.2 SECTION INCLUDES**

- A. Distribution, lighting, and appliance branch circuit panelboards.

##### **1.3 RELATED SECTIONS**

- A. Section 16053 - Electrical System Coordination Study
- B. Section 16070 - Supporting Devices.
- C. Section 16075 - Electrical Identification.
- D. Section 16423 - Contactors.

##### **1.4 REFERENCES**

- A. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

##### **1.5 SUBMITTALS**

- A. Include outline and support point dimensions, NEMA enclosure type, voltage, main bus ampacity and material, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- B. Furnish samples upon request of Architect/Engineer.
- C. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- D. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.
- E. Do not submit equipment shop drawings until short circuit and protective device coordination study has been approved.

##### **1.6 SPARE PARTS**

- A. Keys: Furnish two keys to Owner for each panelboard, all keyed alike.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Cutler-Hammer.
- B. General Electric.
- C. Siemens.
- D. Square D.
- E. I.E.M.

### 2.2 GENERAL

- A. Provide equipment from the same manufacturer throughout the project.
- B. Protective devices and equipment shall be fully rated, not series rated.
- C. Conform to UL standards and bear UL label. Form cabinets from code gage galvanized steel. Form fronts of code gage cold rolled steel bonderized after fabrication.
- D. Provide cabinet fronts with concealed hinges, concealed adjustment means and master keyed flush lock. Finish front in manufacturer's standard gray enamel. Door-within-door style panel.
- E. Provide with main lugs and breakers or fuses as scheduled on the drawings. Provide main lug connection to accommodate two-hole long barrel T & B compression connector on end of cable. Attach connector to panel bus with two bolts per lug. Provide captive type bolts or studs to facilitate reinstallation of the lugs with the wire attached.
- F. Provide all panelboards with copper bus of the ratings scheduled and designed for all indicated devices and spaces, complete with taps and trim.
- G. Provide panelboards, designated with "NL" on Drawings, UL listed for nonlinear loads, bearing UL label, and neutral bar rated at 200 percent of phase buses.
- H. Minimum short circuit rating 22,000 amps RMS symmetrical for 240 volt panelboards.
- I. Size bus bars to limit the temperature rise within the panelboard to 50 degrees C over a 40 degrees C ambient temperature.
- J. Provide adequate space and provisions for wire No. 6 AWG and larger conductors to terminate with compression type connector to main lugs.

- K. Connect all two-section panelboards with copper cable of an ampacity greater than the main bus ampacity.
- L. Circuit breakers serving Fire Alarm Control Panel(s) shall be red in color.
- M. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating as indicated on Drawings.
- N. Provide panelboard enclosures of the type suitable for the application and environment.
- O. Provide NEMA 1 (general purpose) enclosure for interior use unless noted otherwise.
- P. Provide NEMA 3R (water resistant) enclosure for exterior use unless noted otherwise.

### 2.3 DISTRIBUTION PANELBOARDS (1,200 AMPS AND SMALLER)

- A. Enclosure: Type 1, unless scheduled otherwise.
- B. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.
- C. Provide plated copper grounding bus.
- D. Provide full height bussing to accommodate addition of future circuit breakers.

### 2.4 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B. Enclosure: Type 1; unless indicated otherwise.
- C. Provide insulated neutral bus and separate copper grounding bus bonded to enclosure.
- D. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.
- E. Provide ground fault equipment protection circuit breakers for all circuits serving heat trace equipment.
- F. Sequence phase all adjacent breakers. All circuit breaker connection straps shall be rated at 100 amperes minimum.
- G. Provide full height bussing to accommodate addition of future circuit breakers.

## 2.5 MOLDED CASE CIRCUIT BREAKERS

- A. Individually mounted and panelboard mounted, branch and feeder circuit breakers shall be molded case, bolt on and trip indicating.
- B. Where stationary molded case circuit breakers are shown on the drawings to be current limiting type, they shall be current limiting as defined by UL 489 and shall not employ any fusible elements.
- C. Circuit breakers shall have interrupting capacity not less than that shown on the drawings, or if not shown, not less than 25,000 RMS symmetrical amps for 480 volt systems and 22,000 RMS symmetrical amps for 208 volt systems.
- D. Covers shall be sealed on non-interchangeable breakers, and trip unit covers shall be sealed on interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation, or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.
- E. Circuit breakers shall be toggle, quick-make and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.
- F. Multipole breakers shall have a single handle to open and close all contacts simultaneously in both manual operation and under automatic tripping. Interpole barriers shall be provided inside the breaker to prevent any phase-to-phase flashover. Each pole of the breaker shall have means for Arc extinguishing.
- G. All terminals shall be rated at 75 degrees C for aluminum or copper wire.
- H. Circuit breakers with trip ratings 100 amp and smaller shall be ambient temperature compensated, thermal magnetic type unless otherwise noted. Breakers shall be of full size, 1 inch per pole type. Panels with more than one branch breaker larger than 100 amps shall be installed in distribution type panels.
- I. Circuit breakers with trip ratings 101 amps through 400 amps shall have solid state electronic trips with true RMS reading through the 13th harmonic with 1% accuracy, interchangeable trip via front accessible current plug, adjustable instantaneous and short time be rated as shown on drawings at the voltage indicated.
- J. Circuit breakers with trip ratings 401 amps through 1200 amps shall have electronic trips with the following characteristics:
  - 1. Electronic true RMS sensing trip, adjustable via current plug.
  - 2. Adjustable long time setting and delay.
  - 3. Adjustable short time pick-up and delay.
  - 4. Adjustable instantaneous pick-up.
  - 5. Mechanical targets on overload, ground fault, and short circuit.
- K. Accessories: Provide accessories as noted on the drawings, i.e. shunt-trip, auxiliary contacts, undervoltage trip, alarm switch, etc.
- L. Spaces in the boards shall be able to accept any combination of 1, 2 or 3 pole circuit

breakers as indicated. Provide all necessary bus, device supports and mounting hardware sized for frame, not trip rating.

- M. Series rated breakers are not acceptable unless specifically noted on the Drawings.
- N. Refer to the Drawings for breakers requiring ground fault protection. .

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1. Mount securely to walls or structural spaces. Mount floor mounted panelboards on 4-inch housekeeping pads.
- B. Height: Install wall mounted panelboards at 6 feet to the top of the enclosure.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typewritten circuit directory for each branch circuit panelboard mounted in permanent, clear Lexan card holder located on inside of door. Prepare directories only after permanent room numbers have been assigned. Do not use room numbers shown on construction drawings.
- E. Arrange branch circuit connections in 3 phase lighting and appliance panelboards such that when 2 or 3 circuits are run with a common neutral, each circuit is connected to a different phase.
- F. Distribute loading on circuits in panelboards to balance the load as evenly as possible in each phase.
- G. Terminate only one conductor under each lug of branch circuit breakers.
- H. Do not make splices or taps in panelboard gutters.
- I. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors. Where manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.
- J. Install overcurrent protective devices and accessories in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable NEC and NEMA standards for installation.
- K. Identify with arc flash data based on recommendations of Section 16053 Electrical System Coordination Study.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

### 3.3 TESTING

- A. Refer to Specification Section 16080: Electrical Testing.

### 3.4 ADJUSTING

- A. Adjust circuit breaker trip settings based on recommendations of Section 16053 Electrical System Coordination Study.
- B. Adjust circuit breaker trip settings for coordination with other overcurrent protective devices in system.
- C. Adjust circuit breaker trip settings for adequate protection from overcurrent and fault currents.

END OF SECTION 16442



## SECTION 16491

### FUSES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Fuses and spare fuse cabinet.

##### 1.3 REFERENCES

- A. NEMA FU 1 - Low Voltage Cartridge Fuses.

##### 1.4 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for components such as wire, cable, bus structures, and other equipment. Design system to ensure that component damage is within acceptable levels during a fault.
- B. Select fuses to coordinate with time-current characteristics of other overcurrent protective elements, such as other fuses, circuit breakers, and protective relays. Design system to ensure that device closest to fault operates.

##### 1.5 FUSE PERFORMANCE REQUIREMENTS

- A. Motor Load Feeder Switches: Class RK1 (time delay)
- B. Other Feeder Switches: Class RK1 [(time delay)].
- C. General Purpose Branch Circuits: Class RK1 (time delay).
- D. Motor Branch Circuits: Class RK1 (time delay).

##### 1.6 SUBMITTALS

- A. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

##### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

## 1.8 MAINTENANCE MATERIALS

- A. Provide two fuse pullers.

## 1.9 EXTRA MATERIALS

- A. Supply three spare fuses of each Class, size, and rating installed.

## PART 2 - PRODUCTS

### 2.1 FUSES

- A. Manufacturers: Bussman, Gould Shawmut, or approved equal.
- B. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

### 2.2 CLASS RK1 (TIME DELAY) FUSES

- A. Manufacturers: Bussman, Gould Shawmut, or approved equal.
- B. Dimensions and Performance: NEMA FU 1.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

### 2.3 CLASS RK1 (NON-TIME-DELAY) FUSES

- A. Manufacturers: Bussman, Gould Shawmut, or approved equal.
- B. Dimensions and Performance: NEMA FU 1.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.

### 2.4 SPARE FUSE CABINET

Manufacturers: Thomas & Betts, or Federal Pacific, or equal

- A. Product Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Gray enamel.

## PART 3 - EXECUTION

### 3.1 EXISTING WORK

- A. Remove fuses from abandoned circuits.

- B. Ensure access to existing fuses and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.

### 3.2 INSTALLATION

- A. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- B. Install spare fuse cabinet where indicated.

END OF SECTION 16491



## SECTION 16510

### LIGHTING FIXTURES - BUILDING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Light fixtures associated with building, including:
  - 1. Interior luminaires and accessories.
  - 2. Lamps.
  - 3. Ballasts.

##### 1.3 RELATED SECTIONS

- A. Section 16050 - Electrical General Provisions.
- B. Section 16070 – Supporting Devices
- C. Section 16120 - Wire and Cable.
- D. Section 16132 - Conduit.
- E. Section 16423 - Contactors.
- F. Section 16900 - Lighting Control Systems

##### 1.4 SUBMITTALS

- A. Product Data: Include product data for fixtures, including photometric data, reflectance, lens, lamps, ballasts, poles and lighting control.
- B. Samples: Furnish samples upon request.
- C. Operation and Maintenance Manual: Provide operation and maintenance manual.
- D. Furnish samples upon request of Architect/Engineer.
- E. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- F. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

## 1.5 REFERENCES

- A. California Energy Code, Title 24, Part 6.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Lighting Fixtures:
  - 1. Manufacturers of individual lighting fixtures shall be as scheduled on Drawings, and indicate quality and design features required.
  - 2. Products of other manufacturers will be considered upon submittal of proper data.
- B. Lamps:
  - 1. General Electric.
  - 2. Philips.
  - 3. Sylvania.
  - 4. Venture.
- C. Ballasts:
  - 1. Advance.
  - 2. Universal.
  - 3. Valmont.

### 2.2 GENERAL

- A. Provide lighting fixtures of the size, type and rating indicated, complete with lamps, lampholders, reflectors, ballasts, starters, wiring and accessories.
- B. Where fixtures are recessed mounted in ceiling system, provide trim and accessories required for installation in the ceiling system installed.
- C. It is the intent of the Drawings and Specifications to indicate the type of fixture for each intended use. It is generally intended that rooms of similar usage and configuration will have similar fixture types. Where fixture type is not indicated, it is the duty of the Contractor to request clarification prior to proceeding with the work.

### 2.3 INTERIOR LUMINAIRES AND ACCESSORIES

- A. Fluorescent Luminaires:
  - 1. Provide fixtures of code gage steel, painted after fabrication. Fixtures using pre-painted steel will not be acceptable.
  - 2. Provide lensed fixtures with 0.125 inch minimum thick, 9 ounces per square foot, virgin acrylic, KSH-12 lens unless otherwise indicated. Brightness not to exceed 600 foot lamberts at 75 degrees and 85 degrees.
  - 3. Provide corrosion resistant fixtures as scheduled.
  - 4. Provide end caps, corner, tee and sections with trim for suspended fixture arrangement.
  - 5. Provide fixtures in architectural furring to fit space. Leave no more than 4 inches blank space at each end.

6. Ballasts must be certified and listed in the California Energy Commission Directory.
- B. High Bay, HID Fixtures:
1. Where enclosed and gasketed type fixtures are specified, provide luminaires designed for continuous operation in ambient temperature of 55 degrees C.
  2. Provide cast aluminum ballast housing with baked electrocoat paint finish.
  3. Provide single ballast in single ballast housing for both single and twin fixture assembly.
  4. Provide positive aligning disconnect to allow optical assembly to be disconnected from ballast housing without exposing live metal parts.
  5. Provide optical assembly with separate safety chain.
- C. Low Bay, HID Fixtures:
1. Where enclosed and gasketed type fixtures are specified, provide designed for continuous operation in 55 degree C ambient temperature.
  2. Provide cast aluminum ballast housing with baked electrocoat paint finish.
  3. Provide separate mounting components for mounting to structure prior to assembly of remainder of fixture.
  4. Enclose and gasket optical assembly. Hinge and provide captive stainless spring steel door latches. Provide ultraviolet stabilized, injection-molded, prismatic, heat-resistant, acrylic refractors for low brightness.
  5. Provide optical assembly with separate safety chain.

## 2.4 LAMPS

- A. Fluorescent Lamps: 3500 K, energy efficient type.
- B. High Intensity Discharge (HID) Lamps:
1. Metal Halide:
    - a. Clear, 4,000 K, high output.
    - b. Phosphor coated, 3,200 K, standard output.

## 2.5 FLUORESCENT BALLASTS

- A. Fluorescent Ballasts: Unless indicated otherwise in the luminaire schedule, premium electronic; one, two, three, or four lamp, ballast factor not less than 0.9. Total harmonic distortion not greater than 10 percent.
- B. 430 ma Lamp Ballasts: Rapid start, premium type.
- C. Minus 20 degrees F rating when used in exterior or unheated areas.
- D. Certified and listed in the California Energy Commission Directory

## 2.6 HID BALLASTS

- A. High power factor type and potted for low noise level.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Support surface-mounted luminaires to ceiling using bolts, screws, or approved clips.
- B. Install recessed luminaires with proper frames in accordance with manufacturer's recommendations.
- C. Locate recessed luminaires as indicated on reflected ceiling plan.
- D. Support pendant or bracket fixtures as indicated and as recommended by manufacturer for job conditions encountered.
- E. Install suspended luminaires using pendants or aircraft cable as scheduled. Pendants shall be supported from swivel hangers. Provide pendant/cable length required to suspend at indicated height. Install plumb and adjust to align with building lines and with each other.
- F. Wall mount exit fixtures where shown above doors. Coordinate fixture location with actual door arrangement as indicated. Connect exit fixtures to unswitched power source as indicated.
- G. Connect fixtures designated as night lights to unswitched circuit and burn continuously.
- H. Connect photocell into system to signal darkness and timeclock to de-energize system at a preset time.
- I. Earthquake Protection:
  - 1. Provide earthquake clips.
  - 2. Provide earthquake seismic zone restraints for pendant mounted fixtures.
- J. Install lamps in luminaires and lampholders.

### 3.2 FIELD QUALITY CONTROL

- A. Coordinate receipt and installation of all fixtures with regard to the overall schedule of the project.
- B. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt and debris from installed luminaires.
- C. Demonstrate proper operation of all luminaires and controls.
- D. Refer to Section 16050 regarding lamp replacement prior to final acceptance.

END OF SECTION 16510



## SECTION 16520

### LIGHTING FIXTURES - SITE

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Light fixtures associated with site, including:
  - 1. Exterior luminaires and accessories.
  - 2. Lamps.
  - 3. Ballasts.
  - 4. Poles.
  - 5. Pole bases.

##### 1.3 RELATED SECTIONS

- A. Section 02324 - Trenching.
- B. Section 03300 - Cast-in-Place Concrete.
- C. Section 16050 - Electrical General Provisions.
- D. Section 16120 - Wire and Cable.
- E. Section 16132 - Conduit.
- F. Section 16423 - Contactors.

##### 1.4 SUBMITTALS

- A. Include product data for fixtures, including photometric data, reflectance, lens, lamps, ballasts, poles and lighting control.
- B. Samples: Submit two color chips 3 inches by 3 inches in size illustrating unit finish color.
- C. Provide operation and maintenance manual.
- D. Furnish samples upon request of Architect/Engineer.
- E. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- F. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

## 1.5 QUALITY ASSURANCE

- A. Manufacturers of individual lighting fixtures shall be as scheduled on Drawings; manufacturers scheduled represent quality and design features required. Products of other manufacturers will be considered upon submittal of proper data.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Lamps:
  - 1. General Electric.
  - 2. Sylvania.
- B. Ballasts:
  - 1. Advance.
  - 2. Universal.
  - 3. Valmont.

### 2.2 EXTERIOR LUMINAIRES AND ACCESSORIES

- A. Enclosures: Complete with gaskets to form weatherproof assembly.
- B. Provide low temperature ballasts, with reliable starting to minus 20 degrees F.
- C. Provide tempered glass lens in hinged door.

### 2.3 HID LAMPS

- A. Metal Halide:
  - 1. Clear, 4,000 K, standard output.
  - 2. Phosphor coated, 3,200 K, standard output.

### 2.4 HID BALLASTS

- A. High power factor, potted for low noise.

### 2.5 LIGHTING POLES

- A. As scheduled on Drawings. Provide poles compatible with fixtures, style, finish and mounting.
- B. Metal Poles: Steel lighting pole with anchor base. Provide permanent paint as scheduled, electrostatic powder epoxy finish, 3 to 5 mils thick. Straight or tapered round steel as scheduled. Provide color to match color of light fixtures.
- C. Wind Load: 100 miles per hour velocity with luminaires, brackets and related equipment mounted. Deflection at 30 feet above grade less than 5 inches from vertical with 100 miles per hour wind velocity and luminaires, brackets and related equipment mounted.

- D. Hand Hole: Drilled hand access hole at manufacturer's standard location. Provide matching gasketed cover plate.
- E. Provide additional assembly for mounting receptacles on selected poles as indicated.
- F. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Provide bolt cover. Cover shall extend below anchor base to conceal leveling nuts.
- G. Each pole to have internal grounding lug.
- H. Mounting Brackets: As scheduled on Drawings. Provide mounting brackets compatible with pole, style, finish, and mounting.
- I. Provide winch assembly for all hinged poles. Provide two of each type and size required.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide new concrete pole bases for lighting poles. Contractor shall verify pole heights and sizes, and submit concrete base detail signed and sealed by licensed Structural/Civil engineer to A/E for approval. Install poles on bases plumb with anchor bolts that project 2 inches minimum above base and provide double nuts for adjustment . Grout around pole base after aligning pole. Install base cover. Base design to be installed with 30" above finished grade or as noted on the drawings. Exposed edges to be designed with chamfer to minimize chipping.
- B. Provide ground rod at each pole connected to ground lug with No. 6 AWG bare copper conductor.
- C. Use belt slings to raise and set pre-finished poles. Support and protect pole during lifting and setting operations to prevent damage to finish on poles.
- D. Provide styrofoam wedge at midpoint to prevent wire flapping inside pole and provide conductor stress relief at top of pole.
- E. Connect photocell into system to signal darkness and timeclock to de-energize system at a preset time.
- F. Install lamps in luminaires.
- G. Install and orient all hinged poles to allow on site access to luminaire in lowered position. Coordinate orientation with fences, all fixed appurtenances and structures.

### 3.2 FIELD QUALITY CONTROL

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

- B. Repair luminaire and pole finish at completion of work to "as new" condition. If pole finish is marred or damaged and cannot be restored to "as new" condition, replace pole.
- C. Aim luminaire as directed. Provide services of mechanic and bucket truck for night time adjustment before completion.
- D. Demonstrate proper operation of all luminaires and controls.
- E. Refer to Section 16050 regarding lamp replacement prior to final acceptance.

END OF SECTION 16520

## SECTION 16530

### EMERGENCY LIGHTING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.2 SECTION INCLUDES

- A. Emergency lighting units and exit signs.
- B. Central Battery Inverter Systems

##### 1.3 RELATED SECTIONS

- A. Section 16050 - Electrical General Provisions.
- B. Section 16075 - Electrical Identification
- C. Section 16130 - Boxes.
- D. Section 16510 - Lighting Fixtures - Building: Exit signs.

##### 1.4 REFERENCES

- A. NEMA WD 6 - Wiring Devices - Dimensional Requirements.

##### 1.5 SYSTEM DESCRIPTION

- A. Emergency lighting to comprise self contained emergency lighting units, lighting luminaires connected to central battery inverter system and interior lighting luminaires equipped with conversion packs.

##### 1.6 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Samples: Submit two color chips 3 inches by 3 inches in size illustrating unit finish color.
- C. Furnish samples upon request of Architect/Engineer.
- D. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- E. Clearly mark on each data sheet the specific item(s) being submitted and the

proposed application.

- F. Submit sample of labeling system proposed for emergency circuit labeling.
- G. Include outline and support point dimensions of central battery inverter system enclosures and accessories, unit weight, voltage, KVA, and rated temperature rise.
- H. Submit proposed mounting and support details of central battery inverter system enclosures

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle central battery inverter using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

#### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

#### 1.9 MAINTENANCE MATERIALS

- A. Provide one replacement lamps for each lamp installed.
- B. Provide one replacement battery for each battery type and size.

### PART 2 - PRODUCTS

#### 2.1 EMERGENCY LIGHTING UNITS

- A. Self-contained emergency lighting unit as scheduled on the drawings.
- B. Battery: type as scheduled on the drawing, with 1.5 hour capacity.
- C. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- D. Lamps: Compact fluorescent where scheduled on the drawings.
- E. Lamps: 12 watt minimum, sealed beam type in nickel or chrome plated steel housing, where scheduled on the drawings.
- F. Remote Fixtures: Match fixtures on unit.
- G. Housing: as scheduled on the drawings.

- H. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.
- I. TEST switch: Transfers unit from external power supply to integral battery supply.
- J. Electrical Connection Conduit connection.
- K. Input Voltage: 277 volts.

## 2.2 EXIT SIGNS

- A. Manufacturers as scheduled on the drawings.
- B. Exit sign fixture suitable for use as emergency lighting unit.
- C. Housing: as scheduled on the drawings.
- D. Face: Translucent face with red letters on white background.
- E. Directional Arrows: As indicated
- F. Mounting: As indicated
- G. Battery: type as scheduled on the drawing, with 1.5 hour capacity.
- H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- I. Lamps: LED.
- J. Input Voltage: 277 volts.

## 2.3 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

- A. Manufacturers as scheduled on the drawings.
- B. Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.
- C. Lamp Ratings: type as scheduled on the drawing 1,100 lumens minimum unless noted otherwise.
- D. Battery: Sealed lead calcium type, rated for 10-year life.
- E. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

## 2.4 CENTRAL BATTERY EMERGENCY POWER SUPPLY

- A. Uninterruptable power supply for emergency lighting applications, UL924, with 90 min. Sealed lead calcium batteries.
- B. Single phase, 277v in, 277v out.
- C. Enclosures: Unless indicated otherwise, provide general purpose, NEMA 1 for indoor locations; and weatherproof, NEMA 3R for outdoor locations.
- D. Chloride Systems SYNTHESIS CHT range or equal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided under Section 16130 as indicated.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.
- H. Ground and bond emergency lighting units and exit signs under the provisions of Section 16050.
- I. Install local emergency lighting test key switches where indicated to open the hot conductor powering the inverter units. Provide ten keys.

### 3.2 CENTRAL BATTERY INVERTER SYSTEM INSTALLATION

- A. Install in locations shown on Drawings, in accordance with manufacturer's written instructions.
- B. Tighten accessible connections and mechanical fasteners after placing.
- C. Provide a 4-inch concrete housekeeping pad with anchor bolts. Bolt equipment to pad plumb and square.



- D. Set plumb and level. Mount enclosure on vibration isolators to minimize noise transmission from the enclosure to supporting structure. Set floor mounted equipment on a neoprene pad on housekeeping pads.
- E. Provide filler plates for unused spaces.
- F. Provide typewritten circuit directory mounted in permanent, clear Lexan card holder located on inside of door or front of PANEL.
- G. Tighten electrical connectors and terminals; including screws and bolts, in accordance with equipment manufacturers published torque-tightening values for equipment connectors. Where manufacturers torque requirements are not indicated tighten connectors and terminals to comply with tightening torque specified in UL Standard 486A.
- H. Install overcurrent protective devices and accessories in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. All devices shall be installed in accordance with applicable NEC and NEMA standards for installation.
- I. Identify with arc flash data based on recommendations of Section 16053 Electrical System Coordination Study.
- J. Install branch circuit wiring in dedicated conduit system in accordance with Article 700 of the CEC.
- K. Identify all boxes and enclosures, including central batter inverter, controls and power panels for emergency circuits with permanent marking as components of an emergency system. Refer to section 16075.

### 3.3 FIELD QUALITY CONTROL

- A. Operate each unit after installation and connection. Inspect for proper connection and operation.
- B. Check for damage and tight connections prior to energizing.
- C. Prior to energizing the equipment the contractor shall thoroughly clean the interior of enclosure of all construction debris, scrap wire, etc. using manufacturer's approved methods and materials.
- D. Upon completion of project prior to final acceptance the contractor shall thoroughly clean both the interior and exterior of transformer per manufacturers recommended materials and methods. Remove paint splatters and other spots, dirt, and debris.
- E. Touch-up paint any marks, blemishes, or other finish damage suffered during installation.

3.4 ADJUSTING

- A. Aim and adjust lamp fixtures as directed.
- B. Position exit sign directional arrows as indicated.

3.5 PROTECTION OF FINISHED WORK

- A. Relamp emergency lighting units and exit signs that have failed lamps at Substantial Completion.

END OF SECTION 16530

## SECTION 16700

### TELECOMMUNICATIONS BASIC REQUIREMENTS

#### PART 1 - General

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for Sections numbering 167xxx, and is intended to supplement, not supersede, the requirements specified in Division 1.
- B. The requirements described herein include the following:
  - 1. References
  - 2. Definitions
  - 3. System Description and Existing Conditions
  - 4. Submittals
  - 5. Quality Assurance
  - 6. Delivery, Storage And Handling
  - 7. Scheduling
  - 8. Warranty
  - 9. Project Management and Coordination Services
  - 10. Cutting, patching, painting and sealing
  - 11. Field quality control
  - 12. Project Closeout and Record Documents
- C. Related Items
  - 1. General: Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
  - 2. Section 16705 - Telecommunications Equipment Rooms
  - 3. Section 16706 - Telecommunications Bonding
  - 4. Section 16710 - Telecommunications Horizontal Cabling
  - 5. Section 16711 - Telecommunications Backbone Twisted Pair Cabling
  - 6. Section 16712 - Telecommunications Backbone Fiber Optic Cabling
  - 7. Section 16719 - Telecommunications Testing

## 1.03 REFERENCES

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.
- B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
  - 1. National Electric Code (NEC), NFPA 70.
  - 2. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC).
  - 3. Uniform Building Code (UBC).
  - 4. Uniform Fire Code (UFC).
  - 5. Uniform Mechanical Code (UMC).
  - 6. National, State, Local and other binding building and fire codes.
  - 7. FCC Regulations:
    - a. Part 15 – Radio Frequency Devices & Radiation Limits
    - b. Part 68 – Connection of Terminal Equipment to the Telephone Network
- C. Standards: Equipment and materials furnished under this Section shall conform to the following standards where applicable:
  - 1. Underwriter's Laboratories (UL): Applicable listing and ratings.
  - 2. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard.
    - a. Part 1: General Requirements
    - b. Part 2: Balanced Twisted-Pair Cabling Components
    - c. Part 2, Addendum 1: Transmission Performance Specifications For 4-Pair 100 Ohm Category 6 Cable
    - d. Part 3: Optical Fiber Cabling Components Standard
  - 3. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces, including the following addenda:
    - a. TIA/EIA-569-A-1 Surface Raceways
    - b. TIA/EIA-569-A-2 Furniture Pathways and Spaces
    - c. TIA/EIA-569-A-3 Access Floors
    - d. TIA/EIA-569-A-4 Poke-Thru Fittings
    - e. TIA/EIA-569-A-6 Multi-Tenant Pathways and Spaces
    - f. TIA/EIA-569-A-7 Cable Trays and Wirelines
  - 4. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
  - 5. ANSI/J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

6. ANSI/TIA/EIA-758 Customer-Owner Outside Plant Telecommunications Cabling Standard.
    - a. TIA/EIA-758-1 Addendum No. 1
  7. EIA testing standards.
  8. BICSI Telecommunication Distribution Methods Manual.
- D. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
- E. Make a copy of each document readily available during the course of construction for reference by field personnel.

#### 1.04 DEFINITIONS

- A. The Definitions of Division 1 shall apply to the 167xx sections.
- B. In addition to those Definitions of Division 1, the following list of terms as used in this specification shall be defined as follows:
1. "Owner": Santa Cruz Metropolitan Transit District.
  2. "Engineer": TEECOM Design Group.
  3. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.
  4. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation.
  5. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
  6. "As directed": As directed or instructed by the Owner, or their authorized representative.
  7. "Connect": To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
  8. "Cabling": A system comprised of cables, wire, cords, and connecting hardware [e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling].
  9. "Identifier": A unique code assigned to an element of the communications infrastructure that links it to its corresponding record.

#### 1.05 SYSTEM DESCRIPTION

- A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

#### 1.06 SUBMITTALS

- A. General: Submit required submittals in accordance with Conditions of the Contract, and Division 1 Submittal Procedures Section.

## B. Product Data

1. General: Product data submittals must be approved in writing by the Engineer prior to release of order for products and equipment, and prior to installation.
2. Quantity: Furnish quantity of product data submittals as described in Division 1.
3. Format:
  - a. Minimum Format: Provide each product data submittal in an 8-1/2 x 11 inch folder. Preferred Format: Provide each product data submittal in a 3-ring binder with front cover and spine clear pockets for insertion of the submittal information.
  - b. Clearly label the cover and the spine of each submittal with the following information:
    - 1) Client Name
    - 2) Project Name and Address
    - 3) Project Submittal Number
    - 4) Submittal Name (e.g., "Product Data Submittal For Communications Equipment Rooms")
    - 5) Specification Section Number (e.g., "Section 16710").
    - 6) Date of Submittal – Format: <month> <day>, <year> (e.g., "January 1, 2000").
    - 7) Contractor Name
  - c. Include a Table Of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., "2.02-A Equipment Racks").
  - d. Include tabbed separators for improved navigation through the submittal.
4. Content:
  - a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Cover letter shall list in full the items and data submitted, and shall be signed (and stamped, if applicable) by the person who prepared the submittal. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
  - b. Product Information: Product Data submittal shall consist of manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in the specifications numbering 167xx . Also include relevant products that will be installed, which are not listed in the specifications.

- c. Resubmittals: Resubmittals shall include a cover letter that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

#### C. Seismic Calculations

1. General: Seismic calculations submittals must be approved in writing by the Engineer prior to release of order for products and equipment, and prior to installation.
2. Quantity: Furnish quantity of seismic calculations submittal as described in Division 1.
3. Format:
  - a. Generally, submit seismic calculations on 8-1/2 x 11 media.
  - b. Clearly label the cover and the spine of each submittal with the following information:
    - 1) Client Name
    - 2) Project Name and Address
    - 3) Project Submittal Number
    - 4) Submittal Name (e.g., "Seismic Calculations Submittal For Communications Equipment Racks")
    - 5) Specification Section Number (e.g., "Section 16705").
    - 6) Date of Submittal – Format: <month> <day>, <year> (e.g., "January 1, 2000").
    - 7) Contractor Name
4. Content:
  - a. Seismic Calculations: Include anchorage calculations for floor mounted fully loaded equipment racks/frames/cabinets such that it shall remain attached to the mounting surface after experiencing forces in conformance with CCR, Title 24, "Uniform Building Code" for Seismic Zone 4 Area, Importance Factor of 1.25. Specify proof loads for drilled-in anchors, if used. A Structural Engineer registered in the State of California shall prepare calculations and shall wet stamp and sign them. Forward calculations to the City of Santa Cruz for review and approval.
  - b. Resubmittals: Resubmittals shall include a cover letter that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. Resubmittal packages will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

#### D. Submittal Description: Shop Drawings

1. General: Obtain written approval from the Engineer for the shop drawings prior to the release of materials and equipment purchase order and prior to installation.
2. Quantity & Media: Furnish quantity of shop drawing submittals as described in Division 1.
3. Format:
  - a. Prepare shop drawings using AutoCAD Release 14 or later.

- b. Use the same plot size as the Contract Documents drawings.
  - c. Use the project title block.
  - d. Text: minimum of 3/32" high when plotted at full size.
  - e. Use symbols identical to those in the Contract Documents drawings.
  - f. Screen background information.
  - g. Plot system components (devices, pathways, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
  - h. Label each sheet in the shop drawings set with the Specification Section Number (e.g., "16710").
  - i. Scaling:
    - 1) Scale floor plans at 1/8"=1'-0".
    - 2) Scale enlarged room plans at 1/4"=1'-0".
    - 3) Scale wall elevations at 1/2"=1'-0".
    - 4) Scale rack elevations at 1"=1'-0".
4. Content:
- a. If the proposed installation differs from the Contract Documents or the design intent, submit detailed shop drawings.
  - b. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the Contract Documents. Cover letters shall include a drawing index, and shall be signed (and stamped, if applicable) by the person who prepared the submittal. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
  - c. Drawing Information: Shop drawing submittals shall consist of floor plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system that differ from the Contract Documents or the design intent. Use the same scales as the Drawings (e.g., 1/4" = 1'-0" for enlarged room plans).
  - d. Resubmittals: Accompany resubmittals with a cover letter that lists the revisions made to each drawing in response to Submittal Review Comments. Resubmittals will not be reviewed unless accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

E. Submittal Description: Record Drawings

- 1. Quantity & Media: Furnish quantity of record drawing submittals as described in Division 1.
- 2. Format:
  - a. Prepare record drawings using AutoCAD Release 14 or later.
  - b. Use the same plot size as the Contract Documents drawings.
  - c. Use the project title block.
  - d. Text: minimum of 3/32" high when plotted at full size.
  - e. Use symbols identical to those in the Contract Documents drawings.
  - f. Screen background information.
  - g. Plot system components (devices, pathways, cable routes, etc.) and text at a sufficient line weight to stand out against background information.



3. Content:
  - a. Record Drawings shall fully represent actual installed conditions and shall incorporate revisions made during the course of construction.
  - b. Floor plans shall show:
    - 1) Locations and identifiers of outlets.
    - 2) Size, quantity, location, and routes of pathways (such as cable trays, conduits, J-hangers, and other cable support devices).
  - c. Enlarged room floor plans scaled at 1/2"=1'-0" showing exact placement of equipment cabinets/frames, rack bays, and other equipment. Enlarged room overhead plans scaled at 1/2"=1'-0" showing exact placement of overhead cable support devices (e.g., cable tray, cable runway, conduit sleeves, etc.).
    - 1) Applicable rooms: Server Room, PBX Equipment Room, MDF, Entrance facilities, BDFs, IDF.
  - d. Wall elevations scaled at 1"=1'-0" showing exact placement of termination hardware (e.g., termination/crossconnect blocks).
  - e. Installation details.

F. Submittal Description: Operation and Maintenance (O & M) Manuals

1. Quantity: Furnish quantity of O&M Manuals as described in Division 1.
2. Format:
  - a. Furnish each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
  - b. Clearly label the cover of each O & M Manual with the following information:
    - 1) Client Name
    - 2) Project Name and Address
    - 3) Manual Name (e.g., "Operation And Maintenance Manual for Communications Cabling System")
    - 4) Date of Submittal. Format: <month> <day>, <year> (e.g., "January 1, 2000")
    - 5) Contractor Name
  - c. Include a Table Of Contents at the beginning that lists the contents.
  - d. Include tabbed separators for improved navigation through the manual.
3. Content:
  - a. 11"x17" prints of As-Built Drawings, as described above
  - b. Manufacturer's original catalog information sheets for each component provided under applicable Section
  - c. Warranty certificate from the manufacturer and the Contractor
  - d. Manufacturer's instructions for system or component use
  - e. Instructions for maintenance and warranty issues

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
2. Manufacturer(s) of products and equipment specified herein shall demonstrate

that they have a quality assurance program in place to assure that the specifications are met. The program shall include, as a minimum, provisions for:

- a. Incoming inspection of raw materials
  - b. In-process inspection and final inspection of the cable product
  - c. Calibration procedures of test equipment to be used in the qualifications of the product
  - d. Recall procedures in the event that out of calibration equipment is identified.
3. Conformance to certain government standards on quality assurance may be required for some applications within these specifications.

#### B. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License
2. Five continuous years, minimum, experience
3. Five, minimum, completed projects similar to scope and cost
4. Evidence of technicians qualified for the work

#### C. Materials

1. Provide new materials and equipment without defects.
2. Furnish only specified products and equipment, or products and equipment that have been approved in writing.

#### D. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Nothing in these specifications is to be construed to permit work not conforming to the most stringent of the applicable codes.
2. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Consider such codes or standards a part of this Specification as though fully repeated herein.
3. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this series of Sections, nothing in said codes shall be construed or inferred authority for reducing the quality, requirements or extent of the Drawings and Specifications. The Contract Documents address the minimum requirements for construction.

#### E. Project Management And Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
  - a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Division 16 work.

- b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 16 contract documents. Document discrepancies or deviations as follows:
  - 1) Prepare memo summarizing the discrepancy.
  - 2) Provide a copy of the specific shop drawing, indicating via cloud, the discrepancy.
- c. Prepare and maintain a shop drawing review log indicating the following information:
  - 1) Shop drawing number and brief description of the system/material.
  - 2) Date of your review.
  - 3) Indication if follow-up coordination is required.

#### F. Drawings

- 1. Layout: Follow the general layout shown on the Drawings except where other work may conflict with the Drawings.
- 2. Accuracy: Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
- 3. The Drawings do not fully represent the entire installation for the Telecommunications Cabling System. Drawings indicate the general route for the cables and the location of outlets. Conduits, sleeves, hangers, etc. – for the most part – are not shown.
- 4. Complete the details necessary for point-to-point design. This allows the Contractor to achieve desired results applying their own procedures and methods. Submit shop drawings for review prior to installation.

#### G. Role of the Engineer

- 1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.
- 2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.
- 3. In summary, the Engineer will perform the following specific services during the construction phase:
  - a. Review product submittals and shop drawings for general compliance with the contract drawings and specifications.
  - b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
  - c. Interpret field problems for Owner, and translate into understandable language.
  - d. Review the testing procedures to confirm compliance with industry-accepted practices.

### 1.08 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

#### B. Delivery

1. Products shall not be delivered to the site until protected storage space is available.
2. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at jobsite.
3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
4. Replace equipment damaged during shipping at no cost to the Owner.

#### C. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
2. Comply with manufacturer's requirements for each product. Comply with recommended procedures, precautions or remedies as described in the Material Safety Data Sheets (MSDS) as applicable.
3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
4. Storage outdoors covered by rainproof material is not acceptable.
5. Provide heat where required to prevent condensation or temperature related damage.

#### D. Handling

1. Handle in accordance with manufacturer's written instructions.
2. Damaged equipment shall not be installed.
3. Replace damaged equipment at no cost to the Owner.
4. Handle with care to prevent internal component damage, breakage, denting, and scoring.

### 1.09 SCHEDULING

- A. Unless otherwise specified, the construction schedules of the 167xx series Sections may be combined.

### 1.10 WARRANTY

- A. Service must be rendered within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid.
- B. Provide a 15-year, minimum, manufacturer's warranty for the fiber optic and twisted pair cabling systems from the date of acceptance.
- C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. A complete parts department or stocking distributor shall be located close enough to the job site area to supply replacement parts within a 24 hour period.
- D. Warrant installed hardware, under normal use and service, to be free from defects

and faulty workmanship during the warranty period. Keep the system in operating condition at no additional material or labor costs to the Owner during the warranty period.

- E. The manufacturers shall demonstrate that a quality assurance program is in place to assure that the specifications are met. The program shall include, as a minimum, provisions for:
  - 1. Incoming inspection of raw materials
  - 2. In-process inspection and final inspection of the product
  - 3. Calibration procedures of test equipment to be used in the qualifications of the product
  - 4. Recall procedures in the event that out of calibration equipment is identified.
- F. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.
- B. Product numbers listed in the 167xx series sections in are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the General Contractor in writing prior to ordering the material and performing installation work.

### 2.02 SUBSTITUTIONS

- A. Requests for substitutions shall conform to the general requirements and procedure outlined in Division 1.
- B. Where items are noted as "or approved equivalent", a product of equivalent design, construction and performance will be considered. Include in the Product Data submittal: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified.
- C. Only one substitution will be considered for each product specified. Do not use substitution material, processes or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution prior to acceptance by the Engineer is at the sole risk of the Contractor.
- D. Substitutions shall be equivalent, in the opinion of the Engineer, to the specified product. The burden of proof of such shall rest with the Contractor. When the Engineer in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the Specifications.
- E. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish

standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when "or equivalent" follows the manufacturers' names and model number(s).

- F. Whenever material, process or equipment is specified in accordance with a TIA/EIA specification, an ANSI specification, UL rating or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance at no additional cost.
- G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed.
- C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, "True Tape" the conduits to verify cable distances.

### 3.02 FIELD QUALITY CONTROL

- A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule.
- B. Project Management: Coordinate and attend weekly status meetings to review the overall progress and issues to be resolved throughout the course of construction. Prepare and distribute meeting agenda prior to and meeting notes after meetings in a format acceptable to the General Contractor.
- C. Scheduling: Prepare an overall construction schedule based on the results of the planning meetings with the General Contractor. Issue schedule to General Contractor for approval. Prepare and issue updated schedules whenever there are modifications.
- D. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

### 3.03 INSTALLATION

- A. Complete work in a neat, high quality manner.
- B. Conform to applicable federal, state and local codes, and telephone standards.

- C. Coordinate the entire installation with the General Contractor, and their subcontractors, to meet the construction schedule. Include coordination meetings as required to fulfill this requirement.
- D. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.
- E. Manufacturer's Instructions:
  - 1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
  - 2. Maintain jobsite file and comply with Material Safety Data Sheets (MSDS) for each product delivered to jobsite.
- F. Adjusting:
  - 1. Make changes and revisions to the system to optimize operation for final use.
  - 2. Make changes to the system such that defects in workmanship are corrected and cables and the associated termination hardware pass the minimum test requirements.
- G. Protection
  - 1. Protect installed products and finish surfaces from damage during construction.

#### 3.04 REPAIR AND RESTORATION

- A. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.
- B. Punch List:
  - 1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
  - 2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.
- C. Re-Installation:
  - 1. Make changes to adjust the system to optimum operation for final use. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
  - 2. Repair defects prior to system acceptance.

#### 3.05 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.
- B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.
- C. Repair or replace damaged installed products.
- D. Legally dispose of debris.

- E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

### 3.06 DEMONSTRATION

- A. On completion of the acceptance test, schedule a time convenient with the Owner, or owner's representatives, for instruction in the configuration, operation, and maintenance of the system.
- B. Provide 2 hours, minimum, of on-site training by a factory-trained representative. Document dates and times of training, and submit a "sign in" sheet for individuals trained, as part of the close out documentation.

### 3.07 CERTIFICATION

- A. Provide to Owner a written form of acceptance for signature. Corrections must be completed before Owner will give acceptance.

END OF SECTION 16700



## SECTION 16705

### TELECOMMUNICATIONS EQUIPMENT ROOMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes: Build out of telecommunications rooms and spaces.
- B. Products Furnished and Installed by the Owner:
  - 1. Network switches, PBX equipment, and telephone handsets
  - 2. Installation of patch cords for data interconnectivity.
- C. Related Divisions
  - 1. Comply with the Related Sections paragraph of Section 16700.
  - 2. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

##### 1.03 REFERENCES

- A. Comply with the References requirements of Section 16700.
- B. In addition to those codes, standards, etc., list in 16700, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. ANSI/EIA-310-D-1992 Racks, Panels And Associated Equipment

##### 1.04 DEFINITIONS

- A. Refer to the Definitions requirements of Section 16700.

##### 1.05 SYSTEM DESCRIPTION

- A. General
  - 1. Telecommunication spaces shall fall into one of the following space titles:
    - a. Main Distribution Facility (MDF)
    - b. Intermediate Distribution Facility (IDF)
- B. Room Functions
  - 1. Main Distribution Facility / MDF will serve the following functions:
    - a. Act as MPOE for SBC or other telecom utility.
    - b. House telecom service provider's termination field(s).
    - c. Act as an origination and termination point for backbone interbuilding and

- intrabuilding twisted pair and fiber optic cabling,
  - d. House voice system equipment (PBX and voice mail server).
  - e. House main voice crossconnect field and backbone twisted pair terminations.
  - f. House core data network equipment (router, core switch, WAN interface).
  - g. House main data crossconnect field and backbone fiber terminations.
  - h. House computer processing equipment (servers).
2. Intermediate Distribution Facilities serve the following functions:
- a. House interbuilding or intrabuilding backbone twisted pair and fiber optic termination fields.
  - b. House horizontal termination field – both voice and data – of cabling served from this room (refer to floor plans for service areas).
  - c. House data system equipment (access switch).
- C. Base Bid Work
1. Telecommunications Room build out includes the following work:
- a. Submittals.
  - b. Rack bays (equipment racks, vertical management sections, anchoring, and bracing).
  - c. Overhead support system.
  - d. Cable, wire and patch cord management.
  - e. Seismic bracing.
  - f. Identification tags and labeling.
  - g. Record Documents.
  - h. Warranty.

## 1.06 SUBMITTALS

- A. Refer to Submittals of Section 16700 for procedural, quantity, and format requirements.
- B. Pre-Construction Submittal Requirement: Submit the following prior to the start of construction.
- 1. Product Data Submittal: Submit product data on products listed in this section and products not listed in this section to be installed related to this section.
  - 2. Sample Submittal: Submit sample of equipment rack label.
  - 3. Seismic Calculations: Rack anchorage into concrete flooring with overall rack bracing.
  - 4. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for the 167xx series Sections).
  - 5. Shop Drawings Submittal: Consisting of proposed changes to room plans.
- C. Submittal Requirements at Closeout:
- 1. As-Built Drawings.
  - 2. O & M Manuals.

## 1.07 QUALITY ASSURANCE

A. Refer to Quality Assurance requirements of Section 16700.

## 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Refer to Product Delivery, Storage and Handling requirements of section 16700.

## 1.09 WARRANTY

A. Refer to Warranty requirements of section 16700.

## PART 2 - PRODUCTS

### 2.01 EQUIPMENT RACK BAY

#### A. Equipment Rack, 2-Channel Type

1. Application: Suitable for the support of cable termination devices, management devices, common communications equipment, and other similar equipment.
2. Material: High strength, lightweight 6061-T6 aluminum, extrusion construction.
3. Channel:
  - a. Size: The mounting channels shall be 3" deep by 1.265" wide with a 0.17" thick web.
  - b. Flange: The mounting channels shall have front and back mounting flanges ("double sided"). The flanges shall be 0.25" thick, and shall have mounting holes front and back.
  - c. Mounting Holes: The hole pattern shall be industry standard spaced at 5/8" - 5/8" - 1/2", compatible with ANSI/EIA-310-D (1992) standard. The mounting holes shall be pre-threaded as #12-24 rolled threading.
4. Assembled Rack: The rack shall come complete with base angles (3.5" high by 6" deep by .375" thick) and top angles (1.5" high by 1.5" deep by .375" thick). The assembled rack shall be 7'-0" high (overall) by 19" mounting width (20.25" wide overall), and shall contain 45 EIA mounting spaces (1.75").
5. Include required accessories, such as floor installation kit, etc. for a complete installation.
6. Manufacturer, or approved equal:
  - a. CPI #46353-702, 6'-6"H x 19" equipment rack, black
  - b. CPI #46353-703, 7'-0"H x 19" equipment rack, black

#### B. Vertical Management Sections

1. Application: Suitable for cable routing (back) & cord slack storage (front) vertically from the bottom of the rack to the top. The vertical management sections shall be double sided (i.e., the management section shall have covered cable guides on the front and flip-retainers on the rear).
2. Size & Capacity: 7'-0" high by either 6" wide or 4.5" wide, with 5-1/3" deep cable storage capacity in back and 6" cord storage capacity in front.
3. Mounting: The vertical management section shall have matching bolt holes for attachment to the rack.

4. Color: black (guides and cover).
5. Manufacturer, or approved equal:
  - a. CPI #30162-701, vertical mngt section, 6'-0"H x 6"W, double sided
  - b. CPI #30162-703, vertical mngt section, 7'-0"H x 6"W, double sided

#### C. Horizontal Management Panels

1. Application: Suitable for installation into equipment rack for cord routing (front). The horizontal management panel shall match (and fully integrate with) the vertical management sections.
2. Size & Capacity: 2U high, with hinged/removable cover and pass through capacity.
3. Color: black.
4. Manufacturer, or approved equal:
  - a. CPI #30130-719; horizontal cable manager with removable hinged front cover

### 2.02 CABLE RUNWAY

#### A. Cable Runway Straight Sections

1. Application: Suitable for the support & management of communications cables, either overhead or mounted vertically on a wall. Also overhead equipment racks bracing.
2. Material (both stringer and rung): Steel tube, rectangular, 1-1/2" by 3/8" by 0.65" wall thickness.
3. Rungs: 12" on center, welded to stringer.
4. Size: 9' 11-1/2" straight sections; width: refer to Drawings.
5. Manufacturer, or approved equal:
  - a. CPI #10250-712, 12"wide universal cable runway, black
  - b. CPI #10250-718, 18"wide universal cable runway, black
  - c. CPI #10250-724, 24"wide universal cable runway, black

#### B. Cable Runway Installation Accessories

1. Application: Installation accessories for use with cable runway.
2. Refer to Drawings for additional information and instances for installation.
3. Manufacturer, or approved equal:
  - a. CPI #11301-001, butt splice kit
  - b. CPI #10487-001, swivel butt splice kit
  - c. CPI #11313-001, 45-degree butt splice kit
  - d. CPI #11314-001, 90-degree butt splice kit
  - e. CPI #11302-001, junction splice ("T") kit
  - f. CPI #10488-001, swivel junction splice ("T") kit
  - g. CPI #10608-001, vertical wall bracket kit
  - h. CPI #10642-001, end caps
  - i. CPI #11421-712, wall angle support kit for 12" wide cable runway, black
  - j. CPI #11421-718, wall angle support kit for 18" wide cable runway, black

- k. CPI #11421-724, wall angle support kit for 24" wide cable runway, black
- l. CPI #11312-712, triangle support kit for 9" and 12" wide cable runway, black
- m. CPI #11312-718, triangle support kit for 12" and 18" cable runway, black
- n. CPI #11770-712, end closing kit for 12" wide cable runway, black
- o. CPI #11770-718, end closing kit for 18" wide cable runway, black
- p. CPI #11770-724, end closing kit for 24" wide cable runway, black
- q. CPI #10595-712, rack-to-runway attach kit, for 12" wide runway, black
- r. CPI #10595-718, rack-to-runway attachment kit, for 18" wide runway, black

## 2.03 LABEL PLATES FOR EQUIPMENT RACKS

- A. Application: Label plate shall be suitable to affix onto top angle of equipment rack.
- B. Label plate shall be 'engrave-able' stock melamine plastic laminate substrate.
  - 1. Size (minimum): 1/2 inch high by 6 inches long by 1/16-inch thick.
  - 2. Color: Black.
- C. Lettering shall be engraved, shall be 1/8" high, and shall be white.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Comply with the General Execution requirements of Section 16700.

### 3.02 INSTALLATION

- A. Rack Bays
  - 1. Equipment Racks
    - a. Provide parts and accessories required to complete each rack.
    - b. Seismic Bracing
      - 1) Anchor racks to the floor using structural engineer approved concrete anchors.
      - 2) Brace racks overhead to cable runway where shown on the Drawings.
  - 2. Vertical Management Sections
    - a. Provide vertical management sections as shown on Drawings. If not shown, default shall be one vertical management section between each rack and at either end of the bay.
    - b. Bolt vertical management sections to the equipment racks at the points designed by the manufacturer and per the manufacturer's installation instructions.
    - c. Install support devices (e.g., brackets, threaded rod with strut, etc.) per the manufacturer's instructions and fastened to the wall or ceiling using appropriate fasteners.
  - 3. Tolerances:
    - a. Equipment Rack: Field verify dimensions to establish proper clearances as follows:
      - 1) Front: 40" clearance from channel's front mounting flange.

- 2) Back: 57" clearance from channel's back mounting flange.
    - b. Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.
  4. Accessories
    - a. Furnish one bag of 50 mounting screws per MDF/IDF room.
- B. Overhead Cable Runway
  1. Install support devices (e.g., brackets and threaded rod with strut) per the manufacturer's instructions and fastened to the wall or ceiling using appropriate fasteners.
  2. Tolerances
    - a. Install the overhead cable runway centered over the equipment rack, or as shown on the Drawings.
  3. Interface With Other Work: Coordinate the installation of the overhead basket support and cable runway with other trades. Trapeze supports and 'hanger rods' ("all-thread"), for example, may be shared to lower overall construction cost.
- C. Vertical Cable Runway
  1. Provide cable runway installed vertically at the locations as shown on the Drawings for use to support cables routing vertically within telecom rooms.
  2. Provide parts required to complete the installation (e.g., vertical mounting brackets, bolts, etc.).
  3. Install the cable runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward).

### 3.03 LABELING

- A. General Requirements: Labeling and identifier assignment shall conform to TIA/EIA-606 Administration Standard and as approved by Owner before installation.
- B. Equipment Rack Label Requirements: Provide one label plate per rack. Permanently affix label plate and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the rack's front top angle.
- C. Identifier Assignment
  1. Equipment Racks
    - a. Prefix: "RACK"
    - b. First field: the MDF/IDF room identity; for example: "O1.1".
    - c. Second field: the rack number; for example: "01".
    - d. Example; "RACK O1.1-01"

END OF SECTION 16705

## SECTION 16706

### TELECOMMUNICATIONS BONDING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes: Labor, materials and equipment necessary to bond communications infrastructure devices and equipment to Communications Grounding Backbone.
- B. Related Sections
  - 1. Comply with the Related Sections paragraph of Section 16700.
  - 2. Section 16061 – Telecommunications Grounding Backbone

##### 1.03 REFERENCES

- A. Comply with the References requirements of Section 16700.
- B. In addition to those codes, standards, etc., list in Section 16700, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
  - 1. NFPA 70, National Electric Code:
    - a. Article 800: Communications Circuits
    - b. Article 250: Grounding and Bonding
  - 2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. IEEE 467: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
    - b. IEEE P1100: IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

##### 1.04 DEFINITIONS

- A. Definitions as described in Section 16700 shall apply to this section.
- B. In addition, the following list of terms as used in this specification shall be defined as follows:
  - 1. "CM": Circular Mil.
  - 2. "MBRGB": Main Building Reference Grounding Busbar
  - 3. "TBB": Telecommunications Bonding Backbone
  - 4. "TBC": Telecommunications Bonding Conductor

5. "TGB": Telecommunication Grounding Busbar
6. "TMGB": Telecommunication Main Grounding Busbar

## 1.05 SYSTEM DESCRIPTION

- A. Telecommunications Grounding Backbone System, Provided Under Another Section
  1. The Telecommunications Grounding Backbone system contains grounding bus bars, grounding conductors, bonding conductors, and connecting devices. These components provide a low impedance path to ground for stray voltages or spurious signals present on telecommunications media and equipment.
    - a. Refer to Section 16061 for detailed information regarding the Telecommunications Grounding Backbone system.
  2. TMGB: A TMGB will be provided in the MDF. The TMGB has a connection to the following:
    - a. MBRGB, via TBB.
    - b. Overhead cable tray within the room, via TBC.
    - c. Ground bushings installed on conduits opening within the MDF, via TBC.
    - d. Power panels within the MDF dedicated to telecommunication equipment, via TBC.
    - e. Each TBB.
  3. TBB: A TBB will be provided from the MDF, and will route to the IDF with a connection to TGB.
  4. TGB: A TGB will be provided in the IDF rooms.
- B. Base Bid Work
  1. TBCs from the busbar within MDF and IDF to the following components:
    - a. Rack bay to TMGB/TGB.
    - b. Overhead cable runway to TMGB/TGB, where applicable.
    - c. Overhead cable tray to TMGB/TGB, where applicable.
    - d. Ground bushings installed on each conduit opening within the telecommunications room.
  2. Grounding jumpers between cable runway and cable tray joints and splices, and between cable runway and cable tray and the equipment racks.

## 1.06 SUBMITTALS

- A. General: Conform to Submittal requirements as described in Section 16700.
- B. Quantity: Furnish quantities of each submittal as noted in Section 16700.
- C. Product Data Submittal
  1. Format: As described in Section 16700.
  2. Content: In addition to requirements of Section 16700, include the following:
    - a. Product Data: "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) of bonding devices and installation accessories. This data shall clearly describe the physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, and material finish.



- b. Clearly indicate by arrows or brackets precisely the model and accessories submitted on.

D. Substitutions

1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 16700.

1.07 QUALITY ASSURANCE

- A. Comply with Quality Assurance requirements of Section 16700.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with Delivery, Storage and Handling requirements of Section 16700.

PART 2 - PRODUCTS

2.01 BONDING CONDUCTORS

A. TBC

1. Conductor: #6 AWG (up to 25 feet) stranded copper.
2. Insulation: Low-smoke, green in color. The following shall be printed on the conductor's jacket: insulation grade, conductor gauge, and applicable UL jacket listings.
3. Type THHN, or equal.

B. Cable Runway Bonding Straps

1. Conductor: Flexible braided straps with factory terminated connectors.
2. Manufacturer, or equal: CPI #12061-001

C. Cable Tray Bonding Straps

1. Conductor: Flexible braided straps with factory terminated connectors.
2. Manufacturer, or equal: Thomas & Betts #FB95

2.02 CONECTORS

A. General: Connectors shall be UL listed.

B. TBC-To-TGB/TMGB Connection

1. Lug, one-hole standard barrel compression lug.
2. Manufacturer: Panduit #LCD6-14A-L; two hole (1/4" dia. x 5/8" on center) standard barrel lug for #6 AWG conductor, or equal.

C. TBC-To-Runway Connection

1. Lug, two-hole single barrel screw termination lug.

2. Manufacturer: Panduit #HL4-2-X; one hole (1/4") 'premium' single barrel screw lug for #6 AWG, or equal.
- D. TBC-To-Equipment Rack Connection
1. Lug, one-hole standard barrel compression lug.
  2. Manufacturer, or equal: Panduit #LCA6-14-L; one hole (1/4") standard barrel compression lug for #6 AWG
- E. TBC "C" Tap
1. C-type copper thick wall compression tap, for making copper-to-copper connection.
  2. Manufacturer, or equal: Panduit #CTAPG4-6-L; C-type compression tap

## 2.03 MISCELLANEOUS

- A. Wire Clamp
1. Material: nylon, UV stabilized.
  2. Color: black
  3. Size: 0.25" holding diameter for 6 AWG; or size as required based on conductor size.
  4. Manufacturer, or equal: Richco Inc. #N4B-BLK; clamp for 6 AWG.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Comply with the Execution requirements of Section 16700.

### 3.02 EXAMINATION

- A. Examine Communications Grounding Backbone system prior to the start of work within this section. The Telecommunications Contractor is solely responsible to ensure work proposed within this section is fully compatible, in the opinion of the Engineer, with the Communications Grounding Backbone system.

### 3.03 INSTALLATION

- A. Provide TBC and appropriate grounding hardware from telecommunication conduit, cable tray, cable runway, equipment racks, and other metallic telecommunication infrastructure components to the nearest TMGB/TGB.
- B. Telecommunication Bonding Conductors
1. Refer to Drawings for TBC sizing. If not shown, size TBCs as the greater of 6 AWG or based on length of run using 1000CM/linear foot.
  2. Install TBCs in a manner that will protect them from physical and mechanical damage.
  3. Routing:
    - a. Route TBCs in the shortest possible path, using right-angles for turns and routed parallel to building lines.

- b. Utilize a minimum 1 foot bend radius.
  - 4. At TMGB/TGBs:
    - a. Thoroughly clean non electrotin-plated busbar prior to fastening the conductors, bolts, or connectors to the busbar.
    - b. Attach lugs to busbar with appropriate size cadmium bronze bolt, flat washer and Belleville washer.
    - c. Torque connections.
- C. Rack Bay & Overhead Cable Runway Bonding
  - 1. Refer to Drawings for detailed diagrammatic requirements for rack bay bonding.
  - 2. Rack Bay: Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the TMGB/TGB to the busbar.
  - 3. Overhead Runway:
    - a. Bond overhead runway located within the same room or space as the TMGB/TGB to the busbar.
    - b. Provide "grounding kit" (straps & connectors) to bond sections of cable runway for ground continuity. This requirement shall apply to sections of cable runway within a single communication room.
- D. Metallic Raceway Bonding
  - 1. If TBC routes through conduit longer than 1 meter, bond metallic conduit to conductor at both ends.
  - 2. Bond metallic raceways for telecommunications cabling (conduit, cable tray, cable runway, and other metallic telecommunication infrastructure components) located within the same room or space as the TMGB or TGB to the nearest telecommunication grounding busbar.

### 3.04 LABELING

- A. General Requirements
  - 1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner's Representative before installation.
  - 2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.
- B. Label Format
  - 1. Labels shall be permanent with machine-generated text; hand written labels will not be accepted.
  - 2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

C. Identifier Assignment

1. Separate label fields of the identifier with a hyphen.
2. TBC:
  - a. First field: "TBC" (the bonding conductor type).
  - b. Second field: The room identity where TBC exists; for example: "3A-1.1".
  - c. Third field: Connecting component/apparatus; for example: "Rack Bay".
  - d. Example: "TBC-3A-1.1-Rack Bay"

3.05 RECORDS

- A. Telecommunication Bonding System records shall conform to TIA/EIA-606-A Administration Standards. Each component shall have as a minimum, the information as outlined in Table 4.7-1 of TIA/EIA-606-A.

END OF SECTION 16706

## SECTION 16710

### TELECOMMUNICATIONS HORIZONTAL CABLING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes: Horizontal Cabling (subsystem of Telecommunications Cabling Infrastructure).
- B. Related Sections
  - 1. Comply with the Related Sections paragraph of Section 16700.
- C. Products Furnished and Installed Under Another Section:
  - 1. Conduits – for building distribution
  - 2. Conduit stubs & device (back) boxes – for wall mounted outlets
  - 3. Sleeves

##### 1.03 REFERENCES

- A. Comply with the References requirements of Section 16700.

##### 1.04 DEFINITIONS

- A. Refer to Section 16700 for Definitions.
- B. In addition, the following list of terms as used in this specification shall be defined as follows:
  - 1. “CAT3”: Category 3 [UTP]
  - 2. “CAT6”: Category 6 [UTP]
  - 3. “Channel”: End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
  - 4. “CMP”: Communications Media Plenum, plenum rating; synonymous with “MPP”
  - 5. “CMR”: Communications Media Riser, non-plenum riser rating; synonymous with “MPR”
  - 6. “FEP”: Fluorinated Ethylene Propylene
  - 7. “PVC”: PolyVinyl Chloride
  - 8. “Permanent Link”: Test configuration for a horizontal cabling link excluding test

ords, connections at the ends of the test cords, patch cords, equipment cords, line cords; e.g., the 'permanent' portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.

9. "UTP": Unshielded Twisted Pair

## 1.05 SYSTEM DESCRIPTION

### A. Work Covered Under Other Sections

1. Telecommunications Rooms: The buildout of telecommunications rooms (sleeves, cable runway, rack bay, etc.) is covered under another section.
2. Telecommunications Pathways:
  - a. Refer to the Drawings for size (capacity) and route information for pathway system components.
  - b. The overhead cable support in and the exit pathways from the MDF and IDF to the workspaces are covered under another section.
  - c. The pathway system components (cable hangers, etc.) throughout the ceiling space to the device location are covered under another section.
  - d. The conduit stubs and device boxes at the wall and in-floor outlets are covered under another section.

### B. Base Bid Work

1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications Horizontal Cabling System installation described in these specifications. Consider horizontal cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
2. In general, the base bid work includes:
  - a. Submittals
  - b. Horizontal cables, terminations, and outlets
  - c. Cable management
  - d. Patch cords and cross-connects
  - e. Cable identification tags and system labeling
  - f. Record Documents
  - g. Warranty

## 1.06 SUBMITTALS

- A. Comply with the Submittals article of Section 16700 for procedural, quantity, and format requirements.
- B. Submittal Requirements at Start Of Construction:
  1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
  2. Sample Submittal, consisting of the following components:
    - a. Type "A" Outlet Sample – A fully configured outlet including faceplate,

modular jacks, and label.

b. Cable Label Sample.

3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 167xx series Sections.
4. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations.

C. Submittal Requirements at Closeout:

1. Record Drawings
2. Crossconnection records/cut sheets
3. O & M Manuals.

#### 1.07 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 16700.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of Section 16700, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

#### 1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with the Delivery, Storage and Handling requirements of Section 16700.

#### 1.09 WARRANTY

A. Comply with the Warranty requirements of Section 16700.

### PART 2 - PRODUCTS

#### 2.01 HORIZONTAL CABLE - PLENUM AND CAT6 RATED

A. Application: Suitable for indoor installation, above ceiling.

B. Conductors:

1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = PVC, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair), and individually color coded to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:

1. The cable shall have a seamless outer jacket (material = LS-PVC, or equivalent) applied to and completely cover the internal components (twisted pairs). The cable shall be unshielded.

- 2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.
- D. Electrical Performance: Meet or exceed TIA/EIA-568-B.2-1 and ISO/IEC 11801 requirements for CAT6 UTP cabling.
- E. Manufacturers, or equal:
  - 1. SYSTIMAX #2071-004EBL-4/23; CAT6 cable, CMP (plenum) rated, blue
  - 2. Panduit #PUP6004BU-UY; CAT6 cable, CMP (plenum) rated, blue
  - 3. Belden 7882A series cables
  - 4. BerkTek 2307xx series cables
  - 5. Commscope 7504 series cable

## 2.02 MODULAR PATCH CORDS – TYPE: DATA CAT6

- A. Application: Modular patch cords shall be suitable for indoor installation within a telecom room or workstation environment. Cords shall be assembled from a single, continuous length of cordage, homogenous in nature, and shall be terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.
- B. Cordage
  - 1. Insulated Conductors: 24 AWG stranded copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).
  - 2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), and individually color coded.
  - 3. Sheath shall be unshielded, and shall be flame-retardant polyvinyl chloride (PVC) jacketed.
  - 4. Flame Rating: NEC CM (or higher) rated, and UL listed as such.
- C. Electrical Performance: Comply with TIA/EIA-568-B for CAT6 UTP patch cords and Channel requirements (minimum).
- D. Manufacturer, or equal:
  - 1. SYSTIMAX D8CM series patch cords
  - 2. Panduit #UTPCH7
- E. No allowance for furnishing or installing cords for use at the workstations (from the outlet to the end user equipment) will be required for this contract. The Owner will provide these cords.

## 2.03 CROSSCONNECT WIRE

- A. Refer to 16711/2.02 for termination apparatus.

## 2.04 TERMINATION EQUIPMENT – 110 BLOCK

- A. Refer to 16711/2.02 for termination apparatus.
- B. The components/accessories for the horizontal cabling shall be fully compatible, in the opinion of the Engineer, with the termination apparatus specified under Section



16711.

C. The components/accessories for the horizontal cabling shall be 4-pair based.

D. Manufacturer, or equal:

1. SYSTIMAX #110C-4 (103 801 247); 110 IDC connector, 4-pair
2. Panduit #P110CB4; 110 IDC connector, 4-pair

## 2.05 TERMINATION EQUIPMENT – MODULAR PATCH PANEL

A. Application: Modular patch panels shall be suitable for installation within a telecommunication facility, shall be horizontally oriented for a rack mounted configuration, and shall be fully compatible for the termination of the cables specified herein. Modular patch panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and the equipment termination field.

B. Modular patch panels shall have 110-type termination for the cables, and shall have 48 ports each. Each port shall be a CAT6 8 position modular jack, T568A wired.

C. Manufacturer, or equal:

1. SYSTIMAX #1100GS3-48 (700 173 768); “GigaSpeed” CAT6 modular patch panel, 48 ports
2. Panduit #DP48688TGY; “DP6 PLUS” CAT6 modular patch panel, 48 ports

## 2.06 MODULAR CONNECTORS – CAT6 CABLING

A. Application: Suitable for indoor installation, at a workstation area and shall be fully compatible for the termination of the cables specified herein.

B. Modular connectors/jacks shall be CAT6 rated.

C. Modular connectors/jacks shall be T568A wired.

D. Manufacturer, or equal:

1. SYSTIMAX “GigaSpeed” series modular connectors:
  - a. #MGS400-262; CAT6 8-position “GigaSPEED XL” jack, white
  - b. #MGS400-318; CAT6 8-position “GigaSPEED XL” jack, blue
2. Panduit “Giga-Channel Mini-Jack” series modular connectors
  - a. #CJ688TGWH; CAT5e 8-position jack “Mini-Com” series “TX6 Plus”, White
  - b. #CJ688TGBU; CAT5e 8-position jack “Mini-Com” series “TX6 Plus”, Blue

## 2.07 WORKSTATION OUTLETS

A. Flush Mount Outlets – Standard Faceplates

1. Application: Suitable for indoor installation, at a workstation area.
2. Faceplates shall include required accessories, such as icons, blank inserts, labels and label windows
3. Manufacturer, or equal:

- a. SYSTIMAX "M-Series" faceplate with labels
    - 1) #M10LE-262; faceplate, 1-gang, 1 port, White
    - 2) #M12AP-262; faceplate, 1-gang, 2 port, White
    - 3) #M14LE-262; faceplate, 1-gang, 4 port, White
  - b. Panduit "Executive Series" faceplate with labels
    - 1) #UICFPH2WH; faceplate, "Ultimate ID Classic" series, 1-gang, horizontal, 2 ports, white
    - 2) #UICFPH4WH; faceplate, "Ultimate ID Classic" series, 1-gang, horizontal, 4 ports, white
- B. Flush Mount Outlets – Standard Wall Phone Faceplates
- 1. Application: Suitable for indoor installation, at a workstation area, and suitable to accept a wall-mountable telephone.
  - 2. Wall phone faceplates shall come equipped with 1 modular jack and 2 mounting studs.
  - 3. Manufacturer, or equal:
    - a. SYSTIMAX #M10LW series wall phone faceplate
    - b. Panduit #KWP6P wall phone faceplate

## 2.08 LABELS

- A. General: Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Horizontal Cable Labels
- 1. Labels shall be adhesive backed and have a self-laminating feature.
  - 2. Labels shall fit the horizontal cables listed above (i.e., shall fully wrap around the cable's jacket).
  - 3. Printable Area shall be 2" x 0.5", minimum, in size, and shall be white in color.
  - 4. Manufacturer, or equal: Panduit #LJSL7-Y3-1; laser/ink jet labels for cable diameters 0.16"-0.32", white.
- C. Modular Patch Panels
- 1. Labels shall be adhesive backed.
  - 2. Labels shall fit above the port without overlap to the next port or to the port itself.
  - 3. Printable Area shall be 0.61" x 0.33", minimum, in size, and shall be white in color.
  - 4. Manufacturer, or equal: Panduit #CPPLF-5; laser labels for modular patch panels, white
- D. 110 Termination Block Labels
- 1. Labels shall be fully compatible, in the opinion of the Engineer, with the block.
  - 2. Color: Blue, for horizontal termination field.
  - 3. Manufacturers, or equal:

- a. SYSTIMAX #110BB2-4500L (106 657 174); label inserts, blue, 4-pair
- b. Panduit #DSL110-BU; label inserts, blue, 4-pair

## 2.09 MISCELLANEOUS COMPONENTS

### A. Velcro Cable Ties

- 1. Width: .75".
- 2. Color: Velcro cable ties shall be the same color as the cable to which it is being applied.
- 3. Manufacturer: Panduit #HLS-15R-0 Black, 15' roll, cut to length, or equal.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Comply with the General Execution requirements of Section 16700.

### 3.02 INSTALLATION

#### A. Horizontal Cable

- 1. General
  - a. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
- 2. Installation
  - a. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
  - b. Maintain pulling tension within manufacturer's limits.
  - c. Protect cable during installation. Replace cable if damaged during installation.
  - d. Place cables with no kinks, twists, or impact damage to the sheath.
- 3. Routing
  - a. Maintain maximum cable length of 90 meters from the termination in the IDF to the termination at the user's faceplate.
  - b. When routing horizontally within telecom rooms, utilize the overhead cable tray/runway. When routing vertically within telecom rooms, utilize the wall mounted vertical cable runway and support every 24 inches on center using cable ties.
  - c. Place and suspend cables in a manner to protect them from physical interference or damage.
  - d. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
  - e. When routing cables in areas without cable tray/runway, support cables every 5 feet on center utilizing cable hangers.
  - f. Provide dedicated supports for cable hangers (e.g., do not clip hanger to existing ceiling support wire).
  - g. Route station cable homeruns at 90-degree angles, allowing for bending radius, along corridors for ease of access. Do not route through an adjacent

space if a corridor borders at least one wall of the room.

4. Slack

- a. In the Telecommunications Rooms, provide a 10 feet (minimum) sheathed cable slack loop at each end of the run. Place the slack in the overhead cable tray/runway. At the workstation, place cable in ceiling space supported from a cable hanger.
- b. At the workstation, provide a 10 feet (minimum) sheathed cable slack loop at each end of the run. Place the slack in the ceiling space supported from a cable hanger.
- c. Within the device, provide six inches (minimum) of sheathed cable slack behind each workstation outlet faceplate. The slack cable shall be coiled inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.

5. Termination

- a. At the equipment bay in the Telecommunications Room, divide horizontal cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination.
- b. Properly strain relieve cables at termination points per manufacturer's instructions.
- c. Terminate copper pairs at both ends on the specified connecting hardware.
- d. Perform terminations in accordance with manufacturer's instructions and TIA/EIA-568-B standard installation practices.
- e. Perform post-installation testing as described in the Telecommunication Testing specification.

B. Outlet Faceplates

1. Mount faceplates plumb, square, and at the same level as adjacent device faceplates.
2. Patch gaps around faceplates so that faceplate covers the entire opening.

C. Outlet Modular Connectors

1. Terminate pairs of the voice and data cables onto the connector. Terminations shall conform to manufacturer's latest wiring requirements for connector.
2. Replace terminations and connectors not passing the required media test.

D. Termination Block for Horizontal Voice Cabling

1. Refer to Section 16711 Article 3.04 for installation requirements.
2. Provide 4-pair based accessories required for a complete installation.

E. Modular Patch Panels for Horizontal Data Cabling

1. Provide modular patch panels in a quantity to allow termination of data cables served from respective IDF. Install into rack bays as shown on Drawings.
2. Mount the modular patch panels in association with the horizontal management panels such that a management panel is mounted above and below given modular patch panel. The 'middle' management panels will be shared between

the modular patch panels above and below given management panel.

3. Assemble and install according to the manufacturer's instructions.

#### F. Data Patching

1. In IDF, provide one data CAT6 modular patch cord per data link from of the horizontal data termination field to the data network switch. Utilize the horizontal and vertical management components to properly route the patch cord.

#### G. Voice 'Patching' (Crossconnects)

1. In IDF, provide one 1-pair crossconnect to length from pair #1 per voice link of the horizontal voice termination field to an available pair on the backbone voice termination field. Record crossconnections for MDF crossconnection purposes (refer to 16711/3.04/C) and for record documents. Utilize the horizontal and vertical management components to properly route the crossconnect wire.
2. Color:
  - a. For digital handsets, provide: White-Blue / Blue-White
  - b. For analog handsets, provide: White-Red / Red-White
3. Splices in crossconnect wire are prohibited.

### 3.03 LABELING

#### A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner's Representative before installation.
2. Labels shall be permanent with machine-generated text; hand written labels will not be accepted.

#### B. Label Formats

1. Horizontal Cable Labels
  - a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
  - b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
2. Modular Patch Panel Labels
  - a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.
  - b. Use a label color for the respective field type, per TIA/EIA-606.
  - c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.
3. 110 Termination Block Labels
  - a. Provide 4-pair marked blue labels for horizontal field.
  - b. Text Attributes: Black, 3/32" high, minimum, or #10 font size.
4. Outlet Labels
  - a. Use outlet labels included in the product packaging. Request approval by the

Engineer for other labels.

- b. Label Background: White.
- c. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
- d. Install label in the top label window. The bottom label window shall be left blank.

### C. Identifier Assignment

1. General: Separate label fields of the identifier with a hyphen.
2. Horizontal Cables
  - a. First field: the originating MDF/IDF room identity; for example: "O1.1".
  - b. Second field: the destination room number; for example: "207".
  - c. Third field: the cable's intended service type followed by a unique sequential number; for example: "V1" (voice, cable #1) or "D2" (data, cable #2).
  - d. Fourth field: the cable type; for example: "CAT6".
  - e. Example: "O1.1-207-D2-CAT6"
3. Outlets
  - a. First field: originating MDF/IDF/SDF room identity; for example: "O1.1".
  - b. Second field: destination room number; for example: "207".
  - c. Third field: a unique sequential number; for example: "01".
  - d. Example: "O1.1-207-01"
4. Individual Ports at the Outlets
  - a. Though the faceplate may have individual port numbers molded into the product, provide port labels as follows.
  - b. First field: the cable's intended service type followed by a unique sequential number; for example: "V1" (voice, cable #1) or "D2" (data, cable #2).
5. Individual Termination Positions at the 110 Termination Blocks
  - a. First field: the End User Room Number; for example: "207".
  - b. Second field: the cable's intended service type followed by a unique sequential number; for example: "V1" (voice, cable #1).
  - c. Example: "207-V1"
6. Individual Ports at the Modular Patch Panels
  - a. First field: the End User Room Number; for example: "207".
  - b. Second field: the cable's intended service type – for example: "D" (data), and a unique sequential number – for example: "2".
  - c. Example: "207-D2"

### 3.04 FINAL INSPECTION

- A. Inspect installed products and work in conjunction with the Owner or Owner's Representative. Develop a punch list for items needing correction.
- B. Issue punch list to Engineer for review prior to performing punch list with the Engineer.

- C. Repair defects prior to system acceptance.
- D. Inspect installed products and work in conjunction with the Engineer for sign off.

END OF SECTION 16710





## SECTION 16711

### TELECOMMUNICATIONS BACKBONE TWISTED PAIR CABLING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes: Backbone outside plant (OSP) and indoor (ISP) twisted pair cabling.
- B. Related Sections
  - 1. Comply with the Related Sections paragraph of Section 16700.
  - 2. 16719 Telecommunications Testing.

##### 1.03 REFERENCES

- A. Comply with Section 16700 References requirements.

##### 1.04 DEFINITIONS

- A. Refer to Section 16700 for Definitions.
- B. In addition, the following list of terms as used in this specification shall be defined as follows:
  - 1. "BEP": Building Entrance Protection [systems]
  - 2. "CMP": Communications Media Plenum [NEC plenum rating]
  - 3. "CMR": Communications Media Riser [NEC riser/non-plenum rating]
  - 4. "HDPE": High Density Polyethylene
  - 5. "ISP": Inside Plant [cabling]
  - 6. "LDPE": Light Density Polyethylene
  - 7. "OSP": Outside Plant [cabling]
  - 8. "PE": Polyethylene
  - 9. "PIC": Plastic Insulated Conductor
  - 10. "PVC": Polyvinyl Chloride

##### 1.05 SYSTEM DESCRIPTION

- A. General: Refer to Section 16700 for a full description of the project and building.
- B. Work Covered Under Other Sections
  - 1. Telecommunications underground pathways (conduits, pullboxes, etc.) will be

covered under another section. Refer to the Drawings for size/capacity and route information.

2. Telecommunications Rooms: The buildout of telecommunications rooms (sleeves, cable runway, rack bay, etc.) is covered under another section.
3. Telecommunications Pathways:
  - a. Refer to the Drawings for size (capacity) and route information for pathway system components.
  - b. The conduits from the MDF to the IDF is covered under another section.

#### C. Base Bid Work

1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone twisted pair cabling system installation described in these specifications.
2. The Drawings are diagrammatic in nature.
3. Consider backbone cabling shown on the Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
4. In general, the base bid work includes:
  - a. Submittals
  - b. Backbone outside plant (interbuilding) twisted pair (copper) cables
  - c. Building entrance protection and terminals
  - d. Splicing apparatus
  - e. Backbone inside plant (riser) twisted pair (copper) cables
  - f. Terminations
  - g. Cable management
  - h. Crossconnects
  - i. Cable identification tags and system labeling
  - j. Record Documents
  - k. Warranty

### 1.06 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 16700.
- B. Submittal Requirements Prior To Start Of Construction:
  1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
  2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 167xx series Sections.
- C. Submittal Requirements at Closeout:
  1. As-Built Drawings.
  2. Crossconnection records/cut sheets.
  3. O & M Manuals.

## 1.07 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 16700.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of Section 16700, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

## 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 16700.

## 1.09 WARRANTY

- A. The telecommunications cabling system, as specified in this section, shall carry a 15 year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-B performance criteria for backbone cabling.

## PART 2 - PRODUCTS

### 2.01 UNDERGROUND CABLES

A. Application:

1. Cable shall be suitable for outdoor installations, within underground conduit.
2. Cable shall be twisted pair PIC type cable, filled core, with an "ASP" sheath. Cable shall be compatible with Bell System type "ANMW" and RUS type "PE89".

B. Conductors:

1. Conductors shall be 24 AWG annealed solid copper.
2. Conductors shall be fully insulated. Insulation shall consist of an inner layer of expanded PE, covered with an outer layer (skin) of solid PE.
3. Conductors shall be twisted into pairs. Twisted pairs are stranded into 25-pair bundles and into units (and super units, if required by pair count).
4. Color Coding: Twisted pairs and units (supper units, if necessary) shall be individually color coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

C. Core & Sheath:

1. Cable core (twisted pairs) shall have a tape applied longitudinally (wrapped around it's entirety). Tape Material: non-hydroscopic polypropylene film, or equivalent.
2. Filled: Cable core and sheath shall be flooded with filling compound to protect against moisture penetration. Filling compound: "FLEXGEL", or equivalent.

3. Sheath Type: "ASP". Sheath shall consist of a shield and an outer jacket.
  - a. Shield: Dual corrugated tape of inner aluminum and outer steel longitudinally applied, with a locking overlap.
  - b. Jacket: PE, bonded to shield.

D. Manufacturers, or equal:

1. General Cable
  - a. #6987705; 25-pair filled ASP cable
  - b. #6987713; 50-pair filled ASP cable
2. Superior Essex
  - a. #22-097-83; 25-pair filled ASP cable
  - b. #22-100-83; 50-pair filled ASP cable

## 2.02 SPLICE CLOSURES AND ACCESSORIES

A. Splice Closure – Underground Vault Type

1. Application: Splice closure system shall be suitable for outdoor installation within underground vault and/or maintenance hole.
2. Enclosure:
  - a. Enclosure shall be re-enterable.
  - b. Through-splice or butt-splice configurations will be accepted.
  - c. Size enclosure based on splice bundle diameter and largest incoming cable.
3. Manufacturer:
  - a. 3M "Better Burried" series gravity filled closures
  - b. 3M #4460; shield bond connector for cables 100-pair or larger
  - c. 3M #4460-D; shield bond connector for cables 100-pair or smaller
  - d. 3M #25T Ground Braid or #25T Ground Braid with Eyelets

B. Splice Closure – Building Entrance Type

1. Application: Splice closure system shall be suitable for indoor installation within entrance facilities for splicing between OSP and ISP cable.
2. Closure:
  - a. Enclosure shall be re-enterable.
  - b. Through-splice or butt-splice configurations will be accepted.
  - c. Solid or split sleeve will be accepted.
  - d. Size enclosure based on splice bundle diameter and largest incoming cable.
3. Include all required accessories, such as collars, grommets, bushings, bonding connectors, etc. for a complete installation.
4. Closure system shall be air and watertight. Closure system shall be RUS listed and UL approved.
5. Manufacturer, or equal:
  - a. 3M #5-26, 600 pair, solid enclosure.
  - b. 3M #5DS-26, 600 pair, split enclosure.

- c. 3M #C5-100-6, end caps to be sized to cable entry and exits.
- d. 3M #4460; shield bond connector for cables 100-pair or larger
- e. 3M #4460-D; shield bond connector for cables 100-pair or smaller
- f. 3M #25T Ground Braid or #25T Ground Braid with Eyelets

#### C. Encapsulant

- 1. Application: Encapsulant shall be suitable for outdoor installation within underground splice closures (vault and/or maintenance hole).
- 2. Encapsulant shall be re-enterable.
- 3. Manufacturer, or equal: 3M #4442; "High Gel" re-enterable encapsulant

### 2.03 SPLICE MODULES

#### A. Entrance Type Splice Module (710 Dry Straight)

- 1. Application: Cable transition (OSP to ISP) in telecom rooms.
- 2. Modules shall accept mixed solid wire gauges (26 AWG – 19 AWG).
- 3. Modules shall accept mixed insulation types (PIC, PVC, pulp or paper insulated conductors), up to maximum insulation outside diameter of (.70).
- 4. Manufacturer, or equal: 3M Telcom Systems #3M710-SD1-25

#### B. Vault Type Splice Module (710 Filled Straight)

- 1. Application: In-line or branch splicing of OSP cables in underground vaults or manholes.
- 2. Modules shall accept mixed solid wire gauges (26 AWG – 19 AWG).
- 3. Modules shall accept PIC or PVC insulation.
- 4. Modules shall be "preloaded" (filled) with water resistant compound.
- 5. Manufacturer, or equal: 3M Telcom Systems #3M710-SC1-25

### 2.04 BUILDING ENTRANCE PROTECTION

#### A. General: BEP terminals shall offer 110-compatible "output" connection type.

#### B. BEP Terminal – Swivel Stub Input

- 1. Application: BEP terminal shall be suitable for indoor installation, within a telecom room (such as an Entrance Facility or 'MPOE'). BEP terminals shall provide termination of the backbone twisted pair cables and shall protect premises equipment against induced voltages and stray currents.
- 2. Configuration: BEP terminal shall be designed for a wall mounted configuration, shall have the capacity to accept 50 / 100 incoming and outgoing pairs, and shall accept '5-pin' protector modules.
- 3. Media Interface: Incoming media interface shall be 100-pair 26 AWG UTP 'fusible' swivel stub.

4. Manufacturer, or equal: SYSTIMAX
  - a. #489ACC1-050 (107 894 958); 50-pair BEP terminal
  - b. #489ACC1-100 (107 894 966); 100-pair BEP terminal

C. BEP Modules – Without Sneak Current Protection

1. BEP modules shall be standard 5-pin type, and be suitable for installation into BEP terminals.
2. Overvoltage Device: solid state. DC Breakdown Voltage: 220 V. Response time: <100 nsec.
3. Manufacturer: SYSTIMAX #3C1S (105 514 756), or equal.

D. BEP Modules – With Sneak Current Protection

1. BEP modules shall be standard 5-pin type, and be suitable for installation into BEP terminals.
2. Overvoltage Device: solid state. DC Breakdown Voltage: 220 V. Response time: <100 nsec.
3. Sneak Current Device: heat coil. Sneak Current: 1 A. Response Time: < 15 sec.
4. Manufacturer, or equal: SYSTIMAX #4C1S (104 386 545)

## 2.05 BUILDING TWISTED PAIR CABLES – SHIELDED, NON-PLENUM

A. Application:

1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in cable tray, conduit, & hangers).
2. Each and every cable run shall be a continuous single cable, homogenous in nature. Splices are not permitted anywhere.
3. Cable shall be twisted pair PIC type cable, air core, with an “ALVYN” sheath. Cable shall be compatible with Bell System type “ARMM”.

B. Conductors:

1. Conductors shall be 24 AWG annealed solid copper.
2. Conductors shall be fully insulated. Insulation shall consist of an inner layer of expanded polyolefin, covered with an outer layer (skin) of solid PVC.
3. Conductors shall be twisted into pairs. Twisted pairs are stranded into 25-pair bundles and into units (and super units, if required by pair count).
4. Color Coding: Twisted pairs and units (super units, if necessary) shall be individually color coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

C. Core & Sheath:

1. Cable core (twisted pairs) shall have a tape applied longitudinally (wrapped around it's entirety). Tape Material: non-hydroscopic polypropylene film, or equivalent.
2. Sheath Type: “ALVYN”. Sheath shall consist of an inner shield and an outer

jacket.

- a. Shield: Aluminum, 0.008", corrugated tape applied longitudinally, with an overlap.
  - b. Jacket: Flame-retardant PVC, adhesively bonded to shield.
3. Cable shall be NEC rated as CMR, and UL listed as such.

D. Performance:

1. Electrical performance of the twisted pairs and overall cable shall comply with TIA/EIA-568-B Part 2 requirements for Category 3 UTP cabling.

E. Manufacturers, or equal:

1. General Cable
  - a. #2019000; 25-pair filled ASP cable
  - b. #2019001; 50-pair filled ASP cable
2. Superior Essex
  - a. #22-062-03; 25-pair ARMM cable
  - b. #22-065-50; 50-pair ARMM cable

## 2.06 TERMINATION EQUIPMENT

A. Termination Apparatus – 110 Type

1. Application: suitable for indoor installation, within telecommunications room for the termination of the backbone twisted pair (and horizontal twisted pair) cables.
2. Each termination block shall be 110 type, and have a 300-pair capacity. The blocks shall be vertically oriented for a wall mounted column configuration.
3. The termination blocks shall be accompanied by the appropriate quantity of management panels, for horizontal and vertical routing of crossconnect wires.
4. The termination blocks, with the management panels, shall be capable of supporting, organizing, labeling and patching/ crossconnecting the backbone twisted pair cables (as shown on the Drawings).
5. Manufacturers, or equal:
  - a. SYSTIMAX #110PA2-300FT (107 058 802); 110 block, 300 pairs, 5-pair
  - b. SYSTIMAX #188D3 (107 151 193); vertical management panel
  - c. Panduit #P110KT3005Y; 110 block, 300 pairs, 5-pair
  - d. Panduit #P110VCM300; vertical management panel

## 2.07 CROSSCONNECT WIRE

- A. Crossconnect wire shall be suitable for installation within a telecommunication facility and fully compatible with the termination apparatus. Each and every crossconnect wire shall be manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere.
- B. Factory splices of insulated conductors are expressly prohibited.
- C. Conductors:
  1. Insulated Conductors: Conductors shall be 24 AWG solid copper. Conductors

shall be fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).

2. Twisted Pairs: Two insulated conductors shall be “twisted” into a “pair” (twisted pair). Twisted pairs shall be individually color coded.

D. Manufacturer, or equal: SYSTIMAX

1. CCW-F 1/24 S1000 (105 597 231) crossconnect wire, 1 pair, Whi-Red / Red-Whi
2. CCW-F 1/24 S1000 (105 597 264) crossconnect wire, 1 pair, Whi-Blu / Blu-Whi

## 2.08 MISCELLANEOUS MATERIALS

### A. Cable Labels

1. General: Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer. Labels shall be adhesive backed and have a self-laminating feature.
2. Printable Area: 2” x 0.5”, minimum.
3. Color: White.
4. Manufacturer, or equal: Panduit
  - a. LJSL7-Y3-1; laser/ink jet labels for cable diameters 0.16”-0.32”, white
  - b. LJSL8-Y3-1; laser/ink jet labels for cable diameters 0.31”-0.69”, white
  - c. LJSL19-Y3-1; laser/ink jet labels for cable diameters 0.31”-1.42”, white

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Comply with the General Execution requirements of Section 16700.

### 3.02 EXAMINATION

- A. Pathways: Prior to installation, verify pathways (conduits, etc.) exist, are complete, and are ‘ready’ to accept backbone twisted pair cables.
- B. Telecommunications Rooms: Prior to installation, verify telecommunications rooms are ‘ready’ to accept the backbone twisted pair cables and terminations.

### 3.03 PREPARATION

- A. The Contractor is solely responsible to verify that the twisted pair cable is fully operational – both cable sheath and twisted pair conductors – prior to installation.
- B. Documentation of pre-installation testing is not a close out requirement, and shall be the responsibility of the Contractor.

### 3.04 INSTALLATION

#### A. Backbone Cable

1. General
  - a. Cable runs shall have continuous sheath continuity, homogenous in nature.



Splices are not permitted anywhere.

2. Placement
  - a. Place cables within designated pathways.
  - b. Only use UL approved cable-pulling compounds for OSP cables when necessary to reduce pulling tensions. Do not use cable-pulling compound for ISP cable placement.
  - c. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
  - d. Maintain pulling tension within manufacturer's limits.
  - e. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cable if damaged during installation.
3. Routing
  - a. Maintain maximum cable length of 1,500 meters from the termination at the MDF to the termination in IDF.
  - b. When routing horizontally within telecom rooms, utilize the overhead cable tray/runway. When routing vertically within telecom rooms, utilize the wall mounted vertical cable runway and support every 24 inches on center using cable ties.
  - c. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
4. Slack
  - a. Provide a 10 feet (minimum) sheathed cable slack loop at each end of the run. Place the slack in the overhead cable support.
5. Termination
  - a. Properly strain relieve cables at termination points per manufacturer's instructions.
  - b. Perform terminations in accordance with manufacturer's instructions and TIA/EIA-568-B standard installation practices.
  - c. Perform post-installation testing as described in the Communication Testing specification.

#### B. Building Entrance Splicing Systems

1. Provide entrance splice system as shown on the Drawings, including closure, end caps, splice modules, grounding components, and all accessories required for a complete installation. Install splice closure and splice modules per manufacturer's instructions using tools intended for the purpose.
2. Attach splice enclosure to vertical cable runway on wall with metal straps .
3. Fill unused end cap entry holes with appropriate plug (intended for purpose) for future use.
4. Thoroughly clean and separate all binder groups prior to installing splice modules.
5. Grounding and Bonding
  - a. Bond splice enclosure and cable shield to closet busbar using bonding conductor per manufacturer's instructions and/or TIA-607 requirements.

- b. Size bonding conductor 6 AWG up to 25 feet in length; size as 1000 circular mils per foot if longer than 25 feet.
  - 6. Labeling
    - a. Provide labels on each splice module and binder group in splice closure.
- C. Building Entrance Protection
  - 1. Provide BEP system as shown on the Drawings, including terminals, modules, and all accessories required for a complete installation. Install BEP per manufacturer's instructions.
  - 2. Install BEP terminals plumb and square, and at height shown on Drawings. If no height is shown, install such that bottom row is at 24" AFF (+/- 3") .
  - 3. Provide quantity of protector modules to completely populate terminals .
  - 4. Grounding and Bonding
    - a. Bond BEP terminal to closet busbar using bonding conductor per manufacturer's instructions and/or TIA-607 requirements.
    - b. Size bonding conductor 6 AWG up to 25 feet in length; size as 1000 circular mils per foot if longer than 25 feet.
  - 5. Labeling
    - a. Provide and permanently affix label on the terminal's cover.
    - b. Provide label in the label holder at the terminal's "outgoing" connection.
  - 6. Provide quantity of protector modules to completely populate terminals .
- D. Termination Apparatus
  - 1. Provide accessories required for a complete installation.
  - 2. Install the termination blocks such that the bottom row of terminations is at a height as shown on the Drawings. If no height is shown, install top at 5'-6" AFF (+/- 3").
  - 3. Mount blocks plumb and square.
- E. Crossconnects
  - 1. In the MDF, provide one 1-pair crossconnect to length from the equipment field to the backbone field based on the records from the IDF crossconnections.
  - 2. Utilize the horizontal and vertical management components to properly route the crossconnect wire.
  - 3. Color: Comply with color requirements of 16710 / 3.02 / G.
  - 4. Splices in crossconnect wire are prohibited.

### 3.05 LABELING

#### A. General Requirements

- 1. Labeling and identifier assignment shall conform to the TIA/EIA-606 Administration Standard and as approved by Owner's Representative before installation. Label colors shall conform to the TIA/EIA-606 Administration Standard.

2. Provide permanent and machine-generated labels; hand written labels will not be accepted.

## B. Label Formats

### 1. Cable Labels

- a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
- b. Provide labels on both ends of cables. Install labels no more than 4" from the edge of the cable jacket. Fully wrap label around the cable jacket. Install labels such that they are visible by a technician from a normal stance.

### 2. BEP Labels – “Output” Connection

- a. Text shall black, and shall be 3/32" high, minimum, or #10 font size.
- b. Labels shall either be included in the product packaging or shall be fully compatible, in the opinion of the Engineer, with the specified termination apparatus.

### 3. Termination Apparatus Labels

- a. Use labels included in the product packaging. Request approval by the Engineer for substitutions.
- b. Provide white label respective field type, per TIA/EIA-606.
- c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

## C. Identifier Assignment

1. General: Separate label fields of the identifier with a hyphen.

### 2. ISP Backbone Twisted Pair Cables

- a. The first field shall identify the cable type: “CBT” (for Cable, Backbone, Twisted pair).
- b. The second field shall identify the originating termination room identifier as shown on the plans; e.g., “MDF”.
- c. The third field shall identify the ending termination room identifier as shown on the plans; e.g., “IDFO1.1”.
- d. The fourth field shall identify the beginning and ending pair counts.
- e. Identifier Example: “CBT-MDF-IDFO1.1-0001-0100”

### 3. BEP Terminal Cover

- a. The first field of the identifier shall be the other end of the cable’s room; e.g., “FROM MDF”.
- b. The second field of the identifier shall be the pair count; e.g., “0001-0600”.

### 4. BEP “Output” Connection

- a. The first field of the identifier shall be the destination room; e.g., “FROM IDF”.
- b. The second field of the identifier shall be the pair count range; e.g., “0201-0300”
- c. Identifier Example: “FROM MDF 0201 - 0300”

### 5. Termination Positions at the 110 Termination Blocks

- a. The first field of the identifier shall be the destination room; for example “TO IDF-O1.1”.
- b. The second field of the identifier shall be the pair count range; for example,

“0001-0100”

c. Identifier Example:

“TO IDF O1.1 0001 - 0100”

### 3.06 FINAL INSPECTION

- A. Inspect installed products and work in conjunction with the Owner or Owner’s Representative. Develop a punchlist for items needing correction.
- B. Issue punchlist to Engineer for review prior to performing punchlist with the Engineer.
- C. Repair defects prior to system acceptance.
- D. Inspect installed products and work in conjunction with the Engineer for sign off.

END OF SECTION 16711

## SECTION 16712

### TELECOMMUNICATIONS BACKBONE FIBER OPTIC CABLING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

###### A. Section Includes:

1. Backbone outside plant (OSP) fiber optic cabling
2. Outside plant innerduct
3. Conduit plugs and innerduct plugs
4. Backbone ISP (indoor) fiber optic cabling

###### B. Related Sections

1. Comply with the Related Sections paragraph of Section 16700.
2. 16719 Telecommunications Testing

##### 1.03 REFERENCES

- A. Comply with Section 16700 References requirements.

##### 1.04 DEFINITIONS

###### A. Refer to Section 16700 for Definitions.

###### B. In addition, the following list of terms as used in this specification shall be defined as follows:

1. "HDPE": High Density Polyethylene
2. "LDPE": Light Density Polyethylene
3. "MDPE": Medium Density Polyethylene
4. "MM": Multimode [fiber type]
5. "OFNP": Optical Fiber Non-conductive Plenum, plenum rating
6. "OFNR": Optical Fiber Non-conductive Riser, non-plenum riser rating
7. "OFN": Optical Fiber Non-conductive, general purpose indoor rating
8. "PE": Polyethylene
9. "PVC": PolyVinyl Chloride

## 1.05 SYSTEM DESCRIPTION

- A. General: Refer to Section 16700 for a full description of the project and building.
- B. Work Covered Under Other Sections
  - 1. Telecommunications underground pathways (conduits, pullboxes, etc.) is covered under another section. Refer to the Drawings for size/capacity and route information.
  - 2. Telecommunications Rooms: The buildout of telecommunications rooms (sleeves, cable runway, rack bay, etc.) is covered under another section.
  - 3. Telecommunications Pathways:
    - a. The conduits from the MDF to the IDF are covered under another section.
    - b. Refer to the Drawings for size (capacity) and route information for pathway system components.
- C. Base Bid Work
  - 1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications backbone fiber optic cabling system installation described in these specifications.
  - 2. The Drawings are diagrammatic in nature.
  - 3. Backbone fiber optic cabling as shown on Drawings shall be considered as base bid work, unless otherwise noted, including all terminations at both ends.
  - 4. In general, the base bid work includes:
    - a. Submittals
    - b. Innerduct, within underground pathways
    - c. Backbone outside plant fiber optic cables
    - d. Backbone inside plant (riser) fiber optic cables
    - e. Terminations, including connectors, panels, etc.
    - f. Cable management
    - g. Crossconnections / patching
    - h. Cable identification tags and system labeling
    - i. Record Documents
    - j. Warranty

## 1.06 SUBMITTALS

- A. Comply with Submittal procedural, quantity, and format requirements of Section 16700.
- B. Submittal Requirements Prior To Start Of Construction:
  - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
  - 2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 167xx series Sections.

C. Submittal Requirements at Closeout:

1. Copy of the manufacturer's printed reel documentation, including the following.
  - a. Manufacturer's reel number.
  - b. Manufacturer's traceable batch number.
  - c. Length of the fiber cable on the reel.
  - d. Maximum attenuation
  - e. Minimum bandwidth
2. Test results of the installed fiber optic cable – both printed copies and electronic copies.
3. As-Built Drawings.
4. Crossconnection records/cut sheets.
5. O & M Manuals.

1.07 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 16700.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of Section 16700, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 16700.

1.09 WARRANTY

- A. The telecommunications ISP backbone fiber optic cabling system, as specified in this section, shall carry a 15 year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 - PRODUCTS

2.01 OUTSIDE PLANT INNERDUCT AND ACCESSORIES

- A. Application: Outside plant innerduct shall be suitable for an outdoor installation within an underground conduit system for the support of telecommunications cables.
- B. Innerduct shall be circular and of uniform cross-section to the dimensions in accordance with ASTM D3035.
- C. Innerduct shall be a continuous length of smooth in/ribbed out with a low friction internal surface containing no welds or joints, coiled on a reel.
1. Innerduct shall be supplied containing a pulling medium such as tape or rope

(minimum pull tension rating of 1200 pounds).

- D. Innerduct shall be extruded from virgin high density polyethylene (HDPE) resin, in accordance to the requirements of ASTM D3350 Type III.
- E. Density, melt flow, tensile strength at yield, and environmental stress crack shall conform to the values listed ASTM D3350, except as noted below.
- F. Adequate stabilization shall be added during the manufacturing process to protect the polyethylene against thermal and UV degradation throughout the projected lifespan of the finished product.
- G. The innerduct shall conform to the dimensions as outlined in ASTM D3035.
- H. The base colors shall be white, orange, black, and yellow.
- I. Manufacturers: Dura-line #SDR 13.5, or equal.

## 2.02 DUCT PLUGS

### A. Conduit Plugs

- 1. Application: Plugs shall secure three 1 ¼-inch or four 1-inch innerducts within 4-inch conduit.
- 2. Manufacturers: Tyco, Carlon, or equal:
  - a. 4-inch triplex (three 1-1/4 inch innerducts) plug: Tyco #40B167S
  - b. 4-inch quadplex (four 1 inch innerducts) plug: Tyco #40Q136S

### B. Innerduct plugs

- 1. Application: Plugs shall secure cables within innerduct.
- 2. Manufacturers: Tyco, Carlon, or equal:
  - a. #10S035S; 1-inch fiber optic simplex plug
  - b. #11S057SB; 1 ¼-inch fiber optic simplex plug
  - c. #10D104U; 1-inch blank plug
  - d. #12D148U; 1 ¼-inch blank plug

## 2.03 UNDERGROUND FIBER OPTIC CABLES

### A. Application:

- 1. Cable shall be suitable for outdoor installations within underground pathways system and/or within innerduct/sub-ducting.
- 2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
- 3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

### B. Multimode 50/125 μm fiber strands shall meet or exceed the following geometry criteria:

- 1. Core diameter = 50 μm, ±3.0 μm.



2. Cladding diameter = 125  $\mu\text{m}$ ,  $\pm 1.0 \mu\text{m}$ .
  3. Core/Cladding Concentricity =  $\leq 3 \mu\text{m}$ .
  4. Minimum Tensile Strength = 100,000 psi.
- C. Multimode 50/125  $\mu\text{m}$  fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm wavelengths, maximum.
  2. Overfilled Bandwidth = 500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.
  3. Laser Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.
- D. Buffering:
1. Fibers shall be loosely buffered, either in a core tube or in multiple tubes around a central member.
  2. Buffer tube/tubes shall be filled with compound to protect against moisture penetration. Filling compound: "FLEXGEL", or equivalent.
  3. Each buffer tube shall be color-coded for identification, and shall meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, reference ANSI/ICEA Publication S-80-576, and EIA-230).
- E. Sheath:
1. Sheath shall consist of a strength member and an outer jacket, with non-metallic component dielectric sheath.
  2. Strength Member: Aramid yarn (e.g., Kevlar<sup>®</sup>), or reinforced fiberglass rods.
  3. Jacket: PE (MDPE or HDPE).
  4. Rated tensile load: 600 lb. maximum rated load.
  5. Operating Temperature Range: -40 to 158 °F (-40 to 70 °C)
- F. Manufacturers, or equal:
1. SYSTIMAX
    - a. #5024-012A-XXBK (760007377); Outdoor cable, dielectric sheath, 12-strand 50/125  $\mu\text{m}$
    - b. #5024-024A-XXBK (760007393); Outdoor cable, dielectric sheath, 24-strand 50/125  $\mu\text{m}$
  2. Corning Cable Systems
    - a. #012SW4-T4180D20; "ALTOS" gel-free sheath / outdoor cable, 12-strand 50/125  $\mu\text{m}$
    - b. #024SW4-T4180D20; "ALTOS" gel-free sheath / outdoor cable, 24-strand 50/125  $\mu\text{m}$

## 2.04 BUILDING FIBER OPTIC CABLES, NON-PLENUM RATED

### A. Application:

1. Cable shall be suitable for indoor installation, between telecommunications rooms within building conduit and/or between floors in vertical riser system.
2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

### B. Multimode 50/125 $\mu\text{m}$ fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 50  $\mu\text{m}$ ,  $\pm 3.0 \mu\text{m}$ .
2. Cladding diameter = 125  $\mu\text{m}$ ,  $\pm 1.0 \mu\text{m}$ .
3. Core/Cladding Concentricity =  $\leq 3 \mu\text{m}$ .
4. Minimum Tensile Strength = 100,000 psi.

### C. Multimode 50/125 $\mu\text{m}$ fiber strands shall meet or exceed the following performance criteria:

1. Attenuation = 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm wavelengths, maximum.
2. Overfilled Bandwidth = 500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.
3. Laser Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.

### D. Primary Coating:

1. Each fiber shall be completely covered with a "primary coating" (acrylate material).
2. Coating diameter = 250  $\mu\text{m}$ ,  $\pm 5 \mu\text{m}$ .

### E. Buffering:

1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900  $\mu\text{m}$ ,  $\pm 5 \mu\text{m}$ . Material = PVC, or equivalent flame retardant thermoplastic.
2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)

### F. Cable Sheath:

1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
2. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).

3. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
4. Flame Rating: NEC (Article 770) rated as OFNR cable, and UL listed as such.

G. Manufacturers, or equal:

1. SYSTIMAX #5200-012A-ZRAQ (700 208 150); 12 str, 50/125µm, aqua, OFNR rated
2. Corning Cable Systems #12S81-33180-24; 12 str, 50/125µm, aqua, OFNR rated

## 2.05 PATCH CORDS

A. Fiber Optic Patch Cord – 50 micron Multimode

1. Fiber patch cord shall be suitable for indoor installation within a fiber patch panel a telecom room onto. Cord shall be assembled from a single, continuous length of cordage, homogenous in nature, and shall be terminated at both ends via specified connector type. Splices are not permitted anywhere.
2. Cordage
  - a. Conductors: Two 50/125um multimode tight buffered fibers.
  - b. Strength Element: Aramid yarn (Kevlar).
  - c. Jacket: Flame-retardant PVC, or equivalent, in a 'zipcord' configuration.
  - d. NEC rated as OFN (or higher), and UL listed as such.
3. Connector Loss = 0.5dB per mated pair at both 850nm and 1300nm.
4. Manufacturers, or equal:
  - a. SYSTIMAX FZ2SC-SC series, for SC-to-SC 50/125 multimode cords
  - b. Panduit F5D3-3 series, for SC-to-SC 50/125 multimode cords

## 2.06 TERMINATION EQUIPMENT

A. Application:

1. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide patch cord management.
2. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.
3. Fiber optic patch panels shall be rack-mountable.

B. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.

C. Manufacturer:

1. SYSTIMAX:
  - a. #1000G2-4U-MOD-SD (760 023 200); "1000G2 Modular" type patch panel, 4U

- b. #600G2-1U-MOD-FX (760 028 332); "600G2 Modular" type patch panel, 1U
  - c. #MODG2-12LC-LS (760 032 136); "G2 Module" e/w 12 LazrSPEED MM LC adapters
2. Corning Cable Systems
    - a. #CCH-04U; "Connector Closet Housings" type patch panel, 4U, 12 adapter modules
    - b. #CCH-01U; "Connector Closet Housings" type patch panel, 1U, 2 adapter modules
    - c. #CCH-CP12-E4; Adapter Module e/w 6 duplex MM LC aqua adapters
  3. Panduit
    - a. #FMRE4; fiber optic patch panel, 4U, 12 adapter modules
    - b. #FRME1; fiber optic patch panel, 1U, 3 adapter modules
    - c. #FAP6WAQDLC: adapter panel with 6 duplex LC multimode adapters, aqua

## 2.07 CONNECTORS

### A. Multimode Fiber Optic Connectors – LC Type

1. Materials:
  - a. Ferrule: ceramic with pre-radiused finish/face
  - b. Connector Housing: Plastic
2. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
3. Connector shall be installable via either epoxy or anaerobic method.
4. Manufacturer:
  - a. SYSTIMAX
    - 1) #P1001A-Z-125R (760 034 181); LC type connector, MM, pre-radius zirconia ceramic, beige boot, for 0.9 mm buffered fiber
  - b. Corning Cable Systems
    - 1) #95-051-98-SP; LC type connector, ceramic ferrule, for 50/125 μm MM, aqua boot
  - c. Panduit
    - 1) #FLCSMEIY; LC type connector, zirconia ceramic, MM, elec ivory

## 2.08 MISCELLANEOUS COMPONENTS

### A. Cable Labels

1. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
2. Labels shall be adhesive backed and have a self-laminating feature.
3. Labels shall fit the backbone fiber cables listed above (i.e., shall fully wrap around the cable's jacket).
4. Printable Area shall be 2" x 0.5", minimum, in size, and shall be white in color.

5. Manufacturer: Panduit.
  - a. LJSL7-Y3-1; laser/ink jet labels, for cable diameters 0.16"-0.32", white
  - b. LJSL8-Y3-1; laser/ink jet labels, for cable diameters 0.32"-0.69", white
- B. Fiber Slack Storage Reel: Leviton #48900-OFR
- C. Velcro Cable Ties
  1. Width: .75".
  2. Color: Velcro cable ties shall be the same color as the cable to which it is being applied.
  3. Manufacturers: Panduit
    - a. #HLS-15R-0 Black, 15' roll, cut to length.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Comply General Execution requirements of Section 16700.

### 3.02 EXAMINATION

- A. Pathways: Prior to installation, verify pathways (underground conduits, building conduits, etc.) exist and are 'ready' to accept backbone twisted pair cables.
- B. Equipment Rooms: Prior to installation, verify equipment rooms are 'ready' to accept the backbone twisted pair cables and terminations.

### 3.03 PREPARATION

- A. Verify that the fiber optic cable is fully operational – both cable sheath and fiber strands – prior to installation.
- B. Documentation of pre-installation testing is not a close out requirement, and shall be the responsibility of the Contractor.

### 3.04 INSTALLATION

- A. Outside Plant Innerduct
  1. In conduit runs requiring innerduct (refer to Drawings), the duct must be filled with innerduct. Either three 1 ¼-inch innerducts or four 1-inch innerducts shall be used to fill one 4-inch conduit. It is not permissible for one innerduct to be pulled through a 4-inch conduit.
  2. Each innerduct shall have a unique color. Innerducts of a different color shall be placed (four or three depending on innerduct specified) shall be placed within each run on conduit. It is not permissible for two innerducts within the same conduit to be the same color.
    - a. Colors are white, orange, black, and yellow for four 1-inch innerducts within one 4-inch.
    - b. Colors are white, orange, and black for three 1 ¼-inch innerducts within one

4-inch conduit.

3. Secure innerduct at each pull point (e.g., pullbox or vault) and at building entrances using conduit plugs.
4. Secure each fiber optic cable within innerduct at each telecommunications vault, building entrance, and MPOE/MDF with a fiber optic simplex plugs sized depending upon the outside diameter of the cable.
5. Provide blank innerduct plugs at each end of unused innerducts.

## B. Backbone Cable

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Placement
  - a. Install cables within designated pathways.
  - b. Place outdoor cables in innerduct between points of termination throughout entire length (except at the fiber take up reel).
  - c. Bend Radius: Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
  - d. Pulling: Maintain pulling tension within manufacturer's limits.
  - e. Protection: Place and suspend cables in a manner to protect them from physical interference or damage.
  - f. Place cables with no kinks, twists, or impact damage to the sheath.
  - g. Only use UL approved cable-pulling compounds for outdoor cable placement when necessary to reduce pulling tensions. Do not use cable-pulling compounds for indoor cable placement.
  - h. Provide a 15 feet (minimum) sheathed cable slack loop at each end of the run within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall.
  - i. Place a pull rope along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull rope.
3. Routing
  - a. Within Telecommunications Rooms, neatly dress and organize cables on designated cable routing facilities (for example, cable runway), and fasten cables to cable routing facilities via tie wraps or Velcro-type straps.
  - b. When routing overhead within telecommunications rooms, neatly dress and organize cables on designated cable routing facilities (for example, cable runway), and fasten cables to cable routing facilities via tie wraps or Velcro-type straps. When routing vertically within telecommunications rooms, neatly dress and organize cables on designated wall-mounted vertical cable routing facilities (for example, vertical cable runway), and properly fasten cables to cable routing facilities via tie wraps or Velcro-type straps. "Properly fasten" shall consist of cable ties in a 'crossed' configuration per cable or cable bundle (up to three cables or innerducts) every 24 inches on center.

4. Termination
  - a. Properly strain relieve cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.
  - b. Terminate fiber strands via direct connectorization at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer's instructions.
  - c. Provide required accessories and consumables for the complete termination of fiber strands.
  - d. Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions.

C. Fiber Optic Cable Termination Panel

1. Provide fully assembled termination panel in designated equipment rack; locate per Drawings (if not shown, locate at the top). "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.

D. Fiber Optic Cable Termination Panel

1. Provide the termination panel in designated equipment rack; locate per drawings (if not shown, locate at the top).
2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.

### 3.05 LABELING

A. General Requirements

1. Labeling and identifier assignment shall conform to the TIA/EIA-606 Administration Standard and as approved by Owner's Representative before installation. Label colors shall conform to the TIA/EIA-606 Administration Standard.
2. Labels shall be permanent and machine-generated; hand written labels will not be accepted.

B. Label Formats

1. Cable Labels
  - a. Text shall black, and shall be 1/8" high, minimum, or #12 font size.
  - b. Provide labels on both ends of cables. Install labels no more than 4" from the edge of the cable jacket. Fully wrap label around the cable jacket. Install labels such that they are visible by a technician from a normal stance.
2. Termination Apparatus Labels
  - a. Labels shall either be included in the product packaging or shall be fully compatible, in the opinion of the Engineer, with the block system.

- b. Provide white label respective field type, per TIA/EIA-606.
- c. Text shall black, and shall be 3/32" high, minimum, or #10 font size.

C. Identifier Assignment

- 1. General: Separate all label fields of the identifier with a hyphen.
- 2. Backbone ISP Fiber Optic Cables
  - a. The first field shall identify the cable type: "CBF" (for Cable, Backbone, Fiber optic).
  - b. The second field shall identify the originating termination room identifier as shown on the plans; for example, "MDF".
  - c. The third field shall identify the ending termination room identifier as shown on the plans; for example, "IDFO1.1".
  - d. The fourth field shall identify the type and number of strands; for example, "Mxxx" where "M" stands for multimode and xxx stands for the ending fiber strand sequential count.
  - e. Example: "CBF-MDF-IDFO2.1-M024"
- 3. Termination Positions at the Termination Panels
  - a. The first field of the identifier shall be the destination room; for example "TO IDF-O1.1".
  - b. The second field of the identifier shall be the strand count range; for example, "M001-M024"
  - c. Identifier Example: "TO IDFO.1 M001 - M024"

3.06 FINAL INSPECTION

- A. Inspect installed products and work in conjunction with the Owner or Owner's Representative. Develop a punchlist for items needing correction.
- B. Issue punchlist to Engineer for review prior to performing punchlist with the Engineer.
- C. Repair defects prior to system acceptance.
- D. Inspect installed products and work in conjunction with the Engineer for sign off.

END OF SECTION 16712



**SECTION 16719**  
**TELECOMMUNICATIONS TESTING**

**PART 1 - GENERAL**

**1.01 SCOPE OF WORK**

- A. Section Includes: Testing of Telecommunications Cabling – both Backbone and Horizontal Cabling subsystems.
- B. Related Sections
  - 1. Consult all other Sections and Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to completely test a complete and operable system.
  - 2. Section 16700 – Basic Telecommunications Requirements
  - 3. Section 16710 – Telecommunications Horizontal Cabling
  - 4. Section 16711 – Telecommunications Backbone Twisted Pair Cabling
  - 5. Section 16712 – Telecommunications Backbone Fiber Optic Cabling
- C. Products Furnished and Installed Under Another Section:
  - 1. Backbone and Horizontal Cabling System

**1.02 REFERENCES**

- A. Comply with Section 16700References requirements.
- B. Additional references to those listed in Section 16700:
  - 1. TIA/EIA-526-14A (“OFSTP-14”) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
  - 2. TIA/EIA-526-7 (“OFSTP-7”) Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant
  - 3. TIA/EIA-455-171 Attenuation By Substitution Measurement – For Short-Length Multimode Graded-Index And Single-Mode Optical Fiber Cable Assemblies (a.k.a., FOTP-171)
  - 4. BICSI Telecommunication Distribution Methods Manual.

**1.03 DEFINITIONS**

- A. Refer to Definitions of Section 16700 and Sections 16710 through 16716.

- B. In addition, the following list of terms as used in this specification shall be defined as follows:
1. "Adapter" (associated with fiber connectivity): Shall mean a connecting device joining 2 fiber connectors, either like or unlike.
  2. "Channel": Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
  3. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
  4. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" shall be synonymous with the term "Jumper". The cord may be:
    - a. Unshielded twisted pair
    - b. Fiber (multimode or singlemode), jacketed & buffered
  5. "OTDR": Shall mean Optical Time Domain Reflectometer.
  6. "Passive Link Segment": Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units.
  7. "Permanent Link": Shall mean the 'permanent' portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
  8. "System Cord": Shall mean the cord used in the operating electrical or optical circuit.
  9. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

#### 1.04 SYSTEM DESCRIPTION

##### A. Existing Conditions

1. Refer to Sections 16700 through 16712 for a more complete System Description.
2. Backbone Cabling
  - a. The Backbone Cabling includes UTP and fiber cabling from the MDF to each IDF.
3. Horizontal Cabling
  - a. The Horizontal Cabling, in general, consists of 4-pair Category 6 UTP cables to each outlet. Some stations shall require additional cabling, such as Conference Rooms, etc. Refer to the plans for specific requirements.

##### B. Base Bid Work

1. Full testing of a completed communication infrastructure cabling system which includes:
  - a. Equipment and Procedure Submittals.

- b. Testing of the fiber optic passive link segment(s) per the following table:

**Table 16719-1.1: Tests For Fiber Optic Passive Link Segments**

Subsystem	Type	Test	Direction	Wavelength
Backbone	Multimode	Charaterization	Both	850nm and 1300nm
Backbone	Singlemode	Charaterization	Both	1310nm and 1550nm
Backbone	Multimode	Passive Link Ins. Loss	One	850nm and 1300nm
Backbone	Singlemode	Passive Link Ins. Loss	One	1310nm and 1550nm
Horizontal	Multimode	Passive Link Ins. Loss	One	850nm and 1300nm

- c. Testing of the multipair cabling as follows:

**Table 16719-1.2: Tests For UTP Cabling**

Subsystem	Type	Test	Configuration	Notes
Backbone	OSP	*see "Notes"	-	Wire map & length
Backbone	Riser	*see "Notes"	-	Wire map & length
Horizontal	CAT6	Category 6	Permanent Link	Per TIA/EIA-568-B.2-1

- d. Record Documents, including test results.

## 1.05 SUBMITTALS

- A. Refer to Submittals of to Section 16700 for procedural, quantity, and format requirements.
- B. Submittal Requirements at Start Of Construction:
1. Testing Procedures Submittal, describing step by step procedures used by the field technicians.
  2. Product Submittal, including cut sheets of testing equipment to be used (note all software/ firmware versions as applicable).
  3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 167xx series Sections.
- C. Submittal Requirements at Closeout:
1. Record Documents.
- D. Submittal Description: Record Documents

- E. Record Documents Record Documents shall include Test Reports showing the following information:
1. A title page which includes:
    - a. Client Name
    - b. Project Name
    - c. Project Address
    - d. Contractor's Name
    - e. Date of Submittal
  2. Individual tabs which break down the test results by building, and then by MDF and IDF room.
  3. All Backbone Fiber Optic "Post Installation" Passive Link Attenuation test results (utilize the forms provided in Part 4 of this specification for documentation of test results if the tester used does not have data storage capabilities) and Fiber Optic OTDR test results.
  4. All Backbone UTP test results.
  5. All Horizontal cable test results, per cable
  6. Furnish all test results on CD-ROM in their native data format and an exported Microsoft Excel compatible format.
    - a. Include all necessary software to allow viewing and printing of individual test results.
    - b. CD shall be labeled with the project name, contractor name, and date of submission.

#### 1.06 QUALITY ASSURANCE

- A. Comply with the Quality Assurance requirements of Section 16700

#### 1.07 WARRANTY

- A. Warrant the validity of the test results. Under no circumstances shall any cable's test results be substituted for another's. If a since instance of falsification is confirmed, the Contractor shall be liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. The manufacturer may change the product numbers listed in this Section at any time. In the event this Section contains an invalid product number or conflicts with the written description, notify the Engineer in writing prior to issuing submittals or field testing.

#### 2.02 FIBER OPTIC LIGHT SOURCE

- A. All connection interfaces shall be factory installed. No field-configurable adapters will

be allowed at the light source.

- B. Wavelengths output shall be continuous.
- C. LED-based light source for multimode fiber testing shall have a:
  - 1. Center wavelength of  $850\text{nm} \pm 30\text{nm}$  and  $1300\text{nm} \pm 20\text{nm}$
  - 2. Spectral width (FWHM) of  $\leq 50\text{nm}$  at  $850\text{nm}$  and  $\leq 150\text{nm}$  at  $1300\text{nm}$
  - 3. Minimum output power level of  $\geq 14\text{dBm}$
- D. LED-based light source for singlemode fiber testing shall have a:
  - 1. Center wavelength of  $1300\text{nm} \pm 20\text{nm}$
  - 2. Spectral width (FWHM) of  $\leq 150\text{nm}$  at  $1300\text{nm}$
  - 3. Minimum output power level of  $\geq 38\text{dBm}$
- E. LASER-based light source for singlemode fiber testing shall have a:
  - 1. Center wavelength of  $1310\text{nm} \pm 20\text{nm}$  and  $1550\text{nm} \pm 20\text{nm}$
  - 2. Spectral width (FWHM) of  $\leq 5\text{nm}$  at  $1310\text{nm}$  and  $\leq 5\text{nm}$  at  $1550\text{nm}$
  - 3. Minimum output power level of  $\geq 3\text{dBm}$
- F. The light sources may contain internal lenses, pigtails, and modal conditioners, provided they meet the launch conditions as described in "Post-Installation" Passive Link Attenuation Testing Procedures (ref. PART 3 - EXECUTION).
- G. Equipment:
  - 1. Agilent Technologies' WireScope 350 test set
    - a. #450-1070 Fiber SmartProbe testing adapter, multimode  $850\text{nm}$
    - b. #450-1080 Fiber SmartProbe testing adapter, multimode  $1300\text{nm}$
    - c. #450-2020 Fiber SmartProbe testing adapter, singlemode  $1300\text{nm}$
    - d. ScopeData management software (version 5.20)
  - 2. Laser Precision #5150 test set
  - 3. Corning Cable Systems
    - a. #OS-301 light source
    - b. #OS-302 light source
    - c. #OS-100D light source
  - 4. SYSTIMAX
    - a. #938A, for multimode systems
    - b. #958D or 970A, for singlemode systems

### 2.03 FIBER OPTIC POWER METER

- A. The power meter for both multimode and singlemode testing must be capable of measuring relative or absolute power, and must be independent of modal distributions.

- B. All power meters used must be calibrated and traceable to the National Bureau of Standards.
- C. All power meters used shall have a
  - 1. Dynamic range of 0dBm to -40dBm, minimum
  - 2. Accuracy of  $\pm 0.2$ dB
- D. Equipment:
  - 1. Agilent Technologies' WireScope 350 test set
    - a. #450-1070 Fiber SmartProbe testing adapter, multimode 850nm
    - b. #450-1080 Fiber SmartProbe testing adapter, multimode 1300nm
    - c. #450-2020 Fiber SmartProbe testing adapter, singlemode 1300nm
    - d. ScopeData management software (version 5.20)
  - 2. Laser Precision #5025 test set
  - 3. Corning Cable Systems
    - a. #OTS-210 power meter, with data storage capacity
    - b. #OTS-310 power meter, with data storage capacity
  - 4. SYSTIMAX,
    - a. #938A, for multimode systems
    - b. #958D or 970A, for singlemode systems

2.04 FIBER OPTIC MANDREL

- A. For jacketed (3.0 mm) fiber, mandrel diameter shall be 22 mm for 50/125 um fiber and 17 mm for 62.5/125 fiber. For unjacketed buffered (0.9 mm) fiber, mandrel diameter shall be 25 mm for 50/125 um fiber and 20 mm for 62.5/125 fiber.
- B. Equipment: Fluke Networks
  - 1. #NF-MANDREL-50; red mandrel for jacketed 50/125 um fiber
  - 2. #NF-MANDREL-625; gray mandrel for jacketed 62.5/125 um fiber

2.05 FIBER OPTIC OTDR

A. Multimode Source Module:

Wavelength	Dynamic Range	Attenuation Deadzone	Reflective Deadzone	Loss Resolution	Distance Accuracy
850nm	24dB	6.5mt	3.0mt	0.001dB	0.1mt
1300nm	27dB	7.0mt	3.0mt	0.001dB	0.1mt

B. Singlemode Source Module:

Wavelength	Dynamic Range	Attenuation Deadzone	Reflective Deadzone	Loss Resolution	Distance Accuracy
1310nm	40dB	6.0mt	3.5mt	0.001dB	0.1mt
1550nm	28dB	12.0mt	3.5mt	0.001dB	0.1mt

C. Equipment:

1. Agilent Technologies #8147, for multimode & singlemode systems
2. Corning Cable Systems
  - a. 2001HR, for multimode & singlemode systems
  - b. 340 OTDR-Plus Multitester II
  - c. MiniOTDR+, for multimode & singlemode systems
3. Tektronix
  - a. TFP2A FiberMaster
  - b. TFS3031 TekRanger2

2.06 FIBER OPTIC TEST CORDS

A. Multimode Fiber Optic Test Cord

1. The fiber of the multimode test cord(s) shall have the core diameter and numerical aperture nominally equal to that of the multimode fiber optic passive link.
2. The length of test cords used for insertion loss testing shall be between 1mt – 5mt.
3. The connectors of the test cords shall be compatible with the connector types of the light source and the power meter.
  - a. The connector of the test cords shall be that which the light source accepts.
4. The connectors shall exhibit  $\leq 0.5\text{dB}$  loss per connection @ both 850nm and 1300nm, as measured per FOTP-171 D2.

B. Singlemode Fiber Optic Test Cord

1. The fiber of the singlemode test cord(s) shall have the mode field diameter nominally equal to that of the singlemode fiber optic passive link.
2. The length of test cords used for insertion loss testing shall be between 1mt – 5mt.
3. The connectors of the test cords shall be compatible with the connector types of the light source and the power meter.
  - a. The connector of the test cords shall be that which the light source accepts.
4. The connectors shall exhibit  $\leq 0.5\text{dB}$  loss per connection @ both 1300nm and 1550nm, as measured per FOTP-171 D3.
5. All singlemode connectors shall inhibit Fresnel reflections (i.e., have a “PC” finish).

2.07 CATEGORY 6 HORIZONTAL CABLE TESTER

- A. Equipment shall meet TIA/EIA-568B.2 Addendum 1 requirements for Level III accuracy.
- B. Test Standards (minimum): TIA Category 6 (per TIA/EIA-568B.2 Addendum 1); ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

- C. Areas of Test Measurement (minimum): Wire Map; Length; Insertion Loss; Near End Crosstalk (NEXT) loss, at both master unit and remote unit; Power Sum NEXT (PSNEXT) loss, at both master unit and remote unit; Equal Level Far End Crosstalk (ELFEXT), at both master unit and remote unit; Power Sum ELFEXT, at both master unit and remote unit; Return Loss (RL), at both master unit and remote unit; Propagation Delay and Delay Skew; Attenuation-to-Crosstalk Ratio (ACR), at both master unit and remote unit; Power Sum ACR (PSACR), at both master unit and remote unit; Characteristic Impedance; DC Loop Resistance.
- D. Equipment:
  - 1. Agilent Technologies
    - a. #N2600A-100; "WireScope 350" test kit (main unit, remote unit, CAT6 permanent link probe, CAT6 channel probe, accessories), loaded with the latest version of firmware.
    - b. "ScopeData Pro" reporting and documentation software latest version.
  - 2. Fluke Networks
    - a. #DSP-4300; "CableAnalyzer" test kit (main unit, remote unit, CAT6 permanent link adapters, CAT6 channel adapters, accessories), loaded with the latest version of firmware.
    - b. "LinkWare" reporting and documentation latest software

## 2.08 BACKBONE UTP CABLING TESTERS

- A. Areas of Test Measurement (minimum): Wire Map (continuity, opens, shorts, crossed pairs, split pairs).
- B. Equipment
  - 1. Siemon MT-5000 test unit, with 25-pair adapter

## PART 3 - EXECUTION

### 3.01 SCHEDULING

- A. Prepare a schedule based on the schedule developed for Sections 167xx for the testing activities. Prepare updated schedules when changes in the schedule occur.

### 3.02 FIELD QUALITY CONTROL

- A. Complete testing as delineated below prior to system acceptance.
- B. Permanently record all test results and presented in a format acceptable to the Owner or Engineer before system acceptance.
- C. Remove and replace with new, at no cost to the Owner, any cables or conductors (copper or glass) failing to meet the indicated standards. The Owner will not accept the installation until testing has indicated a 100% availability of all cables and conductors or the Owner has approved any deviation from this requirement.
- D. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.



3.03 "PRE-INSTALLATION" CONTINUITY TESTING PROCEDURES

- A. Ensure fiber continuity of all fiber strands of all cables prior to installation.
- B. Reports from "pre-installation" continuity testing are not required to be submitted at project close out.

3.04 BACKBONE FIBER OPTIC CHARACTERIZATION TESTING REQUIREMENTS AND PROCEDURES

- A. Test fiber optic passive links per "Base Bid Requirements" in Part 1 of this Section.
- B. Precautions
  - 1. Adhere to the equipment manufacturer's instructions during all testing.
  - 2. Prior to any testing activity or any measurements taken, complete the following activities:
    - a. Ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
    - b. Clean all launch cords and system cords (if applicable) connectors and all adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
  - 3. Do not power off OTDR's light source during testing activity.
  - 4. Do not remove launch cord from the OTDR's light source at any time (unless the testing is complete or the equipment is being put away for the evening, or during trouble shooting).
  - 5. Do not bend the launch cord smaller than 20 times the cord diameter during testing activities (this may induce loss into the cord reducing the accuracy of the measurement).

C. "Post-Installation" Characterization Testing Procedures

- 1. Equipment settings / measurement parameters:
  - a. Index of Refraction: match cable-under-test fiber parameters; default settings as follows:  
Multimode Fiber:

SYSTIMAX 62.5/125 OptiSPEED	1.496 @ 850nm	1.491 @ 1300nm
SYSTIMAX 50/125 LazrSPEED	1.483 @ 850nm	1.478 @ 1300nm
Corning 62.5/125	1.496 @ 850nm	1.491 @ 1300nm
Corning 50/125 Infinicor	1.481 @ 850nm	1.476 @ 1300nm

Singlemode Fiber:

SYSTIMAX TeraSPEED	1.466 @ 1310nm	1.467 @ 1550nm
Corning SMF-28e+	1.467 @ 1310nm	1.4677 @ 1550nm
  - b. Pulse Width: multimode: 20ns; singlemode: 50 ns.
  - c. Backscatter: multimode: -67dB @ 850nm, -74dB @ 1300nm; singlemode: -

74dB @ 1310nm and 1550nm.

- d. Event Threshold: 0.05dB.
  - e. Reflection Threshold: multimode: -45dB, singlemode: -60dB.
  - f. Fiber Break/End-Of-Fiber: 3dB.
2. Waveform: The waveform shall be real-time/normal density.
  3. Obtain measurements using a 'launch' cord connected to the test instrument and the cable-under-test.
    - a. The fiber of the launch cord should match the fiber of the cable-under-test in manufacturer and product; the fiber of the launch cord shall match the fiber of the cable-under-test in physical and performance parameters (such as type, core/cladding size, index of refraction, refractive profile).
    - b. The length of the launch cord shall be between 25 meters and 100 meters.
  4. Review the results of each test and bring to the attention of the Engineer all fibers that do not meet the manufacturer's allowed loss for splices and connectors, or fibers that do not meet the length of the overall cable length.

D. Record Documents:

1. All cable and fiber IDs of the test reports shall match the IDs as labeled in the field – i.e., the ID on the cable label/fiber port label shall be the same as what is associated with the electronic and printed test record.
2. The units for distance measurements (i.e., the "X" axis of the graph) shown on the print of the test measurements shall be feet.
3. Print reports of a cabling link such that both the x- and y-axis scales of the trace are identical. Preferably, all reports shall be printed with identical scales on both x- and y-axis.
4. The launch cord must be shown in the printed test report.
5. Measurements shall carry a precision through one significant decimal place (minimum).
6. Each test report shall contain the following information (not necessarily in this order):
  - a. Project name,
  - b. Cable identifier, fiber number, and fiber type (e.g., "multimode")
  - c. Measurement direction,
  - d. Date measurement were obtained,
  - e. Operator (company and name),
  - f. Test equipment model and serial number(s),
  - g. Set up parameters (such as pulse width, refractive index, event threshold)
  - h. Wavelength,
  - i. OTDR trace,
  - j. Length of fiber,
  - k. Overall link loss.
7. For each link, include either a schematic graphic or narrative accurately

describing the test set up. In other words, show the launch cord with length, expected events with distances, etc. This information will eliminate many questions the Engineer will have while reviewing the reports.

### 3.05 BACKBONE FIBER OPTIC PASSIVE LINK INSERTION LOSS TESTING REQUIREMENTS AND PROCEDURES

#### A. Testing Requirements

1. Test fiber optic passive links per “Base Bid Requirements” in Part 1 of this Section.
2. Launch Conditions:
  - a. For passive link insertion loss testing for multimode fibers, the modal launch condition from the light source shall be characterized as Category 1 per OFSTP-14.
  - b. For passive link insertion loss testing of singlemode fibers:
    - 1) Use the launch conditions, as described in FOTP-78.
    - 2) Employ a method to remove high-order propagating modes, as described in FOTP-77.
3. Test Methods:
  - a. The passive link insertion loss testing of multimode fibers shall be performed according to “Test Method B: One Jumper Reference”, per OFSTP-14, for ‘permanent’ links, and shall be performed according to “Test Method C: Three Jumper Reference”, per OFSTP-14, for ‘channel’ links.
  - b. The passive link insertion loss testing of singlemode fibers shall be performed according to “Test Method A.1: One Jumper Measurement”, per OFSTP-7.

#### B. Precautions

1. Adhere to the equipment manufacturer’s instructions during all testing.
2. Prior to any testing activity or any measurements taken:
  - a. Ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
  - b. Power on the light source and power meter for at least 5 minutes.
  - c. Clean all test cords & system cords (if applicable) connectors and all adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
3. Do not power off light source or the power meter during testing activity.
4. Do not remove Test Cord #1 from the light source at any time (unless the testing is complete or the equipment is being put away for the evening).
5. Do not bend the test cords smaller than 20 times the cord diameter (this may induce loss into the cord reducing the accuracy of the measurement).

## C. Passive Link Insertion Loss Testing Procedures

### 1. Test Equipment Set Up

- Follow the test equipment manufacturer's initial adjustment and set up instructions.
- If the power meter has a Relative Power Measurement Mode, select this mode.
- If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- Set the light source and power meter to the same wavelength.

### 2. Test Cord Performance Verification

- Connect Test Cord #1 between the light source and the power meter.
- The value displayed on the power meter is the reference power ( $P_{ref}$ ) measurement. If the power meter has a relative power measurement mode, enter this reference power measurement ( $P_{ref}$ ) value into the meter. If it does not, hand-write  $P_{ref}$  onto the record documents for future reference.
- Disconnect Test Cord #1 from the power meter. Do not disconnect Test Cord #1 from the light source.
- Connect the 'open' end of Test Cord #1 to an adapter (of matching connector type). Connect one end of Test Cord #2 to the adapter and the other end of Test Cord #2 to the power meter.
- The value displayed on the power meter is the power measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the test cord #2 connection attenuation. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the connection attenuation:
  - If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc):  

$$\text{Connection Attenuation (dB)} = | P_{sum} - P_{ref} |$$
  - If  $P_{sum}$  and  $P_{ref}$  are in watts: 
$$\text{Connection Attenuation (dB)} = | 10 \times \log_{10} [P_{sum}/P_{ref}] |$$
  - The measured connection attenuation must be less than or equal to the value found in Table 3 (below).
- Flip the ends of Test Cord #2 so that the end connected to the power meter is now connected to the adapter, and the end connected to the adapter is now connected to the power meter.
- The meter reading is the reversed Power Measurement ( $P_{sum}$ ). Perform the proper calculations if not using Relative Power Measurement Mode.
- Verify that both connection attenuation measurements are less than or equal to the value found in Table 3 (below).

**Table 16719-3.1: Acceptable Test Cord Connection Attenuation**

	ST or SC Cord	Mini-Connector Cord
Multimode (62.5, 50)	0.50 dB Max	0.20 dB Max
Singlemode	0.55 dB Max	0.30 dB Max

- If both measurements are found to be less than or equal to the values found in Table 1, test cord #1 is acceptable for testing purposes. Unacceptable

attenuation measurements may be attributable to test cord # or test cord #2. Examine each cord with a portable microscope and clean, polish, or replace if necessary.

- j. Repeat this test procedure from the beginning reversing the test cords in order to verify the performance of test cord #2.
3. Determine the Launch Category of the Light Source
    - a. General: The launch category of a light source can be determined by measuring its Coupled Power Ratio (CPR). The CPR is a measurement of the modal power distribution launched into a multimode fiber. A light source that launches a higher percentage of its power into the higher order modes of a multimode fiber produces a more over-filled condition and is classified as a lower Category than a light source that launches more of its power into just the lower order modes producing an under-filled condition. Under-filled conditions result in lower link attenuation, while over-filled conditions produce higher attenuation. Therefore, adjusting the acceptable link attenuation to compensate for a light source's launch characteristics increases the accuracy of the test procedure.
    - b. Provide two test cords, one multimode (Test Cord #1) and one singlemode (Test Cord #2). Both cords shall be directly terminated on connectors that are compatible with the light source and power meter.
      - 1) The fiber of the multimode test cord shall have the core diameter and numerical aperture nominally equal to those of the permanent link.
      - 2) The fiber of the singlemode test cord shall contain Class IVa singlemode fiber, with a mode field diameter of  $5.0\ \mu\text{m} \pm 0.5\ \mu\text{m}$  for 850nm tests and  $9.0\ \mu\text{m} \pm 1.0\ \mu\text{m}$  for 1300nm tests.
    - c. Connect test cord #1 between the light source and the power meter. Avoid placing bends in the cord that are less than 4 inches in diameter.
    - d. The meter reading is the Reference Power Measurement ( $P_{\text{ref}}$ ). If the power meter has a Relative Power Measurement Mode, enter the Reference Power Measurement ( $P_{\text{ref}}$ ) value into the meter. If it does not, hand-write  $P_{\text{ref}}$  for future reference.
    - e. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
    - f. Connect test cord #2 between the power meter and test cord #1, using an appropriate adapter between the test cords.
      - 1) Test cord #2, the singlemode cord, shall include a high order mode filter. This can be accomplished by twice wrapping the cord around a 1.2" diameter (30-mm) mandrel.
    - g. The meter reading is the Power Measurement ( $P_{\text{sum}}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the CPR. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the CPR:
      - 1) If  $P_{\text{sum}}$  and  $P_{\text{ref}}$  are in the same logarithmic units (dBm, dBu, etc):  $\text{CPR (dB)} = | P_{\text{sum}} - P_{\text{ref}} |$

2) If  $P_{sum}$  and  $P_{ref}$  are in watts:  $CPR (dB) = | 10 \times \log_{10} [P_{sum}/P_{ref}] |$

**Table 16719-3.2:** Coupled Power Ratio (CPR) in dB, for 62.5/125  $\mu$ m Fiber

	<b>Cat-1 Overfilled</b>	<b>Cat-2</b>	<b>Cat-3</b>	<b>Cat-4</b>	<b>Cat-5 Underfilled</b>
850nm source	25 – 29	21 – 24.9	14 – 20.9	7 – 13.9	0 – 6.9
1300nm source	21 – 25	17 – 20.9	12 – 16.9	7 – 11.9	0 – 6.9

**16719-3.3:** Coupled Power Ratio (CPR) in dB, for 50/125  $\mu$ m Fiber

	<b>Cat-1 Overfilled</b>	<b>Cat-2</b>	<b>Cat-3</b>	<b>Cat-4</b>	<b>Cat-5 Underfilled</b>
850nm source	20 – 24	16 – 19.9	11 – 15.9	7 – 10.9	0 – 5.9
1300nm source	16 – 21	12 – 15.9	8 – 11.9	4 – 7.9	0 – 3.9

4. Multimode Insertion Loss Measurement

- a. After setting up the test equipment, verifying the performance of the test cords, and determining the light source's CPR, the insertion loss of the passive link segments can be measured.
- b. Connect test cord #1 between the light source and the power meter.
- c. The meter reading is the Reference Power Measurement ( $P_{ref}$ ). If the power meter has a Relative Power Measurement Mode, enter the Reference Power Measurement ( $P_{ref}$ ) value into the meter. If it does not, hand-write  $P_{ref}$  for future reference and to be included in the Record Documents.
- d. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
- e. Connect test cord #1 to the passive link segment 'input'.
- f. At the opposite end of the passive link segment, connect test cord #2 to the link segment 'input' and the power meter.
- g. The meter reading is the Power Measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the insertion loss:
  - 1) If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc):  $Link\ Segment\ Attenuation\ (dB) = | P_{sum} - P_{ref} |$
  - 2) If  $P_{sum}$  and  $P_{ref}$  are in watts:  $Link\ Segment\ Attenuation\ (dB) = | 10 \times \log_{10} [P_{sum}/P_{ref}] |$
- h. Record  $P_{sum}$  for inclusion into the Record Documents. Refer to Records (ref. PART 3: EXECUTION) for all of the information to record.

5. Singlemode Insertion Loss Measurement

- a. After setting up the test equipment and verifying the performance of the test cords, the insertion loss of the passive link segments can be measured.
- b. Connect test cord #1 between the light source and the power meter.
- c. The meter reading is the Reference Power Measurement ( $P_{ref}$ ). If the power

meter has a Relative Power Measurement Mode, enter the Reference Power Measurement ( $P_{ref}$ ) value into the meter. If it does not, hand-write  $P_{ref}$  for future reference and to be included in the Record Documents.

- d. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
  - e. Connect test cord #1 to the passive link segment 'input'.
  - f. At the opposite end of the passive link segment, connect test cord #2 to the link segment 'input' and the power meter.
  - g. The meter reading is the Power Measurement ( $P_{sum}$ ). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the insertion loss:
    - 1) If  $P_{sum}$  and  $P_{ref}$  are in the same logarithmic units (dBm, dBu, etc): Link Segment Attenuation (dB) =  $| P_{sum} - P_{ref} |$
    - 2) If  $P_{sum}$  and  $P_{ref}$  are in watts: Link Segment Attenuation (dB) =  $| 10 \times \log_{10} [P_{sum}/P_{ref}] |$
  - h. Record  $P_{sum}$  for inclusion into the Record Documents. Refer to Records (ref. PART 3: EXECUTION) for all of the information to record.
6. Acceptable Measurement Values
- a. Any cabling links failing to meet the criteria described in this specification shall be removed and replaced, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
  - b. The general insertion loss equation for any link segment is as follows:
    - 1) Insertion loss = <cable loss> + <connection loss> + <splice loss> + <CPR adjustment>.
    - 2) Note: A connection is defined as the joint made by two mating fibers terminated with remateable connectors (e.g., ST, SC, etc).
  - c. 62.5/125 $\mu$ m Multimode Attenuation Coefficients
    - 1) Cable Loss = Cable Length (km) x (3.5 dB/km @ 850-nm or 1.0 dB/km @ 1300-nm).
    - 2) Connection Loss (ST or SC Connectors) = (Connections x 0.39 dB) + 0.42 dB.
    - 3) Connection Loss (Other mini-connectors) = (Connections x 0.14 dB) + 0.24 dB
    - 4) Splice Loss = Splices x (0.05 dB for fusion or 0.10 dB for mechanical).
    - 5) CPR Adjustment = See table below

**16719-3.4: Multimode Light Source CPR Adjustment**

Connector Type	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5
ST or SC Connectors	+0.50	0.00	-0.25	-0.50	-0.75
Mini-Connectors	+0.25	0.00	-0.10	-0.20	-0.30
Note: Refer to subparagraph					

- d. Singlemode Attenuation Coefficients
  - 1) Cable Loss = Cable Length (km) x (0.50 dB/km @ 1310-nm or 0.50 dB/km @ 1550-nm)

2) Connection Loss (ST or SC Connectors) = (Connections x 0.44 dB) + 0.42 dB

3) Connection Loss (Other mini-connectors) = (Connections x 0.24 dB) + 0.24 dB

4) Splice Loss = Splices x (0.07 dB for fusion or 0.15 dB for mechanical)

5) CPR Adjustment = Not applicable for singlemode.

D. Record Documents:

1. All cable and fiber IDs of the test reports shall match the IDs as labeled in the field – i.e., the ID on the cable label/fiber port label shall be the same as what is entered into the stored test result in the power meter.
2. Measurements shall carry a precision through one significant decimal place (minimum).
3. Each test report shall contain the following information (not necessarily in this order):
  - a. Project name,
  - b. Cable identifier, fiber number, and fiber type (e.g., “multimode”)
  - c. Measurement direction,
  - d. Date measurement were obtained,
  - e. Operator (company and name),
  - f. Test equipment model and serial number(s),
  - g. Wavelength,
  - h. Loss measurement.

3.06 BACKBONE TWISTED PAIR CABLING TESTING REQUIREMENTS AND PROCEDURES

A. Testing Requirements

1. Test backbone multipair cabling per “Base Bid Requirements” in Part 1 of this Section.
2. The installation will be accepted when testing has indicated a 100% availability of all terminated pairs or the Owner has approved any deviation from this requirement.

B. Testing Procedures

1. Test wire map and continuity for all pairs.
2. Test length for 2% of pairs of each cable
  - a. None of the pairs tested for length shall be of the same 25-pair binder group.

C. Record Documents:

1. All cable and pair IDs of the test reports shall match the IDs as labeled in the field – i.e., the ID on the cable label/termination label shall be the same as what appears on the test reports.
2. Measurements shall carry a precision through no significant decimal place.



3. Each test report shall contain the following information (not necessarily in this order):
  - a. Project name,
  - b. Cable identifier, pair number(s),
  - c. Date measurement were obtained,
  - d. Operator (company and name),
  - e. Test equipment model and serial number(s),
  - f. Measurement results.

### 3.07 HORIZONTAL CATEGORY 6 TESTING PROCEDURES

#### A. Precautions

1. Adhere to the equipment manufacturer's instructions during all testing.
2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
3. Fully charge power sources before each day's testing activity

#### B. Test Equipment Set Up

1. Set up the tester to perform a full Category 6 test, as a Permanent Link configuration.
2. If the tester has the capability, set the cable type as product specific setting. If not, set as generic Category 6.
3. Set the tester to save the full test results (all test points, graphs, etc.).
4. Save the test results with the associated cable link identifier to match that as specified in Section 16710.
5. Calibrate the test set per the manufacturer's instructions.

#### C. Acceptable Test Result Measurements

1. Overall Test Results:
  - a. Links which report a Fail, Fail\* or Pass\* for any of the individual tests shall result in an overall link Fail. All individual test results must result in a Pass to achieve an overall Pass.
  - b. Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.
  - c. Any cabling links failing to meet the criteria described in this specification shall be removed and replaced, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
2. Wire Map: All pairs of the cabling link shall be continuous and terminated correctly at both ends. No exceptions shall be accepted.
3. Length: The maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration shall be 94 meters,

including test cords.

4. Insertion Loss: The acceptable insertion loss measurements for any Category 6 cabling link shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
8. Power Sum ELFEXT and FEXT Loss: The acceptable PS-ELFEXT and loss for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
9. Return Loss: The acceptable return loss measurements for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.
10. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any Category 6 cable shall be no greater than that as listed in TIA/EIA-568B.2 Addendum 1.

### 3.08 RECORDS

- A. Permanently record all test results. Submit test results in a format acceptable to the Owner or Engineer before system acceptance.
- B. Export all of the numerical test results to a single Microsoft Excel 2000<sup>®</sup> spreadsheet.
- C. Submit this information at the conclusion of the testing to the Engineer for approval.
- D. Include approved test reports in final record documents submittal.
- E. For each Horizontal Category 3, Category 5E, or Category 6 test, record the following information:
  1. Project name and address.
  2. Contractor's name.
  3. Date of measurement.
  4. Ambient temperature.
  5. Test equipment, including the following:
    - a. Manufacturer, model, and serial number
    - b. Date and time of last calibration.
  6. Operator's name(s).
  7. Identification number of cable.
  8. Overall test result.

## PART 4 - TESTING FORMS

### 4.01 SUMMARY OF FORMS

- A. Fiber Optic Test Instrument Data Sheet
- B. Fiber Optic Reference Power Measurement Method Form
- C. Fiber Optic Relative Power Measurement Method Form

## Fiber Optic Test Instrument Data Sheet

<b>LIGHT SOURCE</b>			
Manufacturer: _____	Serial Number: _____		
Model: _____	Last Calibration: _____		
Spectral Width:	Coupled (Category):	Power	Ratio
850-nm: _____	850-nm: _____	_____	_____
1300-nm: _____	1300-nm: _____	_____	_____
1310-nm: _____	1310-nm: _____	N/A	_____
1550-nm: _____	1550-nm: _____	N/A	_____
<b>POWER METER</b>			
Manufacturer: _____	Serial Number: _____		
Model: _____	Last Calibration: _____		

Note: Submit a separate data sheet for each test set being used.

## Fiber Optic Reference Power Measurement Method Form

TEST SUMMARY INFORMATION	
Test Personnel: _____	Date: _____
Light Source Location: _____	Power Meter Location: _____
Wavelength: _____	Reference Power Measurement ( $P_{ref}$ ): _____
Method: _____	
Page _____ of _____	

TEST RESULTS										
Strand #	Cable ID	Power ( $P_{sum}$ ) (dB)	Link Seg Attn (dB)	AcceptAttn (dB)		Strand #	Cable ID	Power ( $P_{sum}$ ) (dB)	Link Seg Attn (dB)	AcceptAttn (dB)
1						25				
2						26				
3						27				
4						28				
5						29				
6						30				
7						31				
8						32				
9						33				
10						34				
11						35				
12						36				
13						37				
14						38				
15						39				
16						40				
17						41				
18						42				
19						43				
20						44				
21						45				
22						46				
23						47				
24						48				

## Fiber Optic Relative Power Measurement Method Form

### TEST SUMMARY INFORMATION

Test Personnel: \_\_\_\_\_ Date: \_\_\_\_\_  
 Light Source \_\_\_\_\_ Power Meter Location: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 Wavelength: \_\_\_\_\_  
 Method: \_\_\_\_\_  
 Page \_\_\_\_\_ of \_\_\_\_\_

### TEST RESULTS

Strand #	Cable ID	Link Seg Attn (dB)	Acceptance Attn (dB)		Strand #	Cable ID	Link Seg Attn (dB)	Acceptance Attn (dB)
1					25			
2					26			
3					27			
4					28			
5					29			
6					30			
7					31			
8					32			
9					33			
10					34			
11					35			
12					36			
13					37			
14					38			
15					39			
16					40			
17					41			
18					42			
19					43			
20					44			
21					45			
22					46			
23					47			
24					48			

END OF SECTION 16719





## SECTION 16720

### FIRE ALARM SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### 1.02 DESCRIPTION:

- A. This section includes furnishing, installation, and connection of the microprocessor-controlled fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panel, auxiliary control devices, and power supplies specified herein.
- B. The fire alarm system shall comply with requirements of this section and NFPA Standard No. 72 for protected premises signaling systems. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.
- C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-Current Edition.
- D. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians for all installation, programming and final check-out.

##### 1.03 RELATED SECTIONS

- A. Section 01330 - Submittal Procedures

##### 1.04 REFERENCES

- A. NFPA 72 - (current edition with CA Amendments) National Fire Alarm Code.
- B. Santa Cruz Fire Department requirements, including but not limited to:
  - 1. The Santa Cruz Fire Department does not allow installation of Fire alarm Systems prior to the separate Fire Department permit approval. Contractors who engage in such activities may be cited and the project will be "Red Tagged".
  - 2. All Fire Alarm Systems require separate plans, application, review, permit and fee. The specifications are to be used for bid purposes only and shall not construe Fire Department Approval. A minimum of two sets of plans shall be submitted and shall be wet stamped and signed by the person responsible for designing the system. The Fire Department permit needs to be issued to the installing contractor, who will be responsible for requesting all inspections.
  - 3. Fire Alarm plans shall be sent to: Santa Cruz Fire Department Fire prevention Bureau, 230 Walnut Street, Santa Cruz, Ca 95060.

4. The Fire Alarm System is required due to 100 or more sprinkler heads per CBC 904.3, UFC 1003.3.
5. The following components are required for monitoring flow on sprinkler systems with over 100 heads installed per CBC 904.3 & UFC 1003.3 & NFPA 72:
  - a. Monitoring per CFC 1007.3.3.6, CFC 1003.3 (remote or central station)
  - b. Automatic smoke detection at control unit (alarm panel) when located in an area that is not continuously occupied (24/365). NFPA Section 1-5.6
  - c. Smoke detection recall for elevators when required by CBC section 3003.2 and NFPA section 1-5.6 installed per CBC and NFPA 72.
  - d. Duct detectors when required by UMC section 608 when units exceed 2000 CFM.
  - e. One pull station required at main exit from building per NFPA 72, section 3-8.1.2.
  - f. Horn/Strobe devices to be provided which satisfactorily meet the intent of CFC 1003.3.2. Examples: A minimum of one per floor in multi story buildings, or one per tenant space in a multi tenant strip mall. Where the majority of the occupants can hear or see the alarm.
  - g. Temporal 3 notification pattern is required per NFPA 72, section 3-7.2
  - h. When two or more audible appliances can be heard, synchronization is required to maintain temporal pattern 3.
  - i. Audibility and visibility of notification appliances will be field verified at the time of acceptance testing to ensure they are located per sections listed above.
  - j. Detector in shaft per NFPA 72, section 5-1.3.4. Shaft construction to accommodate for heat detector maintenance.
  - k. Heat detector in shaft only for required fire alarm systems per NFPA 72, section 5-2.2.
6. Fire Alarm System and all components shall conform to NFPA72 minimum standards and shall be reviewed and approved by the Fire Department PRIOR to installation. Stamped approved plans shall be kept on site for the review of the fire inspector.
  - a. Fire Alarm Contractor shall provide a complete submittal to the Fire Department.
  - b. Completed packet shall be included with all Fire Alarm plan submittal.
7. The Fire Alarm system shall be monitored by a remote station.
8. Duct Detector required in the air supply when the aggregate of units exceed 2000 CFM per UMC, section 608 and NFPA 72, section 5-11.4.2. Duct detectors shall be installed per NFPA 90A. Detectors shall be supervised when a fire alarm system is installed in the premises.

#### 1.05 SCOPE:

- A. A new microprocessor controlled fire detection and alarm system shall be installed in accordance with this specification. The system(s) shall provide detection and annunciation per the requirements of the codes listed in Section 1.3 above including monitoring of all sprinkler systems and elevator recall as required.

B. Basic Performance:

1. Initiating Device Circuits (IDC) shall be wired Class B (NFPA Style B).
2. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).

1.06 SUBMITTALS:

A. Submittals shall be in accordance with 01330 - Submittal Procedures

B. Submittals Shall Include:

1. Complete descriptive data (cut sheets and installation, operation and maintenance, manuals) in order of FACP, NAC, INITIATING, NOTIFICATION, AND OTHER EQUIPMENT.
2. Complete system wiring connection diagrams, wiring connection details (shop drawings).
3. Show floor plans point to point wiring indicating the number, the gauge of the conductors and the size of conduit/raceway used.
4. Show a detailed riser diagram.
5. Show wiring connection details for components being connected to the system and interface to associated equipment.
6. Provide control panel layout, battery current calculations, voltage drop calculations (for each signaling circuit and any other 24 volt powered circuit, indicating conductor run length and wire size). 10 percent voltage drop maximum.
7. Show on floor plans symbol key with device catalog number, description, back box size and mounting requirements.
8. Matrix of sequence of operation.
9. Indicate system components, and location.
10. Show wire schedule include make, type, and size, of wire.
11. Include manufacturer's name, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
12. Show on floor plans conduit runs, point-to-point wiring of all devices and related equipment. Show wiring to fire doors, HVAC shutdown, fan control, damper control, and other controlled systems and equipment, not listed.
13. Show point-to-point wiring of all sprinkler tamper and flow switches.
14. Show on drawing location of all junction boxes.
15. Show detailed control panel layout. Include all power, notification and IDC circuits. Include power extenders.

C. Manuals:

1. Provide operation and maintenance manuals in quantities and format as specified in Section 01330 - Submittal Procedures. Submit simultaneously with the shop drawings, complete preliminary operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).

D. Certifications:

1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.07 WARRANTY

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

1.08 PERFORMANCE CRITERIA / APPLICABLE PUBLICATIONS

- A. The publications and/or standards listed below form a part of this specification. The publications are referenced in text by the basic designation only.
  1. The system and its components shall be Underwriters Laboratories, Inc. Listed under the appropriate UL testing standard for fire alarm applications and shall be installed in compliance with the UL listing.
  2. Codes listed in 1.3 above.
  3. All requirements of the Authority Having Jurisdiction (AHJ).

1.09 BATTERIES

- A. Shall be sealed, Gel-Cell acid type.
- B. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.
- D. If necessary to meet standby requirements, external battery and charger systems may be used.

1.10 SYSTEM COMPONENTS:

- A. A Digital Alarm Communicator Transmitter (DACT) shall be included in or with the panel. The DACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.
  1. The DACT shall be fully integrated into the control panel or mounted adjacent to the panel
  2. The DACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
  3. The DACT shall be programmed through a keypad . The DACT shall also have the ability with an optional programming kit, to upload and download programming from a PC.

4. The DACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
5. Communication shall include vital system status such as:
  - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
  - b. AC (Mains) Power Loss
  - c. Low Battery and Earth Fault
  - d. System Off Normal
  - e. 12 and 24 Hour Test Signal
  - f. Abnormal Test Signal (per UL requirements)
  - g. Phone Line Failure
6. The DACT shall support independent zone/point reporting when used in the Contact ID format. This enables the central station to have exact details concerning the origin of the fire or response emergency.

B. Enclosure:

1. The control panel shall be housed in a cabinet suitable for surface or flush mounting.

C. Power Supply:

1. The Main Power Supply for the Fire Alarm Control Panel shall provide all control panel and peripheral device power needs, as well as 3.0 amperes of 24 VDC power for each NAC.
2. The power supply shall provide an integral battery charger for use with batteries with up to 60 hours of standby power.

D. Field Charging Power Supply: The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.
5. The FCPS include power limited circuitry, per 1995 UL standards.

E. Specific System Operations

1. Walk Test Operation:
  - a. Walk Test mode shall test Initiating Device Circuits and Notification Device Circuits from the field without returning to the panel to reset the system.
  - b. Upon activation of an IDC, all outputs normally activated by the tested zone

shall activate for four seconds. Subsequent activation of devices on the same zone will activate outputs for one on second.

- c. Inducing a trouble into the initiating circuit shall activate the controlled outputs and remain activated until the trouble is cleared.

2. Alarm Verification Operation:

- a. When an alarm condition is detected on an Initiating Device Circuit which has been programmed for Alarm Verification shall cause the panel to remove power to that IDC to reset 2 wire detectors. After a short reset and retard time if that circuit returns within the confirmation time it will cause a verified alarm.

3. Waterflow Operation:

- a. All Initiating Device Circuits shall be programmable to provide Waterflow detection. If an alarm occurs on a Waterflow zone, all Notification Appliance Circuits which are programmed to activate for that zone will not be affected by the silence switch.
- b. A programmable retard timer shall be available for waterflow circuits. This timer shall allow retards for 1-89 seconds.

4. Supervisory Operation:

- a. An alarm on a Supervisory circuit shall activate all programmed (mapped) outputs, activate a common Supervisory LED, and activate the zone which is in alarm.

5. Signal Silence Operation:

- a. All Notification Appliance Circuits of the system shall be capable of being programmed to deactivate with depression of the Signal Silence switch.

F. Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.
3. Shall be flush or surface mounted as show on plans.

G. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.

H. Duct Smoke Detectors:

1. Duct smoke detectors shall be a 120 VAC/24 VDC type with visual alarm and

power indicators, and a reset switch. Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes.

I. Waterflow Switches:

1. Waterflow switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Waterflow switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
3. All waterflow switches shall come from a single manufacturer and series.
4. Waterflow switches shall be connected under this section but provided and installed by the mechanical contractor.

J. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4-inch conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof.
7. Valve supervisory switches shall be connected under this section and provided and installed by mechanical contractor.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Notifier.
- B. Seimens.
- C. EST.
- D. Or Approved equal.

## 2.02 MATERIALS

### A. Wiring:

1. All Fire Alarm Cable shall be UL listed for fire alarm applications.
2. All Fire Alarm cabling in areas without ceilings shall be installed in EMT or Rigid conduit. EMT/conduit shall be labeled to identify the EMT/conduit as containing fire alarm wiring.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Installation shall be in accordance with the codes listed in Section 1.3 above and as recommended by the equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All fire detection and alarm system devices, and control panels shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. All areas of the Operations Building, except electrical rooms, shall be considered "finished". Office areas of the other building shall be considered "finished".

### 3.02 TEST

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all flow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short Notification appliance circuits and verify that the trouble signal actuates.
- F. Ground device circuits and verify response of trouble signals.
- G. Check proper operation of all alarm notification devices.
- H. Check installation, supervision, and operation of duct detectors.
- I. Verify that each initiating device alarm signal is properly received and processed by the fire alarm control panel (Walk Test).
- J. Conduct tests to verify trouble indications for common mode failures, such as



alternating current power failure.

### 3.03 FINAL INSPECTION

- A. At the final inspection the installer of the system shall demonstrate that the systems function properly in every respect. The engineer shall be present at the final inspection.
- B. Field Quality Control:
  - 1. Upon completion of the installation; subject the system to a complete operational test of all functions, devices and interfaced components and when necessary corrections have been accomplished, advise the Engineer who will schedule a final inspection test with the Owner. Ensure the connections to the fire alarm system have been in service for at least 5 days of trouble/alarm free operation prior to the final inspection. Furnish instruments, labor and materials required for the tests and a qualified technician to conduct the tests. Correct any deficiencies found at no cost and retest system as necessary, prior to final acceptance. The test shall include the following:
    - a. An operation of each initiating device (smoke detectors, heat detectors, pull stations, process and facilities control sequences).
    - b. An operation of each notification device (alarm horn and alarm strobe).
    - c. Operation of all features of the system under normal operation.
    - d. Operation of all supervisory features of the system.
    - e. Test of the systems on standby power after 24 hours with primary power off.
    - f. Field inspection of wire terminations, junctions, T-Tapping and labeling.
    - g. Testing wires for grounding, opens and shorts.
- C. Upon completion of the installation of fire alarm equipment, provide to Engineer a signed, written statement substantially in the form as follows: "The undersigned having been engaged as the Contractor on the facility confirms that the fire alarm equipment was installed in accordance with the Specifications, wiring diagrams, instructions and directions provided by manufacturer."
- D. Submit prior to final acceptance:
  - 1. A letter confirming that inspections have been completed and the system is installed and functioning in accordance with the Specifications. Include Inspection Form and letter of warranty.
  - 2. O&M Manuals
    - a. Provide 3 sets of final Operation and Maintenance manuals to the Engineer. The final manuals shall contain; Record Drawings, battery type and battery calculations, spare parts list, operating procedures, trouble shooting guide, program for fire alarm panel and UDACT, program worksheets, data file and AutoCAD 2010 or greater as-builts on compact disk and a 1 year warranty agreement including parts and labor. Contractor to furnish drawings showing all components, device locations, riser diagram (specific to project) conduit runs, J-box locations, device addresses and point to point wiring diagram of fire alarm panel.

- E. The Contractor shall provide an acceptance test plan and form for review prior to testing. The test plan shall be submitted no later than 2 weeks before the test.

#### 3.04 EQUIPMENT DEMONSTRATION AND PERSONNEL TRAINING

- A. At the direction of Engineer the equipment supplier of the system will provide factory-trained representative to demonstrate the operation of the fire alarm system equipment and to instruct the Owner's personnel in its operation. Provide names and date of instruction prior to final acceptance. Provide staff with a minimum of 4 hours of training on two days for a total of 8 hours of training.

END OF SECTION 16720

## **SECTION 16900**

### **LIGHTING CONTROL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Invitation For Bids (IFB) and other Division 1 Specification Sections, apply to this Section.

##### **1.02 SECTION INCLUDES**

- A. Control wiring.
- B. Contactors and relays.
- C. Time switches.
- D. Timer switches.
- E. Photoelectric relay.
- F. Low voltage lighting control.

##### **1.03 RELATED WORK**

- A. Circuit breakers, Section 16050, Basic Materials and Methods.
- B. Momentary contact switches, Section 16050, Basic Materials and Methods.
- C. Wiring Devices, Section 16140, Wiring Devices

##### **1.04 SUBMITTALS**

- A. Manufacturers literature describing each product.
- B. Shop drawings for the low voltage lighting control system, drawn by a competent draftsman.
- C. Wiring diagrams including a system diagram distinguishing between factory wiring and field wiring.
- D. Furnish samples upon request of Architect/Engineer.
- E. Data/catalog cuts for each product and component specified herein, listing all physical and electrical characteristics and ratings indicating compliance with all listed standards.
- F. Clearly mark on each data sheet the specific item(s) being submitted and the proposed application.

## PART 2 - PRODUCTS

### 2.01 CONTACTORS AND RELAYS

- A. ASCO, Zenith, Square D, or equal, with type, number of poles and enclosure as shown on drawings.

### 2.02 TIME SWITCHES

- A. Maintained Contact Type For Lighting Control: Tork, Sangamo, Paragon, or equal, three pole switch with carry-over, astronomic dial, and operation as shown on the drawings.
- B. Momentary Contact Type: Tork, Sangamo, Paragon, or equal, single pole, double throw with astronomic dial, carry-over, and operation as shown on the drawings.
- C. Time Switch With Photocell: Tork, Sangamo, Paragon, or equal, with operation as shown on drawings.

### 2.03 TIMER SWITCHES

A

- A. M.H. Rhodes "Mark Time" 9000 series, Emerson-Pryne, or equal, spring wound time mechanism with stainless steel plate. Timer shall have 0 to 12 hours timing mechanism and shall time "off".

### 2.04 PHOTO-ELECTRIC RELAY

- A. Tork 2100 series, Fisher-Pierce, or equal, with adjustable "on" settings.

### 2.05 LOW VOLTAGE LIGHTING CONTROL

- A. Application: Operations Building.
- B. Manufacturer: Lighting Control and Design Inc.
- C. Drawings indicate the design intent of the low voltage lighting control system to be provided for the Operations facility. Exact quantities and locations of equipment shall be determined and included by the manufacturer in conjunction with the contractor to provide a fully operational system. Furnish and install a complete lighting control system. System shall include class 2 lighting control relays and micro-processor based programmable lighting controllers. Also include switches, photo-cells, occupancy sensors and other control devices that may be required, and wire, conduit and other materials required for the installation. Exact quantities and equipment configurations to be determined by plans, specifications and lighting control panel schedules. Provide 20 percent spare relays in each lighting control panel.
- D. Lighting control system shall be digital and consist of a master LCP with up to 48 individual relays and Micro Panel LCPs each with up to 4 individual relays, which can be switchable or 0-10Vdc dimmable, digital switches and digital interface cards. All system components shall connect in a "daisy chain" style configuration and be controlled via category 5 patch cable with RJ45 connectors, providing real-time two-way communication with each system component. Analog systems are not acceptable.

- E. Relay panels shall be pre-wired, pre-assembled, preprogrammed and listed to UL 916 (normal). Panels shall be provided with dual voltage power supply and 16 gage barriers to separate high and low voltage, normal and emergency power.
- F. Standard relays shall have normally closed (NC) contacts rated for 120/277V 20A tungsten, ballast or HID. Standard relays shall be zero-cross type.
- G. Relay panel electronics shall provide current visual status and control of each relay or zone. All system control electronics shall store programming in a non-volatile memory and provide 10 year battery back up for time of day.
- H. Lighting control system shall consist of master and slave panel(s) controlled by a 32-channel digital time clock (DTC) that controls and programs the entire lighting control system. The DTC shall supply all time functions and accept other inputs. The dtc shall accept control locally using built in button prompts and use of an 8 line 21-letter display, from a computer, modem, ethernet or internet. All commands shall be in plain English. Help pages shall display on the DTC screen.
- I. All switches shall communicate via RS 485, cat 5 patch cable with RJ45 connectors. Contact closure style switches are not acceptable. Any switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, ethernet or internet. Refer to single line diagram for wiring details. Switches which cannot be programmed remotely shall not be acceptable.
- J. Photocell, exterior (PCO) or interior (PCI), shall provide readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through DTC, locally or remotely. Photocells that require the use of set screws or manual adjustments at the photocell control card shall not be acceptable.
- K. Lighting control system interfaces to include a dry contact input interface, BMS interface, dimming system interface, ethernet/internet interface
- L. Standard lighting control system software, pre-installed into the DTC, shall consist of and use standard graphical management software (GMS) pages. GMS software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. Optional software that accepts job specific graphics shall be available.
- M. Telephone factory dial-up support shall be available at no additional cost to the during and after the 3 year warranty period. Factory to preprogram the lighting control system per plans and approved submittal. The lighting control manufacturer, at no added cost, shall provide additional programming via modem as required for the operational life of the system. Manufacturer to warrant that the DTC software can be upgraded and monitored remotely.
- N. Shop drawings: submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, dtc, photocells and other interfaces. Drawings shall indicate exact location and programming of each device. Indicate all time schedules and switch button engraving.
- O. Switches are momentary contact type.

- P. Data Protection: Programmed data being stored in static RAM, shall be protected from loss during power failures by an internal lithium battery (10 year cumulative life.) The CPU board real time clock shall be protected by capacitor back-up capable of withstanding up to 30 days down time.
- Q. Astro Clock: Each of the timers instead of being assigned a time of day (12:30 PM etc.) may be assigned a time relative to sunrise/sunset.) The choices are: one hour before sunrise, sunrise, one hour after sunrise, one hour before sunset, sunset, one hour after sunset. Controllers that do not have the Astro Clock feature are NOT acceptable.
- R. Provide Master Override - actuated switch locks all affected outputs ON or OFF. Outputs ignore incoming signals from other inputs (or timer signals) that they would normally respond to.
- S. Provide Timer Override switches - as long as switch is ON, relay output(s) controlled by this switch will ignore any timers that they have been programmed to respond to.
- T. Time of Day Scheduling: The controller shall have available timers (events) for use in developing time of day scheduling. A timer is an ON or OFF signal generated by the controller which turns affected outputs ON or OFF at a specific time of day. Any or all of the timers can be assigned to implement a control schedule on one or more days of the week. The controllers feature automatic daylight saving and leap year adjustment.

## 2.06 QUALITY ASSURANCE

- A. Manufacturer: The supplier of the class 2 lighting relays and the programmable lighting controllers shall have been engaged in the manufacture of such equipment for at least five (5) years and have a documented history of successful installations.
- B. UL Compliance: The class 2 lighting relays and programmable control equipment shall be listed under either UL section 916 or 508.
- C. FCC Compliance: The programmable controllers shall comply with FCC emission standards specified in Part 15, sub-part J for commercial applications. In addition, the controllers must meet the higher FCC standards for residential applications. Equipment that cannot meet both commercial and residential FCC certification shall not be acceptable.
- D. Quality Assurance: All components, equipment, assemblies, and software shall be factory tested before shipment. There shall be a 96-hour burn in of controller electronics.

## 2.07 SERVICES

- A. The low voltage lighting control system manufacturer shall provide the following services.
  1. Factory Assembly: All control stations, panels, lighting controllers and associated apparatus shall be factory assembled and tested.
  2. Factory Programming: Controllers shall be factory programmed per project specifications and drawings. All required firmware and software shall be installed prior to factory shipment or downloaded from the factory via modem link.
  3. Factory Support: Provide factory assistance by phone and modem, on site start-up,

- training, and troubleshooting assistance.
4. Documentation: The manufacturer shall provide a complete submittal package for approval prior to shipment. The package shall consist of: product cuts and specifications, bill of materials, warranty information, wire risers, point to point field wiring instructions, and detailed layout of control stations and other custom equipment. In addition to the submittals, a set of installation, operator, and maintenance manuals shall be shipped with the equipment.

## 2.08 WIRING DEVICES AND COVERPLATES

- A. Coordinate and match the color and material for devices and coverplates with Specification 16140 Wiring Devices..

## PART 3 - EXECUTION

### 3.01 CONTROL WIRING

- A. Provide all conduit, wiring, and outlets for all power wiring and all line voltage and low voltage control wiring.

### 3.02 INSTALLATION OF TIME SWITCHES

- A. Where indicated on the drawings as surface mounted, provide NEMA 1 enclosure with padlockable hasp.
- B. Where indicated on the drawings as flush mounted, provide NEMA 1B enclosure with hinged door and key lock.

### 3.03 INSTALLATION OF LOW VOLTAGE CONTROL

- A. Equipment shall be installed utilizing manufacturer's catalogue cut sheets and installation instructions and in accordance with these specifications.
- B. Contractor shall furnish all equipment, labor, system setup and other services necessary for the proper installation of the products/system as indicated on the drawings and specified herein. System setup shall include defining each load type, assigning each load to a zone and setting the control functions.

### 3.04 INSPECTION AND TESTS

- A. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- B. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- C. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
  1. Continuity tests of circuits.
  2. Operational Tests: Set and operate controls to demonstrate their functions and

capabilities in a methodical sequence that cues and reproduces actual operating functions.

- D. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- E. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- F. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- G. Install operating instruction, wiring, schematic and block diagram in glazed frames located near the control panel.
- H. For lighting controls which include daylight or occupant sensing automatic controls, automatic shut-off controls, occupancy sensors, or automatic time switches, the lighting controls shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications. A complete report of test procedures and results shall be prepared and filed with the Owner.

END OF SECTION 16900