



# **100% Construction Documents SUBMITTAL**

## **SPECIFICATIONS Volume 2**

### **Renovate P-Side for Super Pod Phase 2 Building 160**

Project Number: 621-15-120

James H. Quillen VA Medical Center  
Mountain Home, TN

December 21, 2015

---



Planning, Design, Construction  
and Related Services





**DEPARTMENT OF VETERANS AFFAIRS  
VHA MASTER SPECIFICATIONS**

**TABLE OF CONTENTS  
Section 00 01 10**

**VOLUME 1**

	<b>DIVISION 00 - SPECIAL SECTIONS</b>	<b>DATE</b>
00 01 15	List of Drawing Sheets	09-11
	<b>DIVISION 01 - GENERAL REQUIREMENTS</b>	
01 00 00	General Requirements	06-15
01 32 16.15	Project Schedules (Small Projects - Design/Bid/Build	04-13
01 33 23	Shop Drawings, Product Data, and Samples	03-12
01 35 26	Safety Requirements	
01 42 19	Reference Standards	02-15
01 57 19	Temporary Environmental Controls	01-11
01 58 16	Temporary Interior Signage	08-11
01 74 19	Construction Waste Management	09-13
	<b>DIVISION 02 - EXISTING CONDITIONS</b>	
02 41 00	Demolition	02-15
	<b>DIVISION 03 - CONCRETE (NOT USED)</b>	
	<b>DIVISION 04 - MASONRY</b>	
04 73 00	Manufactured Stone	12-15
	<b>DIVISION 05 - METALS</b>	
05 50 00	Metal Fabrications	07-14
	<b>DIVISION 06 - WOOD, PLASTICS AND COMPOSITES</b>	
06 10 00	Rough Carpentry	05-15
06 20 00	Finish Carpentry	06-13
06 26 14	Profile Paneling Non-VA	07-14
06 61 16	Solid-Surfacing Fabrications Non-VA	07-14
06 82 13	Sheet Resin Fabrications Non-VA	07-15
	<b>DIVISION 07 - THERMAL AND MOISTURE PROTECTION</b>	
07 21 13	Thermal Insulation	06-12
07 84 00	Firestopping	05-15
07 92 00	Joint Sealants	05-15

	<b>DIVISION 08 - OPENINGS</b>	
08 06 10	Door Opening Schedule (Non-VA)	08-15
08 06 71	Door Hardware Schedule (Non-VA)	08-15
08 11 13	Hollow Metal Doors and Frames	01-13
08 14 00	Interior Wood Doors	02-15
08 31 13	Access Doors and Frames	10-11
08 56 19	Pass Windows	10-11
08 56 88	Interior Insulating Windows	09-15
08 71 00	Door Hardware	02-15
08 71 13	Automatic Door Operators	06-12
08 80 00	Glazing	05-15
08 90 00	Louvers and Vents	05-15
	<b>DIVISION 09 - FINISHES</b>	
09 05 16	Subsurface Preparation for Floor Finishes	02-15
09 22 16	Non-Structural Metal Framing	10-14
09 29 00	Gypsum Board	11-14
09 30 13	Ceramic/Porcelain Tiling	05-15
09 51 00	Acoustical Ceilings	12-13
09 65 13	Resilient Base and Accessories	10-11
09 65 16	Resilient Sheet Flooring	07-13
09 65 19	Resilient Tile Flooring	05-15
09 68 00	Carpeting	05-15
09 72 16	Vinyl-Coated Fabric Wall Covering	05-15
09 75 00	Stone Facing Non-VA	TBD
09 91 00	Painting	05-15
	<b>DIVISION 10 - SPECIALTIES</b>	
10 14 00	Signage	05-15
10 26 00	Wall and Door Protection	05-15
10 28 00	Toilet, Bath, and Laundry Accessories	11-11
10 44 13	Fire Extinguisher Cabinets	08-14
10 56 17	Wall-Mounted Storage Shelving (Non-VA)	08-15
	<b>DIVISION 11 - EQUIPMENT</b>	
11 52 13	Projector Screens (Non-VA)	08-14
	<b>DIVISION 12 - FURNISHINGS</b>	
12 24 00	Window Shades	05-15
12 32 00	Manufactured Wood Casework	05-15
12 36 00	Countertops	06-13

	<b>DIVISION 13 - SPECIAL CONSTRUCTION (NOT USED)</b>	
	<b>DIVISION 14- CONVEYING EQUIPEMENT (NOT USED)</b>	
	<b>VOLUME 2</b>	
	<b>DIVISION 21 - FIRE PROTECTION</b>	
21 05 00	Common Work Results for Fire Suppression	11-09
21 13 13	Wet-Pipe Sprinkler Systems	06-15
	<b>DIVISION 22 - PLUMBING</b>	
22 05 11	Common Work Results for Plumbing	07-14
22 05 19	Meters and Gages for Plumbing Piping	07-14
22 05 23	General-Duty Valves for Plumbing Piping	07-14
22 07 11	Plumbing Insulation	05-11
22 08 00	Commissioning of Plumbing Systems	06-13
22 11 00	Facility Water Distribution	01-14
22 13 00	Facility Sanitary and Vent Piping	07-14
22 14 00	Facility Storm Drainage	12-09
22 40 00	Plumbing Fixtures	01-14
	<b>DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)</b>	
23 05 11	Common Work Results for HVAC	11-10
23 05 12	General Motor Requirements for HVAC	11-10
23 05 41	Noise and Vibration Control for HVAC Piping and Equipment	11-10
23 05 93	Testing, Adjusting, and Balancing for HVAC	05-11
23 07 11	HVAC Insulation	05-11
23 08 00	Commissioning of HVAC Systems	06-13
23 09 23	Direct-Digital Control System for HVAC	09-11
23 21 13	Hydronic Piping	09-12
23 22 13	Steam and Condensate Heating Piping	03-10
23 31 00	HVAC Ducts and Casings	03-13
23 34 00	HVAC Fans	11-09
23 36 00	Air Terminal Units	03-10
23 37 00	Air Outlets and Inlets	11-09
23 40 00	HVAC Air Cleaning Devices	02-12
23 73 00	Indoor Central-Station Air-Handling Units	04-11
23 81 00	Decentralized Unitary HVAC Equipment	02-11
23 82 16	Air Coils	04-11
	<b>DIVISION 26 - ELECTRICAL</b>	
26 05 11	Requirements for Electrical Installations	12-12
26 05 19	Low-Voltage Electrical Power Conductors and Cables	07-13
26 05 26	Grounding and Bonding for Electrical Systems	12-12
26 05 33	Raceway and Boxes for Electrical Systems	05-14
26 05 73	Overcurrent Protective Device Coordination Study	12-12
26 08 00	Commissioning of Electrical Systems	06-13

26 09 23	Lighting Controls	05-14
26 22 00	Low-Voltage Transformers	08-14
26 24 16	Panelboards	05-14
26 27 26	Wiring Devices	08-14
26 29 11	Motor Controllers	08-14
26 29 21	Enclosed Switches and Circuit Breakers	12-12
26 41 00	Facility Lightning Protection	12-12
26 42 00	Cathodic Protection	12-12
26 51 00	Interior Lighting	08-14
	<b>DIVISION 27 - COMMUNICATIONS</b>	
27 05 11	Requirements for Communications Installations	06-15
27 05 26	Grounding and Bonding for Communications Systems	06-15
27 05 33	Raceways and Boxes for Communications Systems	06-15
27 08 00	Commissioning of Communications Systems	06-15
27 10 00	Structured Cabling	06-15
27 11 00	Communications Equipment Room Fittings	06-15
27 15 00	Communications Horizontal Cabling	06-15
27 31 31	Voice Communications Switching and Routing Equipment - Extension	06-15
27 41 31	Master Antenna Television Equipment and Systems	06-15
27 51 16	Public Address and Mass Notification Systems	06-13
27 51 23	Intercommunications and Program Systems	06-15
27 52 23	Nurse Call and Code Blue Systems	06-13
27 52 31	Security Emergency Call, Duress Alarm, and Telecommunications	06-13
27 53 19	Distributed Radio Antenna (Within Building) Equipment and System	09-12
	<b>DIVISION 28 - ELECTRONIC SAFETY AND SECURITY</b>	
28 05 00	Common Work Results for Electronic Safety and Security	09-11
28 05 13	Conductors and Cables for Electronic Safety and Security	09-11
28 05 28.33	Conduits and Backboxes for Electronic Safety and Security	09-11
28 08 00	Commissioning of Electronic Safety and Security Systems	06-13
28 13 00	Physical Access Control System	10-11
28 13 16	Physical Access Control System and Database Management	09-11
28 13 53	Security Access Detection	09-11
28 16 00	Intrusion Detection System	10-11
28 23 00	Video Surveillance	09-11
28 31 00	Fire Detection and Alarm	10-11
28 52 31	Emergency Call System	06-15
	<b>DIVISION 31 - EARTHWORK: NOT USED</b>	
	<b>DIVISION 32 - EXTERIOR IMPROVEMENTS: NOT USED</b>	
	<b>DIVISION 33 - UTILITIES: NOT USED</b>	
	<b>DIVISION 34 - TRANSPORTATION: NOT USED</b>	
	<b>DIVISION 48 - ELECTRICAL POWER GENERATOR: NOT USED</b>	

**SECTION 21 05 11**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 21.
- B. Definitions:
  - 1. Exposed: Piping and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- E. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 84 00, FIRESTOPPING.
- H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- I. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.

**1.3 QUALITY ASSURANCE**

- A. Products Criteria:
  - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
  - 2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.
  - 3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
  - 5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on

- equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
6. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- C. Guaranty: In GENERAL CONDITIONS.
- D. Extended Guarantee Period Services:
1. Qualifications: All service technicians assigned to perform work under this contract shall be qualified and factory trained by the Original Equipment Manufacturer (O.E.M.). Each technician shall have at least three years experience of working on comparable systems and shall be a full time employee of the contractor. The contractor shall furnish, for the Department of Veterans Affairs (VA) review and approval, resumes of all service technicians scheduled to service the equipment and systems. The resume shall include details of experience, training, and educational qualifications and performance evaluations.
  2. Replacement Parts: The contractor shall be equipped with all replacement parts of all equipment and systems to be serviced and the manufacturer's standard service and repair procedures. All replacement parts shall be brand new and of current design. The replacement parts shall be O.E.M. items. Obsolete or refurbished parts are unacceptable. "Approved Equal" parts must have prior approval of the Contracting Officer. Contractor shall furnish evidence of guaranteed supply of parts for the life of the system.
  3. Service Supplies: The services shall include, without any additional cost to the government, all replacement parts, special tools and equipment, and consumable materials, that is, lubrication oil, grease, and cleaning materials, as required. The requirement of UL listing, where applicable, shall not be voided by any replacement parts, components, software, or modifications provided by the contractor.



4. **Scheduled and Emergency Call Service:** The service shall include a scheduled monthly visit to perform systematic examination of equipment and/or systems and a 7 day, 24 hours call back service for emergency service. The emergency service is defined as a situation created by a breakdown or malfunction of any equipment or system warranting urgent attention. A qualified service representative shall respond to the VA request for emergency service within two hours and assess the problem either by telephone or remote diagnostic capability. If the emergency situation cannot be rectified by the VA personnel, on site emergency service shall be provided by sending a qualified service representative within 24 hours. For the rural locations of the VA medical centers, situated over 200 miles from the contractor's established service depot, the maximum response time of 48 hours shall be acceptable. The emergency service shall be limited to adjustments and repairs specifically required to protect the safety of the equipment for which the emergency service was required to be performed.
5. **Licensing:** The contractor shall be licensed to perform the contracted services. The contractor shall furnish details of all applicable local and state licensing requirements to VA as a part of the qualification requirements. The licenses shall be current, valid through the term of the contract and in the name of the contractor.
6. **Documentation Requirements:** The contractor shall maintain a separate log for each item of equipment and each system covered under the extended guarantee period service contract with the VA Medical Center (VAMC) Engineering Service. The log shall list dates and times of all scheduled and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency, steps taken to rectify the situations, and specific recommendations to avoid such conditions in the future.
7. **Reports:** The contractor shall provide a quarterly report for the first year and twice a year for the remainder of the guarantee period for all equipment and systems serviced under the extended guarantee period contract. The report shall clearly and concisely describe the services rendered, parts replaced, and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
8. **Quality Program:** The contractor shall provide a description of the quality management and control program. The description shall include a tangible proof the existence of such program, names of at least

- three customers who have participated in the program, and specific information showing the applicability of program to the project.
9. Training: During each scheduled service visit, the contractor shall actively involve the VAMC maintenance personnel in performing scheduled service and associated activities. The practical training during the scheduled service visits shall include parting oral and written instructions, for each specific task of the servicing contract, to the VAMC maintenance personnel who shall operate the hardware and software in accordance with the intent of the design and under direct supervision of the service contractor's qualified service technician. At the end of the first year of the service contract, the contractor shall obtain a certificate from the VAMC Engineering Service confirming completion of training to the authorized VA representatives.
  10. Classroom Training: Provide list and costs of available classroom training courses offered by contractor or O.E.M.
- E. Supports for sprinkler piping shall be in conformance with NFPA 13.
  - F. Supports for standpipe shall be in conformance with NFPA 14.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
  1. Equipment and materials identification.
  2. Fire-stopping materials.
  3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  4. Wall, floor, and ceiling plates.
- C. Coordination Drawings: Provide detailed layout drawings of all piping systems including any details necessary to depict the following:
  1. Mechanical equipment rooms.
  2. Interstitial space.
  3. Hangers, inserts, supports, and bracing.
  4. Pipe sleeves.
  5. Equipment penetrations of floors, walls, ceilings, or roofs.
- D. Maintenance Data and Operating Instructions:
  1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.

2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment.

### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A36/A36M-2001.....Carbon Structural Steel
  - A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R (2002)
  - E84-2003.....Standard Test Method for Burning Characteristics of Building Materials
  - E119-2000.....Standard Test Method for Fire Tests of Building Construction and Materials
- C. National Fire Protection Association (NFPA):
  - 90A-2015.....Standard for the Installation of Air Conditioning and Ventilating Systems
  - 101-2015.....Life Safety Code

## **PART 2 - PRODUCTS**

### **2.1 LIFTING ATTACHMENTS**

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

### **2.4 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- B. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- C. Valve Tags and Lists:
  1. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4

- mm (1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
  3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

## **2.5 FIRESTOPPING**

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping.

## **2.6 GALVANIZED REPAIR COMPOUND**

Mil. Spec. DOD-P-21035B, paint form.

## **AK2.7 PIPE PENETRATIONS**

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from this requirement must receive prior approval of Resident Engineer.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms

above basement. Except in mechanical rooms, connect sleeve with floor plate.

- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

## **2.8 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the Resident Engineer, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Resident Engineer.
- D. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.9 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a

watertight joint in spaces where brass or steel pipe sleeves are specified.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Coordinate location of piping, sleeves, inserts, hangers, and equipment. Locate piping, sleeves, inserts, hangers, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Protection and Cleaning:
  - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
  - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly exposed materials and equipment.
- C. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Install gages, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- E. Work in Existing Building:
  - 1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  - 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.

3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Resident Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Resident Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Resident Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

F. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.

G. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.

H. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.3 LUBRICATION**

Field check and lubricate equipment requiring lubrication prior to initial operation.

### **3.4 STARTUP AND TEMPORARY OPERATION**

Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.5 OPERATING AND PERFORMANCE TESTS**

A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the Resident Engineer.

- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.6 INSTRUCTIONS TO VA PERSONNEL**

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -



**SECTION 21 13 13**  
**WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

- A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.
- B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation, for the new addition.
- D. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

**1.2 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Section 33 10 00, WATER UTILITIES.
- C. Section 07 84 00, FIRESTOPPING, Treatment of penetrations through rated enclosures.
- D. Section 09 91 00, PAINTING.
- E. Section 21 10 00, WATER-BASED FIRE-SUPPRESSION SYSTEMS, Dry sprinklers, fire pumps, etc.
- F. Section 21 12 00, FIRE-SUPPRESSION STANDPIPES.
- F. Section 28 31 00, FIRE DETECTION AND ALARM, Connection to fire alarm of flow switches, pressure switches and valve supervisory switches.
- G. Section 21 05 11 COMMON WORK RESULTS FOR FIRE SUPPRESSION

**1.3 QUALITY ASSURANCE**

- A. Installer Reliability: The installer shall possess a valid State of Virginia fire sprinkler contractor's license. The installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past ten years.
- B. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL and approved by FM, or other nationally recognized testing laboratory for the specific purpose for which it is used. All materials, devices, and equipment shall be approved by the VA.
- C. Submittals: Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Prepare detailed working drawings that are signed by a NICET Level III or Level IV Sprinkler Technician or stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As Government review is for technical adequacy only, the installer remains responsible for

correcting any conflicts with other trades and building construction that arise during installation. Material submittals shall be approved prior to the purchase or delivery to the job site. Suitably bind submittals in notebooks or binders and provide index referencing the appropriate specification section. Submittals shall include, but not be limited to, the following:

1. Qualifications:

- a. Provide a copy of the installing contractors fire sprinkler contractors license.
- b. Provide a copy of the NICET certification for the NICET Level III or Level IV Sprinkler Technician who prepared and signed the detailed working drawings unless the drawings are stamped by a Registered Professional Engineer practicing in the field of Fire Protection Engineering.

2. Drawings: Submit detailed 1:100 (1/8 inch) scale (minimum) working drawings conforming to NFPA 13. Include a site plan showing the piping to the water supply test location.

3. Manufacturers Data Sheets:

- a. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.

4. Calculation Sheets: Submit hydraulic calculation sheets in tabular form conforming to the requirements and recommendations of NFPA 13.

5. Final Document Submittals: Provide as-built drawings, testing and maintenance instructions in accordance with the requirements in Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

Submittals shall include, but not be limited to, the following:

- a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
- b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts, periodic cleaning and adjustment of the equipment and components with information as to the address and telephone number of both the manufacturer and the local supplier of each item.

- c. Material and Testing Certificate: Upon completion of the sprinkler system installation or any partial section of the system, including testing and flushing, provide a copy of a completed Material and Testing Certificate as indicated in NFPA 13.
  - d. Certificates shall document all parts of the installation.
  - e. Instruction Manual: Provide one copy of the instruction manual covering the system in a flexible protective cover and mount in an accessible location adjacent to the riser.
- D. Design Basis Information: Provide design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13. Recommendations in appendices shall be treated as requirements.
- 1. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Do not restrict design area reductions permitted for using quick response sprinklers throughout by the required use of standard response sprinklers in the areas identified in this section.
  - 2. Sprinkler Protection: To determining spacing and sizing, apply the following coverage classifications:
    - a. Light Hazard Occupancies: Patient care, treatment, and customary access areas.
    - b. Ordinary Hazard Group 1 Occupancies: Laboratories, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, Repair Shops.
    - c. Ordinary Hazard Group 2 Occupancies: Storage rooms, trash rooms, clean and soiled linen rooms, pharmacy and associated storage, laundry, kitchens, kitchen storage areas, retail stores, retail store storage rooms, storage areas, building management storage, boiler plants, energy centers, warehouse spaces, file storage areas for the entire area of the space up to 140 square meters (1500 square feet) and Supply Processing and Distribution (SPD).
    - d. Request clarification from the Government for any hazard classification not identified.
  - 3. Hydraulic Calculations: Calculated demand including hose stream requirements shall fall no less than 10 percent below the available water supply curve.
  - 4. Water Supply: CONTRACTOR SHALL OBTAIN CURRENT WATER FLOW DATA

5. Zoning:

- a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge. The entire new wing included in this contract shall be considered one new zone.
- b. Sprinkler zones shall conform to the smoke barrier zones shown on the drawings.
- c. Provide seismic protection in accordance with NFPA 13.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA):
  - 13-2013.....Installation of Sprinkler Systems
  - 101-2015.....Life Safety Code
  - 170-2015.....Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL):
  - Fire Protection Equipment Directory - 2014, or
  - Verifiable on UL.com
- D. Factory Mutual Engineering Corporation (FM):
  - Online Approval Guide at FMGlobal.com
- E. Virginia Uniform Statewide Building Code (USBC) - 2012
- F. Foundation for Cross-Connection Control and Hydraulic Research-2005

**PART 2 PRODUCTS**

**2.1 PIPING & FITTINGS**

- A. Sprinkler systems in accordance with NFPA 13. Use nonferrous piping in MRI Scanning Rooms.

**2.2 VALVES**

- A. Valves in accordance with NFPA 13.
- B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).

### **2.3 FIRE DEPARTMENT SIAMESE CONNECTION**

- A. Use existing Yard Fire Department Connection.

### **2.4 SPRINKLERS**

- A. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
- B. Temperature Ratings: In accordance with NFPA 13, except as follows:
  - 1. Sprinklers in elevator shafts, elevator pits, and elevator machine rooms: Intermediate temperature rated.
  - 2. Sprinklers in Generator Rooms: High temperature rated.

### **2.5 SPRINKLER CABINET**

Provide sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed, and a sprinkler wrench for each system. Locate adjacent to the riser. Sprinkler heads shall be installed in center of tile or center to center.

### **2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS**

Plastic, steel or aluminum signs with white lettering on a red background with holes for easy attachment. Enter pertinent data for each system on the hydraulic placard.

### **2.7 SWITCHES:**

- A. Contain in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
- B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.
- C. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

### **2.8 GAUGES**

Provide gauges as required by NFPA 13.

### **2.9 PIPE HANGERS AND SUPPORTS**

Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application.

Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

## **2.10 WALL, FLOOR AND CEILING PLATES**

Provide chrome plated steel escutcheon plates for exposed piping passing through walls, floors or ceilings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.
- D. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.
- F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- G. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.
- I. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the

respective waterflow switch or pipe connection near to the pipe from where they were cut.

- J. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- K. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- L. For each fire department connection, provide the symbolic sign given in NFPA 170 and locate 2400 to 3000 mm (8 to 10 feet) above each connection location. Size the sign to 450 by 450 mm (18 by 18 inches) with the symbol being at least 350 by 350 mm (14 by 14 inches).
- M. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- N. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- O. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- P. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.

### **3.2 INSPECTION AND TEST**

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.
- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test.

Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

### **3.3 INSTRUCTIONS**

Furnish the services of a competent instructor for not less than two hours for instructing personnel in the operation and maintenance of the system, on the dates requested by the COTR/Resident Engineer.

- - - E N D - - -



**SECTION 22 05 11**  
**COMMON WORK RESULTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
  - 1. Exposed: Piping and equipment exposed to view in finished rooms.
- C. Abbreviations/Acronyms:
  - 1. ABS: Acrylonitrile Butadiene Styrene
  - 2. AISI: American Iron and Steel Institute
  - 3. AWG: American Wire Gauge
  - 4. BACnet: Building Automation and Control Network
  - 5. BSG: Borosilicate Glass Pipe
  - 6. CDA: Copper Development Association
  - 7. CO: Carbon Monoxide
  - 8. COR: Contracting Officer's Representative
  - 9. CPVC: Chlorinated Polyvinyl Chloride
  - 10. CR: Chloroprene
  - 11. CWP: Cold Working Pressure
  - 12. db(A): Decibels (A weighted)
  - 13. DDC: Direct Digital Control
  - 14. DISS: Diameter Index Safety System
  - 15. DWV: Drainage, Waste and Vent
  - 16. ECC: Engineering Control Center
  - 17. EPDM: Ethylene Propylene Diene Monomer
  - 18. EPT: Ethylene Propylene Terpolymer
  - 19. ETO: Ethylene Oxide
  - 20. FAR: Federal Acquisition Regulations
  - 21. FD: Floor Drain
  - 22. FG: Fiberglass
  - 23. FNPT: Female National Pipe Thread
  - 24. FPM: Fluoroelastomer Polymer
  - 25. HDPE: High Density Polyethylene
  - 26. HOA: Hands-Off-Automatic
  - 27. HP: Horsepower
  - 28. ID: Inside Diameter

- 29. MAWP: Maximum Allowable Working Pressure
- 30. NPTF: National Pipe Thread Female
- 31. NPS: Nominal Pipe Size
- 32. NPT: National Pipe Thread
- 33. OD: Outside Diameter
- 34. OSD: Open Sight Drain
- 35. OS&Y: Outside Stem and Yoke
- 36. PP: Polypropylene
- 37. PTFE: Polytetrafluoroethylene
- 38. PVC: Polyvinyl Chloride
- 39. PVDF: Polyvinylidene Fluoride
- 40. RTRP: Reinforced Thermosetting Resin Pipe
- 41. SPS: Sterile Processing Services
- 42. SUS: Saybolt Universal Second
- 43. SWP: Steam Working Pressure
- 44. TFE: Tetrafluoroethylene
- 45. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
- 46. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire
- 47. USDA: U.S. Department of Agriculture
- 48. VAC: Voltage in Alternating Current
- 49. WOG: Water, Oil, Gas

## 1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- D. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- E. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- F. NOT USED.
- G. NOT USED
- H. Section 05 31 00, STEEL DECKING: Building Components for Attachment of Hangers.
- I. Section 05 36 00, COMPOSITE METAL DECKING: Building Components for Attachment of Hangers.
- J. Section 05 50 00, METAL FABRICATIONS.
- K. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- L. Section 07 84 00, FIRESTOPPING.

- M. Section 07 92 00, JOINT SEALANTS.
- N. Section 09 91 00, PAINTING.
- O. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- P. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- Q. Section 22 07 11, PLUMBING INSULATION.
- R. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- S. NOT USED
- T. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- U. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- V. Section 26 29 11, MOTOR CONTROLLERS.
- W. Section 31 20 00, EARTH MOVING: Excavation and Backfill.

### 1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
ASME Boiler and Pressure Vessel Code -  
BPVC Section IX-2013....Welding, Brazing, and Fusing Qualifications  
B31.1-2012.....Power Piping
- C. American Society for Testing and Materials (ASTM):  
A36/A36M-2012.....Standard Specification for Carbon Structural Steel  
A575-96(R2013)e1.....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades  
E84-2013a.....Standard Test Method for Surface Burning Characteristics of Building Materials  
E119-2012a.....Standard Test Methods for Fire Tests of Building Construction and Materials  
F1760-01(R2011).....Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
- D. International Code Council, (ICC):  
IBC-2012.....International Building Code  
IPC-2012.....International Plumbing Code
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:

- SP-58-2009.....Pipe Hangers and Supports - Materials, Design,  
Manufacture, Selection, Application and  
Installation
- SP-69-2003.....Pipe Hangers and Supports - Selection and  
Application
- F. Military Specifications (MIL):
- P-21035B.....Paint High Zinc Dust Content, Galvanizing  
Repair (Metric)
- G. National Electrical Manufacturers Association (NEMA):
- MG 1-2011.....Motors and Generators
- H. National Fire Protection Association (NFPA):
- 51B-2014.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work
- 54-2012.....National Fuel Gas Code
- 70-2011.....National Electrical Code (NEC)
- I. NSF International (NSF):
- 5-2012.....Water Heaters, Hot Water Supply Boilers, and  
Heat Recovery Equipment
- 14-2012.....Plastic Piping System Components and Related  
Materials
- 61-2012.....Drinking Water System Components - Health  
Effects
- 372-2011.....Drinking Water System Components - Lead Content
- J. Department of Veterans Affairs (VA):
- PG-18-10.....Plumbing Design Manual
- PG-18-13-2011.....Barrier Free Design Guide

#### **1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 11, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.
- C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems.

Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
  - 1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
  - 2. Equipment and materials identification.
  - 3. Firestopping materials.
  - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  - 5. Wall, floor, and ceiling plates.
- H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device,

component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.

1. Mechanical equipment rooms.
2. Interstitial space.
3. Hangers, inserts, supports, and bracing.
4. Pipe sleeves.
5. Equipment penetrations of floors, walls, ceilings, or roofs.

J. Maintenance Data and Operating Instructions:

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

K. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.

L. Submit training plans, trainer qualifications and instructor qualifications in accordance with the requirements of Section 22 08 00 COMMISSIONING OF PLUMBING SYSTEMS.//

## **1.5 QUALITY ASSURANCE**

A. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.

2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Contracting Officers Representative (COR).
5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
8. Asbestos products or equipment or materials containing asbestos shall not be used.
9. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA

recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopREFERRED.gov>.

- B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
  4. All welds shall be stamped according to the provisions of the American Welding Society.
- C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- D. Execution (Installation, Construction) Quality:
1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the COR for resolution. Printed copies or electronic files of manufacturer's installation instructions shall be provided to the COR at least 10 working days prior to commencing installation of any item.
  2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to



commencing installation work, refer conflicts between this requirement and contract documents to COR for resolution.

3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by VA.
4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or additional time to the Government.

E. Guaranty: Warranty of Construction, FAR clause 52.246-21.

F. Plumbing Systems: IPC, International Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the IPC. For IPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall". Reference to the "code official" or "owner" shall be interpreted to mean the COR.

G. Cleanliness of Piping and Equipment Systems:

1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications and the International Plumbing Code (IPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

## **1.6 DELIVERY, STORAGE AND HANDLING**

A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and

- material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Damaged equipment shall be replaced with an identical unit as determined and directed by the COR. Such replacement shall be at no additional cost or additional time to the Government.
  3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
  4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

#### **1.7 AS-BUILT DOCUMENTATION**

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version ~~2014~~ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing

agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS FOR VARIOUS SERVICES**

- A. NOT USED
- B. NOT USED
- C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.
- D. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
- E. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

### **2.2 FACTORY-ASSEMBLED PRODUCTS**

- A. Standardization of components shall be maximized to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Government.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, shall be the same make and model.

**2.3 COMPATIBILITY OF RELATED EQUIPMENT**

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

**2.4 SAFETY GUARDS**

- A. NOT USED
- B. All Equipment having moving parts shall protected from personal injury.

**2.5 NOT USED****2.6 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING**

- A. All material and equipment furnished and installation methods used shall conform to the requirements of Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. All electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems shall be provided. Premium efficient motors shall be provided. Unless otherwise specified for a particular application, electric motors shall have the following requirements.
- B. Special Requirements:
  - 1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional cost or time to the Government.
  - 2. Assemblies of motors, starters, and controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
  - 3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
    - a. Wiring material located where temperatures can exceed 71° C (160° F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers and water heaters.
    - b. NOT USED
    - c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.
  - 4. NOT USED
  - 5. NOT USED
- C. NOT USED

D. NOT USED

E. NOT USED

F. Rating: Rating shall be continuous duty at 100 percent capacity in an ambient temperature of 40° C (104° F); minimum horsepower as shown on drawings; maximum horsepower in normal operation shall not exceed nameplate rating without service factor.

G. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame shall be measured at the time of final inspection.

## **2.8 EQUIPMENT AND MATERIALS IDENTIFICATION**

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals. Coordinate equipment and valve identification with facility maintenance staff. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING. ~~++~~

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.

C. NOT USED

D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a

punched 3-ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. COR shall instruct contractor where frames shall be mounted.

4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3-ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

## **2.9 FIRESTOPPING MATERAILS**

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 22 07 11, PLUMBING INSULATION, for pipe insulation.

## **2.10 GALVANIZED REPAIR COMPOUND**

- A. Mil. Spec. DOD-P-21035B, paint.

## **2.11 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the International Building Code (IBC) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC) and Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds) shall be submitted for approval of the COR in all cases. See the above specifications for lateral force design requirements.
- B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. For selection and application refer to MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
  1. Concrete insert: Type 18, MSS SP-58.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
- D. NOT USED
- E. NOT USED
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
  1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
  2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- I. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
  1. General Types (MSS SP-58):
    - a. Standard clevis hanger: Type 1; provide locknut.
    - b. Riser clamps: Type 8.
    - c. Wall brackets: Types 31, 32 or 33.
    - d. Roller supports: Type 41, 43, 44 and 46.
    - e. Saddle support: Type 36, 37 or 38.
    - f. Turnbuckle: Types 13 or 15.
    - g. U-bolt clamp: Type 24.

## h. Copper Tube:

- 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
- 2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
- 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.

## i. NOT USED

- j. Spring hangers are required on all plumbing system pumps one horsepower and greater.

## 2. Plumbing Piping (Other Than General Types):

- a. Horizontal piping: Type 1, 5, 7, 9, and 10.
- b. Chrome plated piping: Chrome plated supports.
- c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
- d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

## J. NOT USED

- K. Seismic Restraint of Piping: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

**2.12 PIPE PENETRATIONS**

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 50 mm (2 inch) above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.



3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of COR.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
- K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing

membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

#### **2.14 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

#### **2.15 ASBESTOS**

- A. Materials containing asbestos are not permitted.

### **PART 3 - EXECUTION**

#### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.

- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
  - 1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
  - 2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
  - 3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COR where working area space is limited.
- G. Interconnection of Pneumatic Instrumentation and Controls: Generally, pneumatic interconnections are not shown but must be provided.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- I. Protection and Cleaning:
  - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced at no additional cost or time to the Government.
  - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

- J. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.
- K. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Interconnection of Electrical Instrumentation and Controls: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.
- M. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and Section 23 09 23, DIRECT DIGITAL CONTROL SYSTEM FOR HVAC.
- N. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will cause the least interfere with normal operation of the facility.
- O. NOT USED
- P. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- Q. NOT USED
- R. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Government.
  2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling

under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

### **3.4 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the COR.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC) and these specifications.
- E. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.

2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

F. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

### **3.6 PLUMBING SYSTEMS DEMOLITION**

- A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities

shall be available at all times. All work shall be performed in accordance with recognized fire protection standards including NFPA 51B. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate. Coordinate with the COR and Infection Control.

### **3.7 CLEANING AND PAINTING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.

2. The following Material and Equipment shall NOT be painted:
  - a. Motors, controllers, control switches, and safety switches.
  - b. Control and interlock devices.
  - c. Regulators.
  - d. Pressure reducing valves.
  - e. Control valves and thermostatic elements.
  - f. Lubrication devices and grease fittings.
  - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
  - h. Valve stems and rotating shafts.
  - i. Pressure gages and thermometers.
  - j. Glass.
  - k. Name plates.
3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 09 91 00, Painting.
6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

### **3.8 IDENTIFICATION SIGNS**

- A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance data shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.



**3.9 STARTUP AND TEMPORARY OPERATION**

- A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.
- B. The commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of 2 weeks prior notice.

**3.10 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, all required tests shall be performed as specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TESTS and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.
- D. Perform tests as required for commissioning provisions in accordance with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**3.11 OPERATION AND MAINTENANCE MANUALS**

- A. All new and temporary equipment and all elements of each assembly shall be included.
- B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- C. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

- D. NOT USED
- E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- F. Set points of all interlock devices shall be listed.
- G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
- H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- I. Emergency procedures for shutdown and startup of equipment and systems.

### **3.12 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 22 05 19**  
**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section describes the requirements for water meters and gages primarily used for troubleshooting the system and to indicate system performance.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. NOT USED

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
 B40.100-2013.....Pressure Gauges and Gauge Attachments  
 B40.200-2008.....Thermometers, Direct Reading and Remote Reading
- C. --NOT USED
- D. Institute of Electrical and Electronics Engineers (IEEE):  
 C2-2012.....National Electrical Safety Code (NESC)
- E. International Code Council (ICC):  
 IPC-2012.....International Plumbing Code
- F. National Fire Protection Association (NFPA):  
 70-2011.....National Electrical Code (NEC)
- G. NSF International (NSF):  
 61-2012.....Drinking Water System Components - Health Effects  
 372-2011.....Drinking Water System Components - Lead Content

**1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 19, METERS AND GAGES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. NOT USED
  - 2. Pressure Gages.
  - 3. Thermometers.
  - 4. Product certificates for each type of gage.
  - 5. BACnet communication protocol.
- D. Operations and Maintenance manual shall include:
  - 1. System Description.
  - 2. Major assembly block diagrams.
  - 3. Troubleshooting and preventive maintenance guidelines.
  - 4. Spare parts information.
- E. Shop Drawings shall include the following: One line, wiring and terminal diagrams including terminals identified, protocol or communication modules, and Ethernet connections.

#### **1.5 AS-BUILT DOCUMENTATION**

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit copies of complete operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder per the requirements of Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

#### **PART 2 - PRODUCTS**

SPEC WRITER NOTE: Coordinate with the meter manufacturer for the selection of the best meter for the application.

## **2.8 PRESSURE GAGES FOR WATER USAGE**

- A. ASME B40.100 all metal case 115 mm (4-1/2 inches) diameter, bottom connected throughout, graduated as required for service, and identity labeled. Range shall be 0 to 1380 kPa (0 to 200 psig) gage.
- B. The pressure element assembly shall be bourdon tube. The mechanical movement shall be lined to pressure element and connected to pointer.
- C. The dial shall be non-reflective aluminum with permanently etched scale markings graduated in kPa and psig.
- D. The pointer shall be dark colored metal.
- E. The window shall be glass.
- F. The ring shall be brass or stainless steel.
- G. The accuracy shall be grade A, plus or minus 1 percent of middle half of scale range.
- H. The pressure gage for water domestic use shall conform to NSF 61
- I. NOT USED

## **2.9 THERMOMETERS**

- A. Thermometers shall be straight stem, metal case, red liquid-filled thermometer, approximately 175 mm (7 inches) high, 4 degrees C to 100 degrees C (40 degrees F to 212 degrees F). Thermometers shall comply with ASME B40.200.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Direct mounted pressure gages shall be installed in piping tees with pressure gage located on pipe at the most readable position.
- B. Valves and snubbers shall be installed in piping for each pressure gage.
- C. Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.
- D. Pressure gages shall be installed where indicated on the drawings and at the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure reducing valve.
  - 3. Suction and discharge of each domestic water pump or re-circulating hot water return pump.
- E. Water meter installation shall conform to AWWA C700, AWWA C701, and AWWA C702. Electrical installations shall conform to IEEE C2, NFPA 70,

and to the requirements specified herein. New materials shall be provided.

- F. Remote readout register shall be mounted at the location indicated on the drawings or as directed by the COR.
- G. Thermometers shall be installed on the water heater inlet and outlet piping, thermostatic mixing valve outlet piping, and the hot water circulation pump inlet piping.
- H. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

### **3.2 FIELD QUALITY CONTROL**

- A. The meter assembly shall be visually inspected and operationally tested. The correct multiplier placement on the face of the meter shall be verified.

- - - E N D - - -

**SECTION 22 05 23**  
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- F. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

**1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):  
A112.14.1-2003.....Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):  
1001-2008.....Performance Requirements for Atmospheric Type Vacuum Breakers  
1003-2009.....Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems  
1011-2004.....Performance Requirements for Hose Connection Vacuum Breakers  
1013-2011.....Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers  
1015-2011.....Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies

- 1017-2009.....Performance Requirements for Temperature  
Actuated Mixing Valves for Hot Water  
Distribution Systems
- 1020-2004.....Performance Requirements for Pressure Vacuum  
Breaker Assembly
- 1035-2008.....Performance Requirements for Laboratory Faucet  
Backflow Preventers
- 1069-2005.....Performance Requirements for Automatic  
Temperature Control Mixing Valves
- 1070-2004.....Performance Requirements for Water Temperature  
Limiting Devices
- 1071-2012.....Performance Requirements for Temperature  
Actuated Mixing Valves for Plumbed Emergency  
Equipment
- D. American Society for Testing and Materials (ASTM):
- A126-2004 (R2009).....Standard Specification for Gray Iron Castings  
for Valves, Flanges, and Pipe Fittings
- A276-2013a.....Standard Specification for Stainless Steel Bars  
and Shapes
- A536-1984 (R2009).....Standard Specification for Ductile Iron  
Castings
- B62-2009.....Standard Specification for Composition Bronze  
or Ounce Metal Castings
- B584-2013.....Standard Specification for Copper Alloy Sand  
Castings for General Applications
- E. International Code Council (ICC):
- IPC-2012.....International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings  
Industry, Inc. (MSS):
- SP-25-2008.....Standard Marking Systems for Valves, Fittings,  
Flanges and Unions
- SP-67-2011.....Butterfly Valves
- SP-70-2011.....Gray Iron Gate Valves, Flanged and Threaded  
Ends
- SP-71-2011.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends
- SP-80-2013.....Bronze Gate, Globe, Angle, and Check Valves



SP-85-2011.....Gray Iron Globe & Angle Valves, Flanged and  
Threaded Ends

SP-110-2010.....Ball Valves Threaded, Socket-Welding, Solder  
Joint, Grooved and Flared Ends

G. NOT USED

H. NSF International (NSF):

61-2012.....Drinking Water System Components - Health  
Effects

372-2011.....Drinking Water System Components - Lead Content

I. University of Southern California Foundation for Cross Connection  
Control and Hydraulic Research (USC FCCCHR):  
9th Edition.....Manual of Cross-Connection Control

#### **1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. Ball Valves.
  - 2. NOT USED
  - 3. NOT USED
  - 4. Balancing Valves.
  - 5. Check Valves.
  - 6. NOT USED
  - 7. NOT USED
  - 8. NOT USED
  - 9. Backflow Preventers.
  - 10. NOT USED
  - 11. NOT USED
- D. Test and Balance reports for balancing valves.
- E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
  - 1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
4. Piping diagrams of thermostatic mixing valves to be installed.
- F. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- G. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Valves shall be prepared for shipping as follows:
  1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, and weld ends.
  3. Set angle, gate, and globe valves closed to prevent rattling.
  4. Set ball and plug valves open to minimize exposure of functional surfaces.
  5. Set butterfly valves closed or slightly open.
  6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew point temperature.

## **PART 2 - PRODUCTS**

### **2.1 VALVES, GENERAL**

- A. Asbestos packing and gaskets are prohibited.
- B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
- C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.

- D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
- E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.
- F. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

## **2.2 SHUT-OFF VALVES**

- A. Cold, Hot and Re-circulating Hot Water:
  - 1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.
  - 2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.

## **2.3 BALANCING VALVES**

- A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

**2.4 CHECK VALVES**

- A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

**2.5 NOT USED****2.6 NOT USED****2.7 NOT USED****2.8 BACKFLOW PREVENTERS**

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCC).
- B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.
- C. NOT USED
- D. NOT USED

**2.9 THERMOSTATIC MIXING VALVES**

- A. NOT USED
- B. NOT USED
- C. NOT USED
- D. NOT USED

E. Water Temperature Limiting Devices:

1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
2. Standard: ASSE 1070.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
5. Connections: Threaded union, compression or soldered inlets and outlet.
6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.

F. NOT USED

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

**3.2 INSTALLATION**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- D. Valves shall be installed in a position to allow full stem movement.

- E. NOT USED
- F. Check valves shall be installed for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.
- G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.
  - 1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
- H. Install pressure gages on outlet of backflow preventers.
- I. Do not install bypass piping around backflow preventers.
- J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.
  - 1. Install thermometers if specified.
  - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

### **3.3 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Calibrated balancing valves.
  - 2. Master, thermostatic, water mixing valves.
  - 3. Manifold, thermostatic, water-mixing-valve assemblies.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

### **3.4 ADJUSTING**

- A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.

- B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the VA Contracting Officer's Representative (COR).

### **3.5 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - E N D - - -





**SECTION 22 07 11**  
**PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for
  - 1. Plumbing piping and equipment.
- B. Definitions
  - 1. ASJ: All service jacket, white finish facing or jacket.
  - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  - 3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
  - 4. Concealed: Piping above ceilings and in chases, ~~//~~interstitial space, and pipe spaces.
  - 5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, ~~//~~interstitial spaces, ~~//~~ unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  - 6. FSK: Foil-scrim-kraft facing.
  - 7. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
  - 8. Density:  $\text{kg/m}^3$  - kilograms per cubic meter (Pcf - pounds per cubic foot).
  - 9. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watts per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watts per square meter (BTU per hour per linear foot).
  - 10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
  - 11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum

published permeance of 0.001 perms.

- 12. R: NOT USED
- 13. CW: Cold water.
- 14. SW: Soft water.
- 15. HW: Hot water.
- 16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

## 1.2 RELATED WORK

- A. NOT USED
- B. NOT USED
- C. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- D. NOT USED
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- F. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- G. NOT USED
- H. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklists, and training.

## 1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

- B. Criteria:

- 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

**4.3.3.1** Pipe insulation and coverings, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

**4.3.3.1.1** Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

**4.3.3.3** Pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test

for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

4.3.10.2.6.3 Nonferrous fire sprinkler piping shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

#### **1.4 SUBMITTALS**

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
  - a. Insulation materials: Specify each type used and state surface burning characteristics.
  - b. Insulation facings and jackets: Each type used.
  - c. Insulation accessory materials: Each type used.
  - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

- e. Make reference to applicable specification paragraph numbers for coordination.

#### NOT USED **1.5 STORAGE AND HANDLING OF MATERIAL**

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
- MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation
- MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation
- MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
- MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):
- A167-04 .....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C411-05.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation
- C449-07.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
- C533-09.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

- C534-08 .....Standard Specification for Preformed Flexible  
Elastomeric Cellular Thermal Insulation in  
Sheet and Tubular Form
- C547-07 .....Standard Specification for Mineral Fiber pipe  
Insulation
- C552-07 .....Standard Specification for Cellular Glass  
Thermal Insulation
- C553-08 .....Standard Specification for Mineral Fiber  
Blanket Thermal Insulation for Commercial and  
Industrial Applications
- C585-09.....Standard Practice for Inner and Outer Diameters  
of Rigid Thermal Insulation for Nominal Sizes  
of Pipe and Tubing (NPS System) R (1998)
- C612-10 .....Standard Specification for Mineral Fiber Block  
and Board Thermal Insulation
- C1126-10.....Standard Specification for Faced or Unfaced  
Rigid Cellular Phenolic Thermal Insulation
- C1136-10 .....Standard Specification for Flexible, Low  
Permeance Vapor Retarders for Thermal  
Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven  
and Treated) for Roofing and Waterproofing
- E84-10 .....Standard Test Method for Surface Burning  
Characteristics of Building  
Materials
- E119-09C.....Standard Test Method for Fire Tests of Building  
Construction and Materials
- E. National Fire Protection Association (NFPA):
- 101-09 .....Life Safety Code
- 251-06.....Standard methods of Tests of Fire Endurance of  
Building Construction Materials
- 255-06.....Standard Method of tests of Surface Burning  
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
- 723.....UL Standard for Safety Test for Surface Burning  
Characteristics of Building Materials with  
Revision of 08/03

G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):  
 SP58-2002.....Pipe Hangers and Supports Materials, Design,  
 and Manufacture

## **PART 2 - PRODUCTS**

### **2.1 MINERAL FIBER OR FIBER GLASS**

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m<sup>3</sup> (3 pcf), k = 0.037 (.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F).
- B. ASTM C553 (Blanket, Flexible) Type I, // Class B-3, Density 16 kg/m<sup>3</sup> (1 pcf), k = 0.045 (0.31) // Class B-5, Density 32 kg/m<sup>3</sup> (2 pcf), k = 0.04 (0.27) // at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F)
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

### **2.2 Mineral wool or refractory fiber**

- A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

### **2.3 NOT USED**

### **2.4 NOT USED**

### **2.5 NOT USED**

### **2.6 FLEXIBLE ELASTOMERIC CELLULAR THERMAL**

ASTM C177, C518, k = 0.039 (0.27) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

<b>Insulation Characteristics</b>		
<b>ITEMS</b>	<b>TYPE I</b>	<b>TYPE II</b>
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), Kg/m <sup>3</sup> (lb/ ft <sup>3</sup> )	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft <sup>2</sup> degrees F)@	0.059	0.078

mean temperature of 93 degrees C (200 degrees F)	(0.41)	(0.540)
Surface burning characteristics:		
Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

## 2.7 NOT USED

## 2.8 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance  $\leq 0.02$  or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping //exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas//conveying fluids below ambient temperature//. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.

- F. Factory composite materials may be used provided
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

## **2.9. PIPE COVERING PROTECTION SADDLES**

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

<b>Nominal Pipe Size and Accessories Material (Insert Blocks)</b>	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

## **2.10 ADHESIVE, MASTIC, CEMENT**

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.



F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.

G. Other: Insulation manufacturers' published recommendations.

### **2.11 MECHANICAL FASTENERS**

A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.

B. Staples: Outward clinching galvanized steel

C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.

D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

### **2.12 REINFORCEMENT AND FINISHES**

A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).

B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.

C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.

D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.

E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.

F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

### **2.13 FIRESTOPPING MATERIAL**

Other than pipe insulation, refer to Section 07 84 00 FIRESTOPPING.

### **2.14 FLAME AND SMOKE**

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

**PART 3 - EXECUTION****3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. NOT USED
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- E. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- F. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- G. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- H. NOT USED
- I. Plumbing work not to be insulated:
  - 1. Piping and valves of fire protection system.
  - 2. Chromium plated brass piping.
  - 3. Water piping in contact with earth.

4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
5. Distilled water piping.
- J. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.  
Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- L. Firestop Pipe insulation:
  1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
  2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions

### **3.2 INSULATION INSTALLATION**

- A. NOT USED
- B. Molded Mineral Fiber Pipe and Tubing Covering:
  1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
  2. Contractor's options for fitting, flange and valve insulation:
    - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
    - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures

below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.

- c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
- d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
- 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

C. NOT USED

D. Cellular Glass Insulation:

- 1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
- 2. NOT USED

E. NOT USED

F. Flexible Elastomeric Cellular Thermal Insulation:

- 1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
- 2. Pipe and tubing insulation:
  - a. Use proper size material. Do not stretch or strain insulation.
  - b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
  - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

3. NOT USED

4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.

### 3.3 COMMISSIONING

A. Provide commissioning documentation in accordance with the requirements of section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

### 3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1¼)	38 - 75 (1½ - 3)	100 (4) and Above
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Rigid Cellular Phenolic Foam (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	----	----

--	--	--	--	--	--

- - - E N D - - -

**SECTION 22 08 00****COMMISSIONING OF PLUMBING SYSTEMS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 22, is required in cooperation with the VA and the Commissioning Agent.
- B. The Plumbing systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

**1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - NOT USED****PART 3 - EXECUTION****3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and



resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

----- END -----

**SECTION 22 11 00  
FACILITY WATER DISTRIBUTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING.
- B. Section 09 91 00, PAINTING.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, PIPE INSULATION.
- E. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. All items listed in Part
  - 2. Products.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
  - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A13.1.....Scheme for Identification of Piping Systems
  - B16.3-2011.....Malleable Iron Threaded Fittings Classes 150 and 300
  - B16.9-2007.....Factory-Made Wrought Butt Welding Fittings
  - B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
  - B16.12-2009 .....Cast Iron Threaded Drainage Fittings
  - B16.15-2006 .....Cast Copper Alloy Threaded Fittings Classes 125 and 250
  - B16.18-2001 (R2005).....Cast Copper Alloy Solder-Joint Pressure Fittings

- B16.22-2012.....Wrought Copper and Copper Alloy Solder Joint  
Pressure Fittings
- B16.51-2011.....Copper and Copper Alloy Press-Connect Fittings
- NSF/ANSI 61-2012.....Drinking Water System Components - Health  
Effects
- C. American Society for Testing and Materials (ASTM):
- A47/A47M-99(2009).....Ferritic Malleable Iron Castings
- A53/A53M-12.....Pipe, Steel, Black and Hot-Dipped, Zinc Coated  
Welded and Seamless
- A183-03(2009).....Carbon Steel Track Bolts and Nuts
- B32-08.....Solder Metal
- B61-08.....Steam or Valve Bronze Castings
- B62-09.....Composition Bronze or Ounce Metal Castings
- B75/B75M-11.....Seamless Copper Tube
- B88-09.....Seamless Copper Water Tube
- B584-12a.....Copper Alloy Sand Castings for General  
Applications
- B687-99(2011).....Brass, Copper, and Chromium-Plated Pipe Nipples
- E1120-08.....Liquid Chlorine
- D. American Water Works Association (AWWA):
- C651-05.....Disinfecting Water Mains
- E. American Welding Society (AWS):
- A5.8/A5.8M-2011.....Filler Metals for Brazing
- F. American Society of Sanitary Engineers (ASSE):
- ANSI/ASSE 1001-2008.....Pipe Applied Atmospheric Type Vacuum Breakers
- ANSI/ASSE 1010-2004.....Water Hammer Arresters
- ANSI/ASSE 1018-2001.....Trap Seal Primer Valves - Potable Water  
Supplied
- ANSI/ASSE 1020-2004.....Pressure Vacuum Breaker Assembly
- G. International Code Council (ICC)
- ICC IPC (2012).....International Plumbing Code
- H. NSF International (NSF)
- NSF/ANSI 61 (2012).....Drinking Water System Components - Health  
Effects
- NSF/ANSI 372 (2011).....Drinking Water System Components - Lead Content
- I. Plumbing and Drainage Institute (PDI):
- PDI WH-201 2010.....Water Hammer Arrestor

**1.5 QUALITY ASSURANCE**

- A. A certificate of Welder's certification shall be submitted prior to welding of steel piping. The certificate shall be current and no more than one year old.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
- C. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

**1.6 SPARE PARTS**

- A. For mechanical press-connect fittings, provide tools required for each pipe size used at the facility.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.
- B. NOT USED
- C. NOT USED

**2.2 NOT USED****2.3 ABOVE GROUND (INTERIOR) WATER PIPING**

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn.
- B. Fittings for Copper Tube:
  - 1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
  - 2. Grooved fittings, 2 to 6 inch (50 to 150 mm) wrought copper ASTM B75 C12200, 5 to 6 inch (125 to 150 mm) bronze casting ASTM B584, CDA 844. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
  - 3. Mechanical press-connect fittings for copper pipe and tube shall conform to the material and sizing requirements of ASME B16.51, 2 inch (50 mm) size and smaller mechanical press-connect fittings, double pressed type, with EPDM (ethylene propylene diene monomer)

non-toxic synthetic rubber sealing elements and un-pressed fitting identification feature.

4. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.

C. NOT USED

D. Adapters: Provide adapters for joining screwed pipe to copper tubing.

E. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8, Classification BCuP.

## **2.4 EXPOSED WATER PIPING**

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.

2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish.

3. Nipples: ASTM B 687, Chromium-plated.

4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish.

Unions 2-1/2 inches (65 mm) and larger shall be flange type with approved gaskets.

- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

## **2.5 NOT USED**

## **2.6 NOT USED**

## **2.7 NOT USED**

## **2.8 DIELECTRIC FITTINGS**

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

## **2.9 STERILIZATION CHEMICALS**

- A. Hypochlorite: ASTM E1120-08

- B. Liquid Chlorine: ASTM E1229-08

**2.10 WATER HAMMER ARRESTER:**

A. Closed copper tube chamber with permanently sealed 60 psig (410 KpA) air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI-WH 201). Provide water hammer arrestors at:

1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

**PART 3 - EXECUTION****3.1 INSTALLATION**

A. General: Comply with the International Plumbing Code and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
  - a. All piping shall be supported per the International Plumbing Code.
  - b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with red lead or zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
  - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
    - 1) Solid or split un-plated cast iron.
    - 2) All plates shall be provided with set screws.
    - 3) Pipe Hangers: Height adjustable clevis type.
    - 4) Adjustable Floor Rests and Base Flanges: Steel.

- 5) Concrete Inserts: "Universal" or continuous slotted type.
  - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
  - 7) Riser Clamps: Malleable iron or steel.
  - 8) Rollers: Cast iron.
  - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
  - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
  - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
  - 12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints.
6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
  7. Penetrations:
    - a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
    - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00.



8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. Depth of insertion must be marked on the tube prior to inserting the tube into the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

B. Piping shall conform to the following:

1. Domestic Water:

- a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
- b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

### 3.2 TESTS

- A. General: Test system either in its entirety or in sections. Submit testing plan to Resident Engineer/COR 14 days prior to test date.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psi (1040 kPa) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.
- C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 200 psi (1040 kPa) gage during inspection and prove tight.
- D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

**3.3 STERILIZATION**

- A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
- B. Use liquid chlorine or hypochlorite for sterilization.

**3.4 COMMISSIONING**

- A. Provide commissioning documentation accordance with the requirements of Section 22 08 00.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 22 13 00**  
**FACILITY SANITARY AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- E. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- F. Section 07 92 00, JOINT SEALANTS: Sealant products.
- G. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- I. Section 22 07 11, PLUMBING INSULATION.
- J. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS

**NOT USED NOT USED1.3 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
  - A13.1-2007.....Scheme for the Identification of Piping Systems
  - A112.36.2M-1991(R 2012).Cleanouts
  - A112.6.3-2001 (R2007)...Standard for Floor and Trench Drains
  - B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
  - B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings
  - B16.4-2011.....Standard for Grey Iron Threaded Fittings
    - Classes 125 and 250
  - B16.15-2013.....Cast Copper Alloy Threaded Fittings, Classes
    - 125 and 250

- B16.18-2012.....Cast Copper Alloy Solder Joint Pressure  
Fittings
- B16.21-2011.....Nonmetallic Flat Gaskets for Pipe Flanges
- B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint  
Pressure Fittings
- B16.23-2011.....Cast Copper Alloy Solder Joint Drainage  
Fittings: DWV
- B16.24-2001 (R2006).....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings
- B16.29-2012.....Wrought Copper and Wrought Copper Alloy Solder-  
Joint Drainage Fittings: DWV
- B16.39-2009.....Malleable Iron Threaded Pipe Unions Classes  
150, 250, and 300
- B18.2.1-2012.....Square, Hex, Heavy Hex, and Askew Head Bolts  
and Hex, Heavy Hex, Hex Flange, Lobed Head, and  
Lag Screws (Inch Series)
- C. American Society of Sanitary Engineers (ASSE):
- 1001-2008.....Performance Requirements for Atmospheric Type  
Vacuum Breakers
- 1018-2001.....Performance Requirements for Trap Seal Primer  
Valves - Potable Water Supplied
- 1044-2001.....Performance Requirements for Trap Seal Primer  
Devices - Drainage Types and Electronic Design  
Types
- 1079-2012.....Performance Requirements for Dielectric Pipe  
Unions
- D. American Society for Testing and Materials (ASTM):
- A53/A53M-2012.....Standard Specification for Pipe, Steel, Black  
And Hot-Dipped, Zinc-coated, Welded and  
Seamless
- A74-2013a.....Standard Specification for Cast Iron Soil Pipe  
and Fittings
- A888-2013a.....Standard Specification for Hubless Cast Iron  
Soil Pipe and Fittings for Sanitary and Storm  
Drain, Waste, and Vent Piping Applications
- B32-2008.....Standard Specification for Solder Metal
- B43-2009.....Standard Specification for Seamless Red Brass  
Pipe, Standard Sizes

- B75-2011.....Standard Specification for Seamless Copper Tube
- B88-2009.....Standard Specification for Seamless Copper  
Water Tube
- B306-2013.....Standard Specification for Copper Drainage Tube  
(DWV)
- B584-2013.....Standard Specification for Copper Alloy Sand  
Castings for General Applications
- B687-1999 (R 2011).....Standard Specification for Brass, Copper, and  
Chromium-Plated Pipe Nipples
- B813-2010.....Standard Specification for Liquid and Paste  
Fluxes for Soldering of Copper and Copper Alloy  
Tube
- B828-2002 (R 2010).....Standard Practice for Making Capillary Joints  
by Soldering of Copper and Copper Alloy Tube  
and Fittings
- C564-2012.....Standard Specification for Rubber Gaskets for  
Cast Iron Soil Pipe and Fittings
- F477-2010.....Standard Specification for Elastomeric Seals  
(Gaskets) for Joining Plastic Pipe
- F1545-1997 (R 2009).....Standard Specification for Plastic-Lined  
Ferrous Metal Pipe, Fittings, and Flanges
- E. Cast Iron Soil Pipe Institute (CISPI):
- 2006.....Cast Iron Soil Pipe and Fittings Handbook
- 301-2012.....Standard Specification for Hubless Cast Iron  
Soil Pipe and Fittings for Sanitary and Storm  
Drain, Waste, and Vent Piping Applications
- 310-2012.....Specification for Coupling for Use in  
Connection with Hubless Cast Iron Soil Pipe and  
Fittings for Sanitary and Storm Drain, Waste,  
and Vent Piping Applications
- F. Copper Development Association, Inc. (CDA):
- A4015.....Copper Tube Handbook
- G. International Code Council (ICC):
- IPC-2012.....International Plumbing Code
- H. Manufacturers Standardization Society (MSS):
- SP-123-2013.....Non-Ferrous Threaded and Solder-Joint Unions  
for Use With Copper Water Tube

- I. National Fire Protection Association (NFPA):  
70-2011.....National Electrical Code (NEC)
- J. Plumbing and Drainage Institute (PDI):  
WH-201 (R 2010).....Water Hammer Arrestors Standard
- K. NOT USED

#### **1.4 SUBMITTALS**

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 13 00, FACILITY SANITARY AND VENT PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. Piping.
  - 2. Floor Drains.
  - 3. NOT USED
  - 4. Cleanouts.
  - 5. NOT USED
  - 6. Penetration Sleeves.
  - 7. Pipe Fittings.
  - 8. Traps.
  - 9. Exposed Piping and Fittings.
- D. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

#### **1.5 QUALITY ASSURANCE**

- A. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

#### **1.6 AS-BUILT DOCUMENTATION**

- A. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings

are to be provided, and a copy of them on Auto-Cad version ~~2014~~ provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

- B. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

## **PART 2 - PRODUCTS**

### **2.1 SANITARY WASTE, DRAIN, AND VENT PIPING**

- A. Cast iron waste, drain, and vent pipe and fittings.
  - 1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
    - a. Pipe buried in or in contact with earth.
    - b. Sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.
    - c. Interior waste and vent piping above grade.
  - 2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
  - 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 301, ASTM A888, or ASTM A74.
  - 4. Cast iron pipe and fittings shall be made from a minimum of 95 percent post-consumer recycled material.
  - 5. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM C564.
- B. Copper Tube, (DWV):
  - 1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
  - 2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
  - 3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.

4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

## **2.2 NOT USED**

## **2.3 EXPOSED WASTE PIPING**

- A. Chrome plated brass piping of full iron pipe size shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
  1. The Pipe shall meet ASTM B43, regular weight.
  2. The Fittings shall conform to ASME B16.15 NOT USED
  3. Nipples shall conform to ASTM B687, Chromium-plated.
  4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

## **2.4 SPECIALTY PIPE FITTINGS**

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
  1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
  2. NOT USED
  3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 861 kPa (125 psig) at a minimum temperature of 82 degrees C (180 degrees F). The end connection shall be solder joint copper alloy and threaded ferrous.



- C. Dielectric flange insulating kits shall be of non-conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
- D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F1545 with a pressure rating of 2070 kPa (300 psig) at 107 degrees C (225 degrees F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

## **2.5 CLEANOUTS**

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be

furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

## **2.6 NOT USED**

## **2.7 NOT USED**

## **2.8 NOT USED**

## **2.9 PENETRATION SLEEVES**

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

# **PART 3 - EXECUTION**

## **3.1 PIPE INSTALLATION**

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. The piping shall be installed free of sags and bends.
- H. Seismic restraint shall be installed where required by code.

- I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- L. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".
- M. NOT USED
- N. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

### **3.2 JOINT CONSTRUCTION**

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and

restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
  2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

### **3.3 SPECIALTY PIPE FITTINGS**

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

### **3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES**

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
  1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
  2. 75 mm or DN75 (NPS 3 inch): 1500 mm (60 inches) with 15 mm (1/2 inch) rod.
  3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 inch to NPS 5 inch): 1500 mm (60 inches) with 18 mm (5/8 inch) rod.
  4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 20 mm (3/4 inch) rod.

5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 inch to NPS 12 inch):  
1500 mm (60 inch) with 23 mm (7/8 inch) rod.

E. NOT USED

F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.6 m (15 feet).

G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:

1. Solid or split unplated cast iron.
2. All plates shall be provided with set screws.
3. Height adjustable clevis type pipe hangers.
4. Adjustable floor rests and base flanges shall be steel.
5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
6. Riser clamps shall be malleable iron or steel.
7. Rollers shall be cast iron.
8. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.

H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.

I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.

J. Penetrations:

1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.

2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

### 3.5 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
  1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
  2. For an air test, an air pressure of 34 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
  3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
  4. Final Tests: Either one of the following tests may be used.
    - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of .25 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
    - b. Peppermint Test: Introduce 60 ml (2 ounces) of peppermint into each line or stack.

### **3.6 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -





**SECTION 22 14 00  
FACILITY STORM DRAINAGE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section describes the requirements for storm drainage systems, including piping and all necessary accessories as designated in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- D. Section 22 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Piping.
  - 2. NOT USED.
  - 3. Cleanouts.
  - 4. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI).
- C. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A112.21.2m-83.....Roof Drains
  - A13.1-07.....Scheme for Identification of Piping Systems
  - B16.3-06.....Malleable Iron Threaded Fittings, Classes 150 and 300. B16.9-07 Factory-Made Wrought Steel Butt welding Fittings

- B16.11-05.....Forged Steel Fittings, Socket-Welding and  
Threaded B16.12-98 (R 2006) Cast Iron  
Threaded Drainage Fittings
- B16.15-06).....Cast Bronze Threaded Fittings, Class 125 and  
250
- B16.18-01 (R 2005).....Cast Copper Alloy Solder-Joint Pressure  
Fittings
- B16.22-01 (R 2005).....Wrought Copper and Copper Alloy Solder Joint  
Pressure Fittings
- D. American Society for Testing and Materials (ASTM):
- A47-99 (R 2004).....Standard Specification for Steel Sheet,  
Aluminum Coated, by the Hot-Dip Process
- A53-07.....Standard Specification for Pipe, Steel, Black  
And Hot-Dipped, Zinc-coated Welded and Seamless
- A74-06.....Standard Specification for Cast Iron Soil Pipe  
and Fittings
- A183-03).....Standard Specification for Carbon Steel Track  
Bolts and Nuts
- A312-03.....Standard Specification for Seamless and Welded  
Austenitic Stainless Steel Pipe
- A536-84(R 2004).....Standard Specification for Ductile Iron  
Castings
- A733-03.....Standard Specification for Welded and Seamless  
Carbon Steel and Austenitic Stainless Steel  
Pipe Nipples
- B32-04.....Standard Specification for Solder Metal
- B61-08.....Standard Specification for Steam or Bronze  
Castings
- B62-02.....Standard Specification for Composition Bronze  
or Ounce Metal Castings
- B75-02.....Standard Specification for Seamless Copper Tube
- B88-03.....Standard Specification for Seamless Copper  
Water Tube
- B306-02.....Standard Specification for Copper Drainage Tube  
(DWV)
- B584-08.....Standard Specification for Copper Alloy Sand  
Castings for General Applications

- B687-99.....Standard Specification for Brass, Copper, and  
Chromium-Plated Pipe Nipples
- C564-06a.....Standard Specification for Rubber Gaskets for  
Cast Iron Soil Pipe and Fittings
- E. American Welding Society (AWS):
- A5.8-04.....Specification for Filler Metals for Brazing and  
Braze Welding
- F. International Code Council (ICC):
- IPC-06.....International Plumbing Code
- G. Cast Iron Soil Pipe Institute (CISPI):
- 301-05.....Hubless Cast Iron Soil and Fittings for  
Sanitary and Storm Drain, Waste, and Vent  
Piping Applications
- 310-04.....Couplings for Use in Connection with Hubless  
Cast Iron Soil and Fittings for Sanitary and  
Storm Drain, Waste, and Vent Piping  
Applications
- H. Manufacturers Standardization Society of the Valve and Fittings  
Industry, Inc. (MSS):
- SP-72-99.....Standard for Ball Valves with Flanged or Butt  
Welding For General Purpose
- SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends

## **PART 2 - PRODUCTS**

### **2.1 STORM WATER DRAIN PIPING**

- A. Cast Iron Storm Pipe and Fittings:
1. Cast iron storm pipe and fittings shall be used for the following applications:
    - a. NOT USED.
    - b. Extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls.
    - c. Interior storm piping above grade.
    - d. All mechanical equipment rooms or other areas containing mechanical air handling equipment.
  2. The cast iron storm Pipe shall be bell and spigot, or hubless (plain end or no-hub) as required by selected jointing method.

3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888, or ASTM A-74.

4. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with leak and oakum.

B. Copper Tube, (DWV): May be used for piping above ground.

1. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.

2. The Copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.

3. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

C NOT USED

D. NOT USED

## **2.2 NOT USED**

## **2.3 SPECIALTY PIPE FITTINGS**

A. Transition pipe couplings shall join piping with small differences in outside diameters or be of different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear erring and corrosion resistant metal tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.

2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.

3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.

- C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
- D. The dielectric nipples shall be electroplated steel nipple comply with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

#### **2.4 CLEANOUTS**

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged storm sewer line.
- B. NOT USED
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless steel cover with minimum opening of 150 mm by 150 mm (6 inch by 6 inch) shall be provided at each wall cleanout.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

#### **2.5 NOT USED**

#### **2.6 WATERPROOFING**

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.
- B. Walls: See detail shown on drawings.

## **PART 3 - EXECUTION**

### **3.1 PIPE INSTALLATION**

- A. The pipe installation shall comply with the requirements of the International code and these specifications.
- B. Branch piping shall be installed from the piping system and connect to all drains and outlets.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.
- F. Unless otherwise stated on the documents, minimum horizontal slope shall be one inch for every 1.22 m (4 feet) of pipe length.
- G. The piping shall be installed free of sags and bends.
- H. Seismic restraint shall be installed where required by code.
- I. Changes in direction for storm drainage piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep  $\frac{1}{4}$  bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and  $\frac{1}{8}$  bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Buried storm drainage piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- L. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".

**3.2 JOINT CONSTRUCTION**

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. NOT USED
- E. NOT USED

**3.3 SPECIALTY PIPE FITTINGS**

- A. NOT USED
- B. NOT USED

**3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES:**

- A. All piping shall be supported according to the International plumbing code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
  - 1. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
  - 2. NPS 3 (DN 80): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
  - 3. NPS 4 to NPS 5 (DN 100 to DN 125): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
  - 4. NPS 6 to NPS 8 (DN 150 to DN 200): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
  - 5. NPS 10 to NPS 12 (DN 250 to DN 300): 1500 mm (60 inches) with 22 mm (7/8 inch) rod.
- E. The maximum support spacing for horizontal plastic shall be 1.22 m (4 feet).

- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates shall have the following characteristics:
1. Solid or split unplated cast iron.
  2. All plates shall be provided with set screws.
  3. Height adjustable clevis type pipe hangers.
  4. Adjustable Floor Rests and Base Flanges shall be steel.
  5. Hanger Rods shall be low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
  6. Riser Clamps shall be malleable iron or steel.
  7. Roller shall be cast iron.
  8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gage steel. The shield shall be sized for the insulation.
- H. Miscellaneous Materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- I. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
  2. Water proofing: At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.



K. Piping shall conform to the following:

1. Storm Water Drain and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm (3 inches) and smaller	2%
100 mm (4 inches) (4 inches) and larger	1%

### 3.5 TESTS

- A. Storm sewer system shall be tested either in its entirety or in sections.
- B. Storm Water Drain tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
  - 1. If entire system is tested with water, tightly close all openings in pipes except the highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
  - 2. For an air test, an air pressure of 35 kPa (5 psi) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
  - 3. Final Tests: Either one of the following tests may be used.
    - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
    - b. Peppermint Test: Introduce .06 liters (2 ounces) of peppermint into each line or stack.

- - - E N D - - -



**SECTION 22 40 00  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

**1.2 RELATED WORK**

- A. Sealing between fixtures and other finish surfaces: Section 07 92 00, JOINT SEALANTS.
- B. Flush panel access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.
- C. Through bolts: Section 10 21 13, TOILET COMPARTMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.  
Requirements for commissioning, systems readiness checklist, and training.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

**1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):  
The American Society of Mechanical Engineers (ASME):  
A112.6.1M-02 (R2008).....Floor Affixed Supports for Off-the-Floor  
Plumbing Fixtures for Public Use  
A112.19.1M-08 .....Enameled Cast Iron Plumbing Fixtures  
A112.19.2M-03.....Vitreous China Plumbing Fixtures  
A112.19.3-2001 (R2008)...Stainless Steel Plumbing Fixtures (Designed for  
Residential Use)
- C. American Society for Testing and Materials (ASTM):  
A276-2010 .....Stainless and Heat-Resisting Steel Bars and  
Shapes  
WW-P-541-E/GEN .....Plumbing Fixtures with Amendment 1

- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM  
AMP 500-505  
Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):  
1016-05.....Performance Requirements for Individual  
Thermostatic, Pressure Balancing and Combination  
Pressure Balancing and Thermostatic Control  
Valves for Individual Fixture Fittings
- F. NSF International (NSF)  
NSF/ANSI 14 (2013).....Plastics Piping System Components and Related  
Materials  
NSF/ANSI 61 (2012).....Drinking Water System Components - Health  
Effects  
NSF/ANSI 372 (2011).....Drinking Water System Components - Lead Content
- G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and  
Surfaces
- H. Environmental Protection Agency EPA PL 93-523 1974; A 1999) Safe  
Drinking Water Act.
- I. International Building Code, ICC IPC 2012.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

### **2.2 STAINLESS STEEL**

- A. Corrosion-resistant Steel (CRS):
  - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
  - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

### **2.3 STOPS**

- A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type

faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.

- B. Furnish keys for lock shield stops to Resident Engineer.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
- E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

#### **2.4 ESCUTCHEONS**

Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

#### **2.5 LAMINAR FLOW CONTROL DEVICE**

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
  1. Capable of restricting flow from 95 ml/s to 110 ml/s (1.5 gpm to 1.7 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
  2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psi and 80 psi).
  3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

#### **2.6 CARRIERS**

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction steel plate as detailed on drawing. // All lavatory chair carriers shall

be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.

- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

## 2.7 WATER CLOSETS

A. NOT USED

B. NOT USED

- C. (P-103) Water Closet (Wall Hung, ASME/ANSI A112.19.2M, Figure 9) office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, wall outlet. Top of rim shall be between 406 mm and 432 mm (18 inches) above finished floor. Handicapped water closet shall have rim set 457 mm (18 inches) above finished floor.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
2. Fittings and Accessories: Gaskets-neoprene; bolts with chromium plated caps nuts and washers.
3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation, sensor operated with manual override, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance 25 mm (1 inch) screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, a high back pressure vacuum breaker, spud coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges, and sweat solder adapter with cover tube and set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Seat bumpers shall be integral part of flush valve. Set centerline of inlet 292 mm (11 1/2 inches) above rim.

E. NOT USED

F. NOT USED

G. NOT USED

H. NOT USED

I. NOT USED

- J. NOT USED
- K. NOT USED
- M. NOT USED
- O. NOT USED

## 2.10 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.
- C. NOT USED
- D. NOT USED
- E. NOT USED
- F. NOT USED
- G. NOT USED
- H. NOT USED
- I. NOT USED
- J. NOT USED
- K. NOT USED
- L. (P-418) Lavatory (Sensor Control, Gooseneck Spout, ASME/ANSI A112.19.2M, Figure 16) straight back, approximately 508 mm by 457 mm (20 inches by 18 inches) and a 102 mm (4 inches) minimum apron, first quality vitreous china with punching for gooseneck spout. Set rim 864 mm (34 inches) above finished floor.
  - 1. Faucet: Solid cast brass construction, chrome plated, gooseneck spout with outlet 102 mm to 127 mm (4 inches to 5 inches) above rim. Electronic sensor operated, 102 mm (4 inches) center set mounting, wiring box 120/24 volt solenoid plug in transformer back check valves solid brass hot-cold water mixer adjusted from top deck with barrier free design control handle. Provide laminar flow control device. Breaking the light beam shall activate the water flow. Flow shall stop when user moves away from light beam. // Provide steel access door with key operated cylinder lock. See Section 08 31 13, ACCESS DOORS AND FRAMES // All connecting wiring between transformer, solenoid valve and sensor shall be cut to length with no excess hanging or wrapped up wiring allowed.
  - 2. Drain: Cast or wrought brass with flat grid strainer with offset tailpiece, brass, chrome plated.
  - 3. Stops: Angle type. See paragraph 2.2.Stops

4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches) P-trap. Adjustable with connected elbow and 17 gage tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to wall.

5. Provide cover for drain, stops and trap per A.D.A 4-19.4.

M. NOT USED

## 2.11 SINKS AND LAUNDRY TUBS

- A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.

B. NOT USED

C. NOT USED

D. NOT USED

E. NOT USED

F. NOT USED

G. NOT USED

H. NOT USED

I. NOT USED

J. NOT USED

K. NOT USED

L. NOT USED

M. NOT USED

N. NOT USED

- O. (P-524) Sink, (Solid surface by millwork provider) CRS, Double Compartment, Under Counter Mounted, ASME A112.19.3, Kitchen Sinks approximately 838 mm by 559 mm (33 inches by 22 inches) with two compartments inside dimensions approximately 343 mm by 406 mm by 191 mm (13 1/2 inches by 16 inches by 6 1/2 inches), minimum 20 gage CRS. Corners and edges shall be well rounded.

1. Faucet: Kitchen sink, solid brass construction, 8.3 L/m (2.2 gpm) swing spout, chrome plated copper alloy with spray and hose.

2. Drain: Drain plug with cup strainer, stainless steel.

3. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap with cleanout plug, continuous drain with wall connection and escutcheon.

4. Provide cover for exposed piping, drain, stops and trap per A.D.A.

P. NOT USED

Q. NOT USED

R. NOT USED



**2.12 DISPENSER, DRINKING WATER**

- A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.
- B. NOT USED
- E. (P-609) Electric Water Cooler: Mechanically cooled, self contained, wheel chair, bubbler style fully exposed dual height stainless steel fountain, recessed in wall refrigeration system, stainless steel grille, stainless steel support arm, wall mounting box, energy efficient cooling system consisting of a hermetically sealed reciprocating type compressor, 115v, 60 Hz, single phase, fan cooled condenser, permanently lubricated fan motor. Set highest bubbler 1016 mm (40 inches) above finished floor.

**2.13 SHOWER BATH FIXTURE**

- A. NOT USED
- B. NOT USED
- C. NOT USED
- D. NOT USED
- E. NOT USED
- F. NOT USED

**2.14 EMERGENCY FIXTURES**

- A. NOT USED
- B. NOT USED
- C. NOT USED
- D. NOT USED

**2.15 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES**

- A. NOT USED
- B. NOT USED
- C. NOT USED
- D. NOT USED
- E. NOT USED
- F. NOT USED
- G. NOT USED
- H. NOT USED
- I. NOT USED
- J. NOT USED

**2.16 MENTAL HEALTH PLUMBING FIXTURES**

- A. NOT USED
- B. NOT USED

- C. NOT USED
- D. NOT USED
- E. NOT USED
- F. NOT USED
- G. NOT USED
- H. NOT USED
- I. NOT USED
- J. NOT USED
- K. NOT SUED
- L. NOT USED
- M. NOT USED
- N. NOT USED
- O. NOT USED

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Do not use aerators on lavatories and sinks.

**3.2 CLEANING**

At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

**3.3 WATERLESS URINAL**

Manufacturer shall provide an operating manual and onsite training for the proper care and maintenance of the urinals.

**3.4 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -



**SECTION 23 05 11  
COMMON WORK RESULTS FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
  - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.
  - 3. COTR
  - 4. COTR: Contracting Officer's Technical Representative.

**1.2 RELATED WORK**

- A. Section 00 72 00, GENERAL CONDITIONS
- B. Section 01 00 00, GENERAL REQUIREMENTS
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
- D. NOT USED
- E. NOT USED
- F. Section 31 20 00, EARTH MOVING: Excavation and Backfill
- G. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout
- H. Section 05 31 00, STEEL DECKING
- I. Section 05 50 00, METAL FABRICATIONS
- J. Section 07 84 00, FIRESTOPPING
- K. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations
- L. Section 07 92 00, JOINT SEALANTS
- M. Section 09 91 00, PAINTING
- N. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- O. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC
- P. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT
- Q. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC
- R. Section 23 07 11, HVAC Insulation
- S. NOT USED
- T. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC
- U. NOT USED
- V. NOT USED
- W. Section 23 21 13, HYDRONIC PIPING
- X. Section 23 21 23, HYDRONIC PUMPS

Y. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING  
 Z. NOT USED  
 AA. Section 23 23 00, REFRIGERANT PIPING  
 BB. NOT USED  
 CC. Section 23 31 00, HVAC DUCTS and CASINGS  
 DD. Section 23 34 00, HVAC FANS  
 EE. Section 23 36 00, AIR TERMINAL UNITS  
 FF. Section 23 37 00, AIR OUTLETS and INLETS  
 GG. NOT USED  
 HH. Section 23 40 00, HVAC AIR CLEANING DEVICES  
 II. NOT USED  
 JJ. NOT USED  
 KK. NOT USED  
 LL. NOT USED  
 MM. NOT USED  
 NN. NOTUSED  
 OO. NOT USED  
 PP. Section 23 73 00, CENTRAL-STATION AIR-HANDLING UNITS  
 QQ. NOT USED  
 RR. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT  
 SS. NOT USED  
 TT. NOT USED  
 UU. NOT USED  
 VV. NOT USED  
 WW. Section 23 82 16, AIR COILS  
 XX. NOT USED  
 YY. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for  
 commissioning, systems readiness checklists, and training  
 ZZ. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS  
 AAA. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS

### **1.3 QUALITY ASSURANCE**

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

C. Equipment Vibration Tolerance:

1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.

D. Products Criteria:

1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the COTR.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

E. Equipment Service Organizations:

1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
  1. NOT USED
  2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
  3. Certify that each welder has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
- G. Execution (Installation, Construction) Quality:
  1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the COTR for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the COTR at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
  2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.
- H. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.
- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each



reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

- E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.
- F. NOT USED
- G. NOT USED
- H. Layout Drawings:
  - 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
  - 2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.
  - 3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
  - 4. In addition, for HVAC systems, provide details of the following:
    - a. Mechanical equipment rooms.
    - b. NOT USED
    - c. Hangers, inserts, supports, and bracing.
    - d. Pipe sleeves.
    - e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- I. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
  - 1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COTR.
  - 2. Submit electric motor data and variable speed drive data with the driven equipment.
  - 3. Equipment and materials identification.
  - 4. Fire-stopping materials.

- 5. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
- 6. Wall, floor, and ceiling plates.
- J. HVAC Maintenance Data and Operating Instructions:
  - 1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
  - 2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- K. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating and Refrigeration Institute (AHRI):  
430-2009.....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):  
B31.1-2007.....Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):  
IP-20-2007.....Specifications for Drives Using Classical  
V-Belts and Sheaves  
IP-21-2009.....Specifications for Drives Using Double-V  
(Hexagonal) Belts  
IP-22-2007.....Specifications for Drives Using Narrow V-Belts  
and Sheaves
- E. Air Movement and Control Association (AMCA):  
410-96.....Recommended Safety Practices for Air Moving  
Devices
- F. NOT USED
- G. American Society for Testing and Materials (ASTM):  
A36/A36M-08.....Standard Specification for Carbon Structural  
Steel  
A575-96(2007).....Standard Specification for Steel Bars, Carbon,  
Merchant Quality, M-Grades  
E84-10.....Standard Test Method for Surface Burning  
Characteristics of Building Materials

- E119-09c.....Standard Test Methods for Fire Tests of Building  
Construction and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings  
Industry, Inc:
- SP-58-2009.....Pipe Hangers and Supports-Materials, Design and  
Manufacture, Selection, Application, and  
Installation
- SP 69-2003.....Pipe Hangers and Supports-Selection and  
Application
- SP 127-2001.....Bracing for Piping Systems, Seismic - Wind -  
Dynamic, Design, Selection, Application
- I. National Electrical Manufacturers Association (NEMA):
- MG-1-2009.....Motors and Generators
- J. National Fire Protection Association (NFPA):
- 31-06.....Standard for Installation of Oil-Burning  
Equipment
- 54-09.....National Fuel Gas Code
- 70-08.....National Electrical Code
- 85-07.....Boiler and Combustion Systems Hazards Code
- 90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems
- 101-09.....Life Safety Code

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
  2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the COTR. Such repair or replacement shall be at no additional cost to the Government.
  3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
  4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. NOT USED
4. NOT USED
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

#### **1.7 JOB CONDITIONS - WORK IN EXISTING BUILDING**

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities, that serve the medical center.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COTR during periods when the demands are not critical to the operation of the medical center. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least one week advance notice to the COTR.
- D. Phasing of Work: Comply with all requirements shown on drawings or specified.
- E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.
- F. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

- G. Temporary Facilities: Refer to Article, TEMPORARY PIPING AND EQUIPMENT in this section.

## **PART 2 - PRODUCTS**

### **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

### **2.2 COMPATIBILITY OF RELATED EQUIPMENT**

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

### **2.3 BELT DRIVES**

- A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
- B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 25 m/s (5000 feet per minute).
- E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.

- F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.
- G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
- H. Sheaves and Pulleys:
  - 1. Material: Pressed steel, or close grained cast iron.
  - 2. Bore: Fixed or bushing type for securing to shaft with keys.
  - 3. Balanced: Statically and dynamically.
  - 4. Groove spacing for driving and driven pulleys shall be the same.
- I. Drive Types, Based on ARI 435:
  - 1. Provide adjustable-pitch drive as follows:
    - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
    - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
  - 2. Provide fixed-pitch drives for drives larger than those listed above.
  - 3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

#### **2.4 DRIVE GUARDS**

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory fabricated air handling unit casings.
- B. NOT USED
- C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.
- D. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- E. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

#### **2.5 LIFTING ATTACHMENTS**

Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand

any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

## **2.6 ELECTRIC MOTORS**

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT; Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

## **2.7 VARIABLE SPEED MOTOR CONTROLLERS**

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for specifications.
- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
- C. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.
- E. Controller shall be provided with the following operating features and accessories:
  - 1. Suitable for variable torque load.
  - 2. Provide thermal magnetic circuit breaker or fused switch with external operator and incoming line fuses. Unit shall be rated for minimum 25,000 AIC. Provide AC input line reactors (3% impedance) on incoming power line. Provide output line reactors on line between drive and motor where the distance between the breaker and motor exceeds 50 feet.

## **2.8 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.

- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.
- D. Control Items: Label all temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.
- E. Valve Tags and Lists:
  - 1. HVAC: Provide for all valves.
  - 2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm (1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
  - 3. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
  - 4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

## **2.9 FIRESTOPPING**

Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC INSULATION, for firestop pipe and duct insulation.

## **2.10 GALVANIZED REPAIR COMPOUND**

Mil. Spec. DOD-P-21035B, paint form.

## **2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:
  - 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum



- height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- D. Attachment to Concrete Building Construction:
1. Concrete insert: MSS SP-58, Type 18.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the COTR for each job condition.
  3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the COTR for each job condition.
- E. Attachment to Steel Building Construction:
1. Welded attachment: MSS SP-58, Type 22.
  2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- F. Attachment to Metal Pan or Deck: As required for materials specified in Section 05 31 00, STEEL DECKING
- G. Attachment to existing structure: Support from existing floor/roof frame.
- H. Attachment to Wood Construction: Wood screws or lag bolts.
- I. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 38 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- J. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
  2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4-inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2-inch)

galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

K. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
  - a. Standard clevis hanger: Type 1; provide locknut.
  - b. Riser clamps: Type 8.
  - c. Wall brackets: Types 31, 32 or 33.
  - d. Roller supports: Type 41, 43, 44 and 46.
  - e. Saddle support: Type 36, 37 or 38.
  - f. Turnbuckle: Types 13 or 15. Preinsulate.
  - g. U-bolt clamp: Type 24.
  - h. Copper Tube:
    - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
    - 2) For vertical runs use epoxy painted or plastic coated riser clamps.
    - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
    - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
  - i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
3. High and Medium Pressure Steam (MSS SP-58):
  - a. Provide eye rod or Type 17 eye nut near the upper attachment.
  - b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
  - c. Piping with Vertical Expansion and Contraction:
    - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.

- 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
- 4. Converter and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.
- L. NOT USED
- M. Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

## 2.12 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  - 1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
  - 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
  - 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COTR.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.

- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

### **2.13 DUCT PENETRATIONS**

- A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

### **2.14 SPECIAL TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COTR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.
- D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COTR.
- E. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

### **2.15 WALL, FLOOR AND CEILING PLATES**

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## **2.16 ASBESTOS**

Materials containing asbestos are not permitted.

## **PART 3 - EXECUTION**

### **3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING**

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
  - 1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by COTR where working area space is limited.
  - 2. Locate holes to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COTR for approval.
  - 3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

- H. Electrical and Pneumatic Interconnection of Controls and Instruments:  
This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COTR. Damaged or defective items in the opinion of the COTR, shall be replaced.
  2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Install steam piping expansion joints as per manufacturer's recommendations.
- M. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
  2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
  3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the COTR. Locate

openings that will least effect structural slabs, columns, ribs or beams. Refer to the COTR for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After COTR's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.

N. NOT USED

O. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 ft.) above the equipment of to ceiling structure, whichever is lower (NFPA 70).

P. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

### **3.2 TEMPORARY PIPING AND EQUIPMENT**

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Paragraph 3.1 apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

### **3.3 RIGGING**

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of

phasing and maintenance of service as well as structural integrity of the building.

- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to COTR for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

#### **3.4 PIPE AND EQUIPMENT SUPPORTS**

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COTR.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. HVAC Vertical Pipe Supports:
  - 1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
  - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:



1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

G. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

### 3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the COTR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this

plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the RE or COTR with regard to rigging, safety, fire safety, and maintenance of operations.

- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to COTR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

E. NOT USED

### **3.6 CLEANING AND PAINTING**

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
  - 2. Material And Equipment Not To Be Painted Includes:
    - a. Motors, controllers, control switches, and safety switches.
    - b. Control and interlock devices.
    - c. Regulators.
    - d. Pressure reducing valves.

- e. Control valves and thermostatic elements.
  - f. Lubrication devices and grease fittings.
  - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
  - h. Valve stems and rotating shafts.
  - i. Pressure gauges and thermometers.
  - j. Glass.
  - k. Name plates.
3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
  4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same color as utilized by the pump manufacturer
  5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
  6. Paint shall withstand the following temperatures without peeling or discoloration:
    - a. Condensate and feedwater -- 38 degrees C (100 degrees F) on insulation jacket surface and 120 degrees C (250 degrees F) on metal pipe surface.
    - b. Steam -- 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (375 degrees F) on metal pipe surface.
  7. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.

### **3.7 IDENTIFICATION SIGNS**

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16-inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

### **3.8 MOTOR AND DRIVE ALIGNMENT**

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

### **3.9 LUBRICATION**

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and 0.5 kg (one pound) of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to COTR in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

### **3.10 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specifications will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.11 STARTUP AND TEMPORARY OPERATION**

Start up equipment as described in equipment specifications. Verify that vibration is within specified tolerance prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

### **3.12 OPERATING AND PERFORMANCE TESTS**

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS and submit the test reports and records to the COTR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and

for cooling systems respectively during first actual seasonal use of  
respective systems following completion of work.

**3.13 NOT USED**

- - - E N D - - -



**SECTION 23 05 12**  
**GENERAL MOTOR REQUIREMENTS FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies the furnishing, installation and connection of motors for HVAC and steam generation equipment.

**1.2 RELATED WORK:**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements common to more than one Section of Division 26.
- B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Starters, control and protection for motors.
- C. Section 26 24 19, MOTOR-CONTROL CENTERS: Multiple motor control assemblies, which include motor starters.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. NOT USED
- F. Section 23 21 23, HYDRONIC PUMPS.
- G. NOT USED
- H. Section 23 34 00, HVAC FANS.
- I. Section 23 36 00, AIR TERMINAL UNITS.
- J. NOT USED
- K. NOT USED
- L. NOT USED
- M. NOT USED
- N. Section 23 73 00, CENTRAL-STATION AIR-HANDLING UNITS.
- O. NOT USED
- P. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT.
- Q. NOT USED
- R. NOT USED
- S. NOT USED
- T. NOT USED
- U. NOT USED
- V. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 SUBMITTALS:**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
  - 1. Provide documentation to demonstrate compliance with drawings and specifications.

2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.

D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the COTR:

1. Certification that the motors have been applied, installed, adjusted, lubricated, and tested according to manufacturer published recommendations.

E. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

#### 1.4 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):  
MG 1-2006 Rev. 1 2009 ..Motors and Generators  
MG 2-2001 Rev. 1 2007...Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
- C. National Fire Protection Association (NFPA):  
70-2008.....National Electrical Code (NEC)
- D. Institute of Electrical and Electronics Engineers (IEEE):  
112-04.....Standard Test Procedure for Polyphase Induction Motors and Generators
- E. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):  
90.1-2007.....Energy Standard for Buildings Except Low-Rise Residential Buildings

## PART 2 - PRODUCTS

### 2.1 MOTORS:

- A. For alternating current, fractional and integral horsepower motors, NEMA Publications MG 1 and MG 2 shall apply.



- B. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.
- C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
- D. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.
  - 1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.
- E. Voltage ratings shall be as follows:
  - 1. Single phase:
    - a. Motors connected to 120-volt systems: 115 volts.
    - b. Motors connected to 208-volt systems: 200 volts.
    - c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
  - 2. Three phase:
    - a. Motors connected to 208-volt systems: 200 volts.
    - b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 208-230/460 volts, dual connection.
    - c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
    - d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
    - e. Motors connected to high voltage systems (Over 600V): Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.
- F. Number of phases shall be as follows:
  - 1. Motors, less than 373 W (1/2 HP): Single phase.
  - 2. Motors, 373 W (1/2 HP) and larger: 3 phase.
  - 3. Exceptions:
    - a. Hermetically sealed motors.
    - b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.

- G. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F) environment, where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation. If the motors exceed 40°C (104°F), the motors shall be rated for the actual ambient temperatures.
- H. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.
- I. Motor Enclosures:
1. Shall be the NEMA types as specified and/or shown on the drawings.
  2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed. Enclosure requirements for certain conditions are as follows:
    - a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.
    - b. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.
    - c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.
  3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
- J. Special Requirements:
1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.
  2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
  3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
    - a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
    - b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
    - c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
5. Motors utilized with variable frequency drives shall be rated "inverter-duty" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.
- K. Additional requirements for specific motors, as indicated in the other sections listed in Article 1.2, shall also apply.
- L. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts (1 HP) or more shall meet the minimum full-load efficiencies as indicated in the following table. Motors of 746 Watts or more with open-, drip-proof or totally enclosed fan-cooled enclosures shall be NEMA premium efficiency type, unless otherwise indicated. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section. Motors not specified as "premium efficiency" shall comply with the Energy Policy Act of 2005 (EPACT).

Minimum Premium Efficiencies Open Drip-Proof				Minimum Premium Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%

93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%
112 (150)	95.4%	95.8%	94.1%	112 (150)	95.8%	95.8%	95.0%
149.2 (200)	95.4%	95.8%	95.0%	149.2 (200)	95.8%	96.2%	95.4%

M. Minimum Power Factor at Full Load and Rated Voltage: 90 percent at 1200 RPM, 1800 RPM and 3600 RPM.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

Install motors in accordance with manufacturer's recommendations, the NEC, NEMA, as shown on the drawings and/or as required by other sections of these specifications.

#### **3.2 FIELD TESTS**

- A. Perform an electric insulation resistance Test using a megohmmeter on all motors after installation, before start-up. All shall test free from grounds.
- B. Perform Load test in accordance with ANSI/IEEE 112, Test Method B, to determine freedom from electrical or mechanical defects and compliance with performance data.
- C. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

#### **3.3 STARTUP AND TESTING**

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with COTR and Commissioning Agent. Provide a minimum of 7 days prior notice.

#### **3.4 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

#### **3.5 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - - -

**SECTION 23 05 41**  
**NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Noise criteria, seismic restraints for equipment, vibration tolerance and vibration isolation for HVAC and plumbing work.

**1.2 RELATED WORK**

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete inertia bases.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic requirements for non-structural equipment
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- D. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING: Requirements for flexible pipe connectors to reciprocating and rotating mechanical equipment.
- E. Section 23 73 00, CENTRAL-STATION AIR-HANDLING UNITS: requirements for optional Air Handling Unit internal vibration isolation.
- F. Section 23 31 00, HVAC DUCTS and CASINGS: requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.
- G. SECTION 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: requirements for sound and vibration tests.
- H. SECTION 23 37 00, AIR OUTLETS and INLETS: noise requirements for G-grilles.
- I. NOT USED.
- J. SECTION 23 34 00, HVAC FANS: sound and vibration isolation requirements for fans.
- K. NOT USED.
- L. NOT USED.
- M. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Noise Criteria:
  - 1. Noise levels in all 8 octave bands due to equipment and duct systems shall not exceed following NC levels:

TYPE OF ROOM	NC LEVEL
Bathrooms and Toilet Rooms	40
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40
Lobbies, Waiting Areas	40
Offices, Small Private	35
Operating Rooms	40
Treatment Rooms	35

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.

C. Seismic Restraint Requirements:

1. Equipment:
  - a. All mechanical equipment not supported with isolators external to the unit shall be securely anchored to the structure. Such mechanical equipment shall be properly supported to resist a horizontal force of 20 percent of the weight of the equipment furnished.
  - b. All mechanical equipment mounted on vibration isolators shall be provided with seismic restraints capable of resisting a

horizontal force of 50 percent of the weight of the equipment furnished.

2. Piping: Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

3. Ductwork: Refer to specification Section 23 31 00, HVAC DUCTS AND CASINGS.

D. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not to exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.

#### **1.4 SUBMITTALS**

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Vibration isolators:

- a. Floor mountings
- b. Hangers
- c. Snubbers
- d. Thrust restraints

2. Bases.

3. Seismic restraint provisions and bolting.

4. Acoustical enclosures.

C. Isolator manufacturer shall furnish with submittal load calculations for selection of isolators, including supplemental bases, based on lowest operating speed of equipment supported.

D. Seismic Requirements: Submittals are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, standard connections, and manufacturer's certification that all specified equipment will withstand seismic Lateral Force requirements as shown on drawings.

#### **1.5 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):  
2009 .....Fundamentals Handbook, Chapter 7, Sound and Vibration
- C. American Society for Testing and Materials (ASTM):  
A123/A123M-09.....Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products  
A307-07b.....Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength  
D2240-05(2010).....Standard Test Method for Rubber Property - Durometer Hardness
- D. Manufacturers Standardization (MSS):  
SP-58-2009.....Pipe Hangers and Supports-Materials, Design and Manufacture
- E. Occupational Safety and Health Administration (OSHA):  
29 CFR 1910.95.....Occupational Noise Exposure
- F. American Society of Civil Engineers (ASCE):  
ASCE 7-10 .....Minimum Design Loads for Buildings and Other Structures.
- G. American National Standards Institute / Sheet Metal and Air Conditioning Contractor's National Association (ANSI/SMACNA):  
001-2008.....Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd Edition.
- H. International Code Council (ICC):  
2009 IBC.....International Building Code.
- I. Department of Veterans Affairs (VA):  
H-18-8 2010.....Seismic Design Requirements.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Type of isolator, base, and minimum static deflection shall be as required for each specific equipment application as recommended by isolator or equipment manufacturer but subject to minimum requirements indicated herein and in the schedule on the drawings.
- B. Elastometric Isolators shall comply with ASTM D2240 and be oil resistant neoprene with a maximum stiffness of 60 durometer and have a straight-line deflection curve.
- C. Exposure to weather: Isolator housings to be either hot dipped galvanized or powder coated to ASTM B117 salt spray testing standards.



Springs to be powder coated or electro galvanized. All hardware to be electro galvanized. In addition provide limit stops to resist wind velocity. Velocity pressure established by wind shall be calculated in accordance with section 1609 of the International Building Code. A minimum wind velocity of 75 mph shall be employed.

- D. Uniform Loading: Select and locate isolators to produce uniform loading and deflection even when equipment weight is not evenly distributed.
- E. Color code isolators by type and size for easy identification of capacity.

## **2.2 SEISMIC RESTRAINT REQUIREMENTS FOR EQUIPMENTS**

- A. Bolt pad mounted equipment, without vibration isolators, to the floor or other support using ASTM A307 standard bolting material.
- B. Floor mounted equipment, with vibration Isolators: Type SS. Where Type N isolators are used provide channel frame base horizontal restraints bolted to the floor, or other support, on all sides of the equipment. Size and material required for the base shall be as recommended by the isolator manufacturer.
- C. On all sides of suspended equipment, provide bracing for rigid supports and provide restraints for resiliently supported equipment.

## **2.3 VIBRATION ISOLATORS**

- A. Floor Mountings:
  - 1. Double Deflection Neoprene (Type N): Shall include neoprene covered steel support plated (top and bottom), friction pads, and necessary bolt holes.
  - 2. Spring Isolators (Type S): Shall be free-standing, laterally stable and include acoustical friction pads and leveling bolts. Isolators shall have a minimum ratio of spring diameter-to-operating spring height of 1.0 and an additional travel to solid equal to 50 percent of rated deflection.
  - 3. Captive Spring Mount for Seismic Restraint (Type SS):
    - a. Design mounts to resiliently resist seismic forces in all directions. Snubbing shall take place in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum of 6 mm (1/4-inch) before contacting snubbers. Mountings shall have a minimum rating of one G coefficient of gravity as calculated and certified by a registered structural engineer.
    - b. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than

0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall have ports for spring inspection. Provide an all directional neoprene cushion collar around the equipment bolt.

4. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting. // Isolators shall have a minimum seismic rating of one G. //
  5. Pads (Type D), Washers (Type W), and Bushings (Type L): Pads shall be natural rubber or neoprene waffle, neoprene and steel waffle, or reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).
  6. Seismic Pad (Type DS): Pads shall be natural rubber / neoprene waffle with steel top plate and drilled for an anchor bolt. Washers and bushings shall be reinforced duck and neoprene. Size pads for a maximum load of 345 kPa (50 pounds per square inch).
- B. Hangers: Shall be combination neoprene and springs unless otherwise noted and shall allow for expansion of pipe.
1. Combination Neoprene and Spring (Type H): Vibration hanger shall contain a spring and double deflection neoprene element in series. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
  2. Spring Position Hanger (Type HP): Similar to combination neoprene and spring hanger except hanger shall hold piping at a fixed elevation during installation and include a secondary adjustment feature to transfer load to spring while maintaining same position.
  3. Neoprene (Type HN): Vibration hanger shall contain a double deflection type neoprene isolation element. Hanger rod shall be separated from contact with hanger bracket by a neoprene grommet.

4. Spring (Type HS): Vibration hanger shall contain a coiled steel spring in series with a neoprene grommet. Spring shall have a diameter not less than 0.8 of compressed operating spring height. Spring shall have a minimum additional travel of 50 percent between design height and solid height. Spring shall permit a 15 degree angular misalignment without rubbing on hanger box.
  5. Hanger supports for piping 50 mm (2 inches) and larger shall have a pointer and scale deflection indicator.
  6. Hangers used in seismic applications shall be provided with a neoprene and steel rebound washer installed  $\frac{1}{4}$ ' clear of bottom of hanger housing in operation to prevent spring from excessive upward travel
- C. Snubbers: Each spring mounted base shall have a minimum of four all-directional or eight two directional (two per side) seismic snubbers that are double acting. Elastomeric materials shall be shock absorbent neoprene bridge quality bearing pads, maximum 60 durometer, replaceable and have a minimum thickness of 6 mm (1/4 inch). Air gap between hard and resilient material shall be not less than 3 mm (1/8 inch) nor more than 6 mm (1/4 inch). Restraints shall be capable of withstanding design load without permanent deformation.
- D. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

#### **2.4 BASES**

- A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.
- B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height

of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm (four inches).

- C. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm (six inches). Form shall include 13-mm (1/2-inch) reinforcing bars welded in place on minimum of 203 mm (eight inch) centers running both ways in a layer 40 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm (1/16 inch).
- D. Curb Mounted Isolation Base (Type CB): Fabricate from aluminum to fit on top of standard curb with overlap to allow water run-off and have wind and water seals which shall not interfere with spring action. Provide resilient snubbers with 6 mm (1/4 inch) clearance for wind resistance. Top and bottom bearing surfaces shall have sponge type weather seals. Integral spring isolators shall comply with Spring Isolator (Type S) requirements.

## **2.5 SOUND ATTENUATING UNITS**

Refer to specification Section 23 31 00, HVAC DUCTS and CASINGS.

## **2.6 NOT USED**

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Vibration Isolation:
  - 1. No metal-to-metal contact will be permitted between fixed and floating parts.
  - 2. Connections to Equipment: Allow for deflections equal to or greater than equipment deflections. Electrical, drain, piping connections, and other items made to rotating or reciprocating equipment (pumps, compressors, etc.) which rests on vibration isolators, shall be isolated from building structure for first three hangers or supports with a deflection equal to that used on the corresponding equipment.
  - 3. Common Foundation: Mount each electric motor on same foundation as driven machine. Hold driving motor and driven machine in positive

- rigid alignment with provision for adjusting motor alignment and belt tension. Bases shall be level throughout length and width. Provide shims to facilitate pipe connections, leveling, and bolting.
4. Provide heat shields where elastomers are subject to temperatures over 38 degrees C (100 degrees F).
  5. Extend bases for pipe elbow supports at discharge and suction connections at pumps. Pipe elbow supports shall not short circuit pump vibration to structure.
  6. Non-rotating equipment such as heat exchangers and convertors shall be mounted on isolation units having the same static deflection as the isolation hangers or support of the pipe connected to the equipment.
- B. Inspection and Adjustments: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.

### **3.2 ADJUSTING**

- A. Adjust vibration isolators after piping systems are filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4inch (6-mm) movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's recommendations.
- F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- G. Torque anchor bolts according to equipment manufacturer's recommendations to resist seismic forces.

### **3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 -

COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -

**SELECTION GUIDE FOR VIBRATION ISOLATORS**

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
<b>ROOF FANS</b>															
ABOVE OCCUPIED AREAS:															
5 HP & OVER	---	---	---	CB	S	1.0	CB	S	1.0	CB	S	1.0	CB	S	1.0
<b>CENTRIFUGAL FANS</b>															
UP TO 50 HP:															
UP TO 200 RPM	B	N	0.3	B	S	2.5	B	S	2.5	B	S	3.5	B	S	3.5
201 - 300 RPM	B	N	0.3	B	S	2.0	B	S	2.5	B	S	2.5	B	S	3.5
301 - 500 RPM	B	N	0.3	B	S	2.0	B	S	2.0	B	S	2.5	B	S	3.5
501 RPM & OVER	B	N	0.3	B	S	2.0	B	S	2.0	B	S	2.0	B	S	2.5
<b>AIR HANDLING UNIT PACKAGES</b>															
FLOOR MOUNTED:															
UP THRU 5 HP	---	D	---	---	S	1.0	---	S	1.0	---	S	1.0	---	S	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	D	---	R	S, THR	1.5	R	S, THR	2.5	R	S, THR	2.5	R	S, THR	2.5
501 RPM & OVER	---	D	---	---	S, THR	0.8	---	S, THR	0.8	R	S, THR	1.5	R	S, THR	2.0
<b>CONDENSING UNITS</b>															

EQUIPMENT	ON GRADE			20FT FLOOR SPAN			30FT FLOOR SPAN			40FT FLOOR SPAN			50FT FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL	BASE TYPE	ISOL TYPE	MIN DEFL
ALL	---	SS	0.25	---	SS	0.75	---	SS	1.5	CB	SS	1.5	---	---	NA



**SECTION 23 05 93**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:

1. Planning systematic TAB procedures.
2. Design Review Report.
3. Systems Inspection report.
4. Duct Air Leakage test report.
5. Systems Readiness Report.
6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
7. Vibration and sound measurements.
8. Recording and reporting results.

B. Definitions:

1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of 2007 ASHRAE Handbook, "HVAC Applications".
2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
3. AABC: Associated Air Balance Council.
4. NEBB: National Environmental Balancing Bureau.
5. Hydronic Systems: Includes chilled water and heating hot water
6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flowrate from values (design) in the contract documents.

**1.2 RELATED WORK**

- A. NOT USED.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.
- D. Section 23 07 11, HVAC INSULATION: Piping and Equipment Insulation.
- E. NOT USED
- F. NOT USED

- G. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.
- H. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.
- I. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings.
- J. Section 23 82 16, AIR COILS
- K. NOT USED
- L. Section 23 73 00, CENTRAL-STATION AIR-HANDLING UNITS
- M. NOT USED
- N. Section 23 34 00, HVAC FANS
- O. NOT USED
- P. NOT USED
- Q. Section 23 37 00, AIR OUTLETS AND INLETS
- R. NOT USED
- S. NOT USED
- T. Section 23 21 13, HYDRONIC PIPING
- U. NOT USED
- V. NOT USED
- W. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS. Requirements for commissioning, systems readiness checklists, and training
- X. Section 23 05 12 GENERAL MOTOR REQUIREMENTS FOR HVAC

### **1.3 QUALITY ASSURANCE**

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Qualifications:
  - 1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
  - 2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the COTR and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work

- related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the COTR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.
  4. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the COTR. The responsibilities would specifically include:
    - a. Shall directly supervise all TAB work.
    - b. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB.
    - c. Would follow all TAB work through its satisfactory completion.
    - d. Shall provide final markings of settings of all HVAC adjustment devices.
    - e. Permanently mark location of duct test ports.
  5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB

C. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

D. Tab Criteria:

1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
  - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.
  - b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
  - c. NOT USED.
  - d. Minimum outside air: 0 percent to plus 10 percent.
  - e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to a space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
  - f. Heating hot water coils: Minus 5 percent to plus 5 percent.
  - g. NOT USE.
  - h. Chilled water coils: Minus 0 percent to plus 5 percent.
3. Systems shall be adjusted for energy efficient operation as described in PART 3.
4. Typical TAB procedures and results shall be demonstrated to the COTR for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the COTR) and one hydronic system (pumps and three coils) as follows:
  - a. When field TAB work begins.

- b. During each partial final inspection and the final inspection for the project if requested by VA.

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
- C. For use by the COTR staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
  - 1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.
  - 2. Systems inspection report on equipment and installation for conformance with design.
  - 3. Duct Air Leakage Test Report.
  - 4. Systems Readiness Report.
  - 5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
  - 6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
  - 2007 .....HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):
  - 2002.....AABC National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

7<sup>th</sup> Edition 2005 .....Procedural Standards for Testing, Adjusting,  
Balancing of Environmental Systems

2nd Edition 2006 .....Procedural Standards for the Measurement of  
Sound and Vibration

3<sup>rd</sup> Edition 2009 .....Procedural Standards for Whole Building Systems  
Commissioning of New Construction

E. Sheet Metal and Air Conditioning Contractors National Association  
(SMACNA):

3<sup>rd</sup> Edition 2002 .....HVAC SYSTEMS Testing, Adjusting and Balancing

**PART 2 - PRODUCTS**

**2.1 PLUGS**

Provide plastic plugs to seal holes drilled in ductwork for test  
purposes.

**2.2 INSULATION REPAIR MATERIAL**

See Section 23 07 11, HVAC and BOILER PLANT INSULATION Provide for  
repair of insulation removed or damaged for TAB work.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals  
for HVAC equipment and automatic control systems.

**3.2 DESIGN REVIEW REPORT**

The TAB Specialist shall review the Contract Plans and specifications  
and advise the COTR of any design deficiencies that would prevent the  
HVAC systems from effectively operating in accordance with the sequence  
of operation specified or prevent the effective and accurate TAB of the  
system. The TAB Specialist shall provide a report individually listing  
each deficiency and the corresponding proposed corrective action  
necessary for proper system operation.

**3.3 SYSTEMS INSPECTION REPORT**

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution  
equipment is on site and duct installation has begun, but well in  
advance of performance testing and balancing work. The purpose of the  
inspection is to identify and report deviations from design and ensure  
that systems will be ready for TAB at the appropriate time.

- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

#### **3.4 DUCT AIR LEAKAGE TEST REPORT**

TAB Agency shall perform the leakage test as outlined in "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS and CASINGS for TAB agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

#### **3.5 SYSTEM READINESS REPORT**

- A. The TAB Contractor shall measure existing air and water flow rates associated with existing systems utilized to serve renovated areas as indicated on drawings. Submit report of findings to COTR.
- B. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to RE in standard format and forms prepared and or approved by the Commissioning Agent.
- C. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the COTR.

#### **3.6 TAB REPORTS**

- A. Submit an intermediate report for 50 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data immediately in writing to the COTR if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval at no additional cost to the owner.
- D. Do not proceed with the remaining systems until intermediate report is approved by the COTR.

#### **3.7 TAB PROCEDURES**

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration

shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

- C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre-construction air and water flow rate and for each phase of the project prior to partial final inspections of each phase of the project. Return existing areas outside the work area to pre constructed conditions.
- D. Allow 30 days' time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Air Balance and Equipment Test: Include air handling units, fans, terminal units, and room diffusers/outlets/inlets.
  - 1. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.
  - 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
  - 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
  - 4. Variable air volume (VAV) systems:
    - a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
    - b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode. Record and report outdoor air flow rates under all operating conditions (The test shall demonstrate that the minimum outdoor air ventilation rate shall remain constant under all operating conditions).



- c. Adjust operating pressure control setpoint to maintain the design flow to each space with the lowest setpoint.
- 5. Record final measurements for air handling equipment performance data sheets.
- F. Water Balance and Equipment Test: Include circulating pumps, convertors, coils, coolers and condensers:
  - 1. NOT USED.
  - 2. Adjust flow rates for equipment. Set coils to values on equipment submittals, if different from values on contract drawings.
  - 3. NOT USED.
  - 4. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

### **3.8 VIBRATION TESTING**

- A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including pumps, fans and motors.
- B. Record initial measurements for each unit of equipment on test forms and submit a report to the COTR. Where vibration readings exceed the allowable tolerance Contractor shall be directed to correct the problem. The TAB agency shall verify that the corrections are done and submit a final report to the COTR.

### **3.9 SOUND TESTING**

- A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
  - 1. Take readings in rooms, approximately fifteen (15) percent of all rooms. The COTR may designate the specific rooms to be tested.
  - 2. NOT USED.
- B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Sound reference levels, formulas and coefficients shall be according to ASHRAE Handbook, "HVAC Applications", Chapter 46, SOUND AND VIBRATION CONTROL.

D. Determine compliance with specifications as follows:

1. When sound pressure levels are specified, including the NC Criteria in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT:

- a. Reduce the background noise as much as possible by shutting off unrelated audible equipment.
- b. Measure octave band sound pressure levels with specified equipment "off."
- c. Measure octave band sound pressure levels with specified equipment "on."
- d. Use the DIFFERENCE in corresponding readings to determine the sound pressure due to equipment.

DIFFERENCE:	0	1	2	3	4	5 to 9	10 or More
FACTOR:	10	7	4	3	2	1	0

Sound pressure level due to equipment equals sound pressure level with equipment "on" minus FACTOR.

- e. Plot octave bands of sound pressure level due to equipment for typical rooms on a graph which also shows noise criteria (NC) curves.

2. When sound power levels are specified:

- a. Perform steps 1.a. thru 1.d., as above.
- b. For indoor equipment: Determine room attenuating effect, i.e., difference between sound power level and sound pressure level. Determined sound power level will be the sum of sound pressure level due to equipment plus the room attenuating effect.
- c. For outdoor equipment: Use directivity factor and distance from noise source to determine distance factor, i.e., difference between sound power level and sound pressure level. Measured sound power level will be the sum of sound pressure level due to equipment plus the distance factor. Use 10 meters (30 feet) for sound level location.

3. Where sound pressure levels are specified in terms of dB(A), measure sound levels using the "A" scale of meter. Single value readings will be used instead of octave band analysis.

- E. Where measured sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action approved by the COTR and the necessary sound tests shall be repeated.
- F. Test readings for sound testing could go higher than 15 percent if determination is made by the COTR based on the recorded sound data.

### **3.10 MARKING OF SETTINGS**

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the COTR.

### **3.11 IDENTIFICATION OF TEST PORTS**

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

### **3.12 PHASING**

- A. Phased Projects: Testing and Balancing Work to follow project with areas shall be completed per the project phasing. Upon completion of the project all areas shall have been tested and balanced per the contract documents.
- B. Existing Areas: Systems that serve areas outside of the project scope shall not be adversely affected. Measure existing parameters where shown to document system capacity.

### **3.13 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - E N D - - -



**SECTION 23 07 11**  
**HVAC INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Field applied insulation for thermal efficiency and condensation control for
1. HVAC piping, ductwork and equipment.
  2. NOT USED.
  3. Re-insulation of HVAC piping, ductwork and equipment.
- B. Definitions
1. ASJ: All service jacket, white finish facing or jacket.
  2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  3. Cold: Equipment, ductwork or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
  4. Concealed: Ductwork and piping above ceilings and in chases, and pipe spaces.
  5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical and electrical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  6. FSK: Foil-scrim-kraft facing.
  7. Hot: HVAC Ductwork handling air at design temperature above 16 degrees C (60 degrees F); HVAC equipment or piping handling media above 41 degrees C (105 degrees F).
  8. Density: kg/m<sup>3</sup> - kilograms per cubic meter (Pcf - pounds per cubic foot).
  9. Runouts: Branch pipe connections up to 25-mm (one-inch) nominal size to reheat coils for terminal units.
  10. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watt per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
  11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).

12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
13. HPS: High pressure steam (415 kPa [60 psig] and above).
14. HPR: High pressure steam condensate return.
15. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
16. MPR: Medium pressure steam condensate return.
17. LPS: Low pressure steam (103 kPa [15 psig] and below).
18. LPR: Low pressure steam condensate gravity return.
19. PC: Pumped condensate.
20. HWH: Hot water heating supply.
21. HWHR: Hot water heating return.
22. NOT USED.
23. NOT USED.
24. NOT USED.
25. NOT USED.
26. NOT USED.
27. NOT USED.
28. NOT USED.
29. NOT USED.
30. NOT USED.
31. NOT USED.
32. NOT USED.
33. NOT USED.
34. NOT USED.
35. NOT USED.
36. CH: Chilled water supply.
37. CHR: Chilled water return.
38. NOT USED.
39. NOT USED.
40. R: Refrigerant.
41. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

## **1.2 RELATED WORK**

- A. NOT USED.

- B. NOT USED.
- C. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- D. NOT USED.
- E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- F. NOT USED.
- G. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT
- H. NOT USED.
- I. NOT USED
- J. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING
- K. NOT USED
- L. NOT USED
- M. NOT USED
- N. NOT USED.
- O. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant piping and fittings.
- P. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING: Piping and equipment.
- Q. Section 23 21 13, HYDRONIC PIPING: Hot water, chilled water, and glycol piping.
- R. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.
- S. NOT USED.
- T. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS, Requirements for commissioning, systems readiness checklists, and training.

### **1.3 QUALITY ASSURANCE**

- A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Criteria:
  - 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:
    - 4.3.3.1** Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided

for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

**4.3.3.1.1** Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

**4.3.3.1.2** The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

**4.3.3.2** Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

(1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors

(2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

**4.3.3.3** Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

**4.3.3.3.1** In no case shall the test temperature be below 121°C (250°F).

**4.3.3.4** Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

**4.3.3.5\*** Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

**4.3.3.6** Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.

**4.3.10.2.6** Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

**4.3.10.2.6.1** Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance



with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.2 Pneumatic tubing for control systems shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 1820, Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

4.3.10.2.6.4 Optical-fiber and communication raceways shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with UL 2024, Standard for Safety Optical-Fiber Cable Raceway.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

(1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides

(2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings:
  - 1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
    - a. Insulation materials: Specify each type used and state surface burning characteristics.
    - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
    - c. Insulation accessory materials: Each type used.
    - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
    - e. Make reference to applicable specification paragraph numbers for coordination.
- C. Samples:
  - 1. Each type of insulation: Minimum size 100 mm (4 inches) square for board/block/ blanket; 150 mm (6 inches) long, full diameter for round types.
  - 2. Each type of facing and jacket: Minimum size 100 mm (4 inches square).
  - 3. Each accessory material: Minimum 120 ML (4 ounce) liquid container or 120 gram (4 ounce) dry weight for adhesives / cement / mastic.

**1.5 STORAGE AND HANDLING OF MATERIAL**

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

**1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

L-P-535E (2)- 99.....Plastic Sheet (Sheeting): Plastic Strip; Poly  
(Vinyl Chloride) and Poly (Vinyl Chloride -  
Vinyl Acetate), Rigid.

C. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic  
Thermal Insulation

MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and  
Water-Resistant, Vapor-Barrier

MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread,  
Glass and Wire-Reinforced Glass

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

A167-99(2004).....Standard Specification for Stainless and  
Heat-Resisting Chromium-Nickel Steel Plate,  
Sheet, and Strip

B209-07.....Standard Specification for Aluminum and  
Aluminum-Alloy Sheet and Plate

C411-05.....Standard test method for Hot-Surface  
Performance of High-Temperature Thermal  
Insulation

C449-07.....Standard Specification for Mineral Fiber  
Hydraulic-Setting Thermal Insulating and  
Finishing Cement

C533-09.....Standard Specification for Calcium Silicate  
Block and Pipe Thermal Insulation

C534-08.....Standard Specification for Preformed Flexible  
Elastomeric Cellular Thermal Insulation in  
Sheet and Tubular Form

C547-07.....Standard Specification for Mineral Fiber pipe  
Insulation

C552-07.....Standard Specification for Cellular Glass  
Thermal Insulation

C553-08.....Standard Specification for Mineral Fiber  
Blanket Thermal Insulation for Commercial and  
Industrial Applications

- C585-09.....Standard Practice for Inner and Outer Diameters  
of Rigid Thermal Insulation for Nominal Sizes  
of Pipe and Tubing (NPS System) R (1998)
- C612-10.....Standard Specification for Mineral Fiber Block  
and Board Thermal Insulation
- C1126-04.....Standard Specification for Faced or Unfaced  
Rigid Cellular Phenolic Thermal Insulation
- C1136-10.....Standard Specification for Flexible, Low  
Permeance Vapor Retarders for Thermal  
Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven  
and Treated) for Roofing and Waterproofing
- E84-10.....Standard Test Method for Surface Burning  
Characteristics of Building  
Materials
- E119-09c.....Standard Test Method for Fire Tests of Building  
Construction and Materials
- E136-09b.....Standard Test Methods for Behavior of Materials  
in a Vertical Tube Furnace at 750 degrees C  
(1380 F)
- E. National Fire Protection Association (NFPA):
- 90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems
- 96-08.....Standards for Ventilation Control and Fire  
Protection of Commercial Cooking Operations
- 101-09.....Life Safety Code
- 251-06.....Standard methods of Tests of Fire Endurance of  
Building Construction Materials
- 255-06.....Standard Method of tests of Surface Burning  
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
- 723.....UL Standard for Safety Test for Surface Burning  
Characteristics of Building Materials with  
Revision of 09/08
- G. Manufacturer's Standardization Society of the Valve and Fitting  
Industry (MSS):
- SP58-2009.....Pipe Hangers and Supports Materials, Design,  
and Manufacture

## **PART 2 - PRODUCTS**

### **2.1 MINERAL FIBER OR FIBER GLASS**

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m<sup>3</sup> (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m<sup>3</sup> (1 pcf), k = 0.045 (0.31) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

### **2.2 MINERAL WOOL OR REFRACTORY FIBER**

- A. Comply with Standard ASTM C612, Class 3, 450 degrees C (850 degrees F).

### **2.3 RIGID CELLULAR PHENOLIC FOAM**

- A. Preformed (molded) pipe insulation, ASTM C1126, type III, grade 1, k = 0.021(0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.
- B. Equipment and Duct Insulation, ASTM C 1126, type II, grade 1, k = 0.021 (0.15) at 10 degrees C (50 degrees F), for use at temperatures up to 121 degrees C (250 degrees F) with rigid cellular phenolic insulation and covering, and all service vapor retarder jacket.

### **2.4 CELLULAR GLASS CLOSED-CELL**

- A. Comply with Standard ASTM C177, C518, density 120 kg/m<sup>3</sup> (7.5 pcf) nominal, k = 0.033 (0.29) at 240 degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

### **2.5 POLYISOCYANURATE CLOSED-CELL RIGID**

- A. Preformed (fabricated) pipe insulation, ASTM C591, type IV, K=0.027(0.19) at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for use at temperatures up to 149 degree C (300 degree F) with factory applied PVDC or all service vapor retarder jacket with polyvinyl chloride premolded fitting covers.

- B. Equipment and duct insulation, ASTM C 591, type IV,  $K=0.027(0.19)$  at 24 degrees C (75 degrees F), for use at temperatures up to 149 degrees C (300 degrees F) with PVDC or all service jacket vapor retarder jacket.

## **2.6 FLEXIBLE ELASTOMERIC CELLULAR THERMAL**

ASTM C177, C518,  $k = 0.039 (0.27)$  at 24 degrees C (75 degrees F), flame spread not over 25, smoke developed not over 50, for temperatures from minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No jacket required.

## **2.7 NOT USED**

## **2.8 NOT USED**

## **2.9 INSULATION FACINGS AND JACKETS**

- A. Vapor Retarder, higher strength with low water permeance  $\leq 0.02$  or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.

- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- F. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- H. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.
- I. NOT USED

#### **2.10 REMOVABLE INSULATION JACKETS**

- A. Insulation and Jacket:
  - 1. Non-Asbestos Glass mat, type E needled fiber.
  - 2. Temperature maximum of 450°F, Maximum water vapor transmission of 0.00 perm, and maximum moisture absorption of 0.2 percent by volume.
  - 3. Jacket Material: Silicon/fiberglass and LFP 2109 pure PTFE.
  - 4. Construction: One piece jacket body with three-ply braided pure Teflon or Kevlar thread and insulation sewn as part of jacket. Belt fastened.

#### **2.11 PIPE COVERING PROTECTION SADDLES**

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long
200 (8), 250 (10), 300 (12)	225 (9) long
350 (14), 400 (16)	300 (12) long
450 through 600 (18 through 24)	350 (14) long

B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m<sup>3</sup> (3.0 pcf).

C. NOT USED.

#### **2.12 ADHESIVE, MASTIC, CEMENT**

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

#### **2.13 MECHANICAL FASTENERS**

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel.
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.



**2.14 REINFORCEMENT AND FINISHES**

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: 25 mm (one inch) mesh, 0.85 mm thick (22 gage) galvanized steel.
- E. Corner beads: 50 mm (2 inch) by 50 mm (2 inch), 0.55 mm thick (26 gage) galvanized steel; or, 25 mm (1 inch) by 25 mm (1 inch), 0.47 mm thick (28 gage) aluminum angle adhered to 50 mm (2 inch) by 50 mm (2 inch) Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

**2.15 FIRESTOPPING MATERIAL**

Other than pipe and duct insulation, refer to Section 07 84 00  
FIRESTOPPING.

**2.16 FLAME AND SMOKE**

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

**PART 3 - EXECUTION****3.1 GENERAL REQUIREMENTS**

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the COTR for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. NOT USED.
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and

smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).

- E. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- F. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- G. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- H. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- I. Insulate PRVs, flow meters, and steam traps.
- I. HVAC work not to be insulated:
  - 1. Internally insulated ductwork and air handling units.
  - 2. Relief air ducts (Economizer cycle exhaust air).
  - 3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
  - 4. Equipment: Expansion tanks, flash tanks, hot water pumps, steam condensate pumps.
  - 5. In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.

J. NOT USED

K. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

L. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

M. Firestop Pipe and Duct insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
  - a. Pipe risers through floors
  - b. Pipe or duct chase walls and floors
  - c. Smoke partitions
  - d. Fire partitions

N. Freeze protection of above grade outdoor piping (over heat tracing tape): 26 mm (10 inch) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. Provide for cold water make-up to cooling towers and condenser water piping and chilled water piping as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).

O. Provide vapor barrier jackets over insulation as follows:

1. All piping and ductwork exposed to outdoor weather.
2. All interior piping and ducts conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature.

P. Provide metal jackets over insulation as follows:

1. All piping and ducts exposed to outdoor weather.
2. NOT USED.
3. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

### 3.2 INSULATION INSTALLATION

#### A. Mineral Fiber Board:

1. Faced board: Apply board on pins spaced not more than 300 mm (12 inches) on center each way, and not less than 75 mm (3 inches) from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.
2. Plain board:
  - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 225 mm (9 inches) on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
  - b. For hot equipment: Stretch 25 mm (1 inch) mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 6 mm (1/4 inch) thick, trowel led to a smooth finish.
  - c. For cold equipment: Apply meshed glass fabric in a tack coat 1.5 to 1.7 square meter per liter (60 to 70 square feet per gallon) of vapor mastic and finish with mastic at 0.3 to 0.4 square meter per liter (12 to 15 square feet per gallon) over the entire fabric surface.
  - d. NOT USED.
3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
  - a. 50 mm (2 inch) thick insulation faced with ASJ (white all service jacket): Supply air duct and afterfilter housing.
  - b. 50 mm (2 inch) thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
  - c. Outside air intake ducts: 25 mm (one inch) thick insulation faced with ASJ.
  - d. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer

vapor barrier with a maximum water vapor permeability of 0.001 perms.

4. NOT USED.
5. NOT USED.
6. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
  - a. Convertors, air separators, steam condensate pump receivers.
  - b. Reheat coil casing and separation chambers on steam humidifiers located above ceilings.
  - c. NOT USED.
  - d. NOT USED.
7. NOT USED.

B. Flexible Mineral Fiber Blanket:

1. Adhere insulation to metal with 75 mm (3 inch) wide strips of insulation bonding adhesive at 200 mm (8 inches) on center all around duct. Additionally secure insulation to bottom of ducts exceeding 600 mm (24 inches) in width with pins welded or adhered on 450 mm (18 inch) centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To prevent condensation insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.
3. Concealed supply air ductwork.
  - a. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with FSK.
  - b. Above ceilings for other than roof level: 40 mm (1 ½ inch) thick insulation faced with FSK.
4. Concealed return air duct:
  - a. NOT USED.
  - b. Above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 40 mm (1-1/2 inch) thick, insulation faced with FSK.

c. NOT USED

d. Concealed return air ductwork in other locations need not be insulated.

5. Concealed outside air duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.

6. NOT USED.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.

2. Contractor's options for fitting, flange and valve insulation:

a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.

b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.

c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.

d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

D. Rigid Cellular Phenolic Foam:

1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B
3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
8. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a maximum water vapor permeance of 0.00 perms.
9. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
  - a. HVAC: Cooling coil condensation piping to waste piping fixture or drain inlet. Omit insulation on plastic piping in mechanical rooms.

E. Cellular Glass Insulation:

1. Pipe and tubing, covering nominal thickness in millimeters and inches as specified in the schedule at the end of this section.
2. NOT USED.
  - a. 75 mm (3 inches) thick for hot water piping.
  - b. As scheduled at the end of this section for chilled water piping.
  - c. NOT USED.
  - d. Provide expansion chambers for pipe loops, anchors and wall penetrations as recommended by the insulation manufacturer.
  - e. Underground insulation shall be inspected and approved by the COTR as follows:
    - 1) Insulation in place before coating.
    - 2) After coating.
  - f. Sand bed and backfill: Minimum 75 mm (3 inches) all around insulated pipe or tank, applied after coating has dried.
3. NOT USED.
4. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing

membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a water vapor permeability of 0.00 perms.

F. Polyisocyanurate Closed-Cell Rigid Insulation:

1. Polyisocyanurate closed-cell rigid insulation (PIR) may be provided for exterior piping, equipment and ductwork for temperature up to 149 degree C (300 degree F).
2. Install insulation, vapor barrier and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor barrier integrity.
3. Install insulation with all joints tightly butted (except expansion joints in hot applications).
4. If insulation thickness exceeds 63 mm (2.5 inches), install as a double layer system with longitudinal (lap) and butt joint staggering as recommended by manufacturer.
5. For cold applications, vapor barrier shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor barrier shall be used to attach the vapor barrier or jacketing. No wire ties capable of penetrating the vapor barrier shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
6. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
7. For cold applications, the vapor barrier on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor barrier adhesive tape.
8. All PVC and metal jacketing shall be installed so as to naturally shed water. Joints shall point down and shall be sealed with either adhesive or caulking (except for periodic slip joints).
9. NOT USED.



10. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.
  11. Note the NFPA 90A burning characteristic requirements of 25/50 in paragraph 1.3B. Refer to paragraph 3.1 for items not to be insulated.
  12. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section.
- G. Flexible Elastomeric Cellular Thermal Insulation:
1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
  2. Pipe and tubing insulation:
    - a. Use proper size material. Do not stretch or strain insulation.
    - b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
    - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
  3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
  4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
  5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
  6. NOT USED.

7. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.

H. NOT USED

I. NOT USED

### 3.3 NOT USED

### 3.4 NOT USED

### 3.5 NOT USED

### 3.6 NOT USED

### 3.7 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

### 3.8 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1½)	38 - 75 (1½ - 3)	100 (4) and Above
122-177 degrees C (251-350 degrees F) (HPS, MPS)	Mineral Fiber (Above ground piping only)	75 (3)	100 (4)	113 (4.5)	113 (4.5)
100-121 degrees C (212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Mineral Fiber (Above ground piping only)	62 (2.5)	62 (2.5)	75 (3.0)	75 (3.0)
100-121 degrees C	Rigid Cellular	50	50 (2.0)	75 (3.0)	75 (3.0)

(212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Phenolic Foam	(2.0)			
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, )	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, )	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
39-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, )	Polyiso- cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	----	----
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, )	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	----	----
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and R for DX refrigeration)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and R for DX refrigeration)	Cellular Glass Closed- Cell	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and R for DX refrigeration)	Polyiso- cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

(40-60 degrees F) (CH, CHR, GC, GCR and R for DX refrigeration)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

- - - E N D - - -

**SECTION 23 08 00****COMMISSIONING OF HVAC SYSTEMS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 23.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility exterior closure, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 23, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

**1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule HVAC systems inspections as required, to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and

resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the COTR. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the COTR and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA COTR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

----- END -----



**SECTION 23 09 23**  
**DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide (a) direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include a complete and working direct-digital control system. Include all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.
1. The direct-digital control system(s) shall consist of high-speed, peer-to-peer network of DDC controllers, a control system server, and an Engineering Control Center. Provide a remote user using a standard web browser to access the control system graphics and change adjustable setpoints with the proper password.
  2. The direct-digital control system(s) shall be native BACnet. All new workstations, controllers, devices and components shall be listed by BACnet Testing Laboratories. All new workstations, controller, devices and components shall be accessible using a Web browser interface and shall communicate exclusively using the ASHRAE Standard 135 BACnet communications protocol without the use of gateways, unless otherwise allowed by this Section of the technical specifications, specifically shown on the design drawings and specifically requested otherwise by the VA.
    - a. NOT USED.
    - b. NOT USED.
  3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and items required for complete and fully functional Controls Systems.
  4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The contractor

administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.

5. The control system for new equipment shall be tied into existing.

B. Some products are furnished but not installed by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the installation of the products. These products include the following:

1. Control valves.
2. Flow switches.
3. Flow meters.
4. Sensor wells and sockets in piping.
5. Terminal unit controllers.

C. Some products are installed but not furnished by the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the procurement of the products. These products include the following:

1. NOT USED.
2. Factory-furnished accessory thermostats and sensors furnished with unitary equipment.

D. Some products are not provided by, but are nevertheless integrated with the work executed by, the contractor administered by this Section of the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the particulars of the products. These products include the following:

1. Fire alarm systems. If zoned fire alarm is required by the project-specific requirements, this interface shall require multiple relays, which are provided and installed by the fire alarm system contractor, to be monitored.

2. NOT USED.
3. NOT USED.
4. Terminal units' velocity sensors
5. NOT USED.
6. Unitary HVAC equipment (split systems and heat transfer package) controls. These include:
  - a. Discharge temperature control.
  - b. NOT USED.
  - c. Flowrate control.
  - d. Setpoint reset.
  - e. Time of day indexing.
  - f. Status alarm.
7. Variable frequency drives. These controls, if not native BACnet, will require a BACnet Gateway.
8. NOT USED

E. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Control system low voltage and communication wiring	23 09 23	23 09 23	23 09 23	N/A
Terminal units	23	23	N/A	26
Controllers for terminal units	23 09 23	23	23 09 23	16
LAN conduits and raceway	23 09 23	23 09 23	N/A	N/A
Automatic dampers (not furnished with equipment)	23 09 23	23	N/A	N/A
Automatic damper actuators	23 09 23	23 09 23	23 09 23	23 09 23
Manual valves	23	23	N/A	N/A
Automatic valves	23 09 23	23	23 09 23	23 09 23
Pipe insertion devices and taps, flow and pressure stations.	23	23	N/A	N/A
Thermowells	23 09 23	23	N/A	N/A
Current Switches	23 09 23	23 09 23	23 09 23	N/A
Control Relays	23 09 23	23 09 23	23 09 23	N/A
Power distribution system monitoring interfaces	23 09 23	23 09 23	23 09 23	26
All control system nodes, equipment, housings,	23 09 23	23 09 23	23 09 23	26

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
enclosures and panels.				
Smoke detectors	28 31 00	28 31 00	28 31 00	28 31 00
Fire/Smoke Dampers	23	23	28 31 00	28 31 00
Smoke Dampers	23	23	28 31 00	28 31 00
Fire Dampers	23	23	N/A	N/A
VFDs	23 09 23	26	23 09 23	26
Fire Alarm shutdown relay interlock wiring	28	28	28	26
Control system monitoring of fire alarm smoke control relay	28	28	23 09 23	28
Fire-fighter's smoke control station (FSCS	28	28	28	28
Starters, HOA switches	23	23	N/A	26

F. NOT USED.

G. This campus has standardized on an existing standard ASHRAE Standard 135, BACnet/IP Control System supported by a preselected controls service company. This entity is referred to as the "Control System Integrator" in this Section of the technical specifications. The Control system integrator is responsible for ECC system graphics and expansion. It also prescribes control system-specific commissioning/verification procedures to the contractor administered by this Section of the technical specification. It lastly provides limited assistance to the contractor administered by this Section of the technical specification in its commissioning/verification work.

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.
2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator's area control through an Ethernet connection provided by the Control System Integrator.

3. The contractor administered by this Section of the technical specifications shall provide a peer-to-peer networked, stand-alone, distributed control system. This direct digital control (DDC) system shall include one portable operator terminal - laptop, one digital display unit, microprocessor-based controllers, instrumentation, end control devices, wiring, piping, software, and related systems. This contractor is responsible for all device mounting and wiring.
4. Responsibility Table:

Item/Task	Section 23 09 23 contractor	Control system integrator	VA
ECC expansion		X	
ECC programming		X	
Devices, controllers, control panels and equipment	X		
Point addressing: all hardware and software points including setpoint, calculated point, data point(analog/binary), and reset schedule point	X		
Point mapping		X	
Network Programming	X		
ECC Graphics		X	
Controller programming and sequences	X		
Integrity of LAN communications	X		
Electrical wiring	X		
Operator system training		X	
LAN connections to devices	X		
LAN connections to ECC		X	
IP addresses			X
Overall system verification		X	
Controller and LAN system verification	X		

H. Unitary standalone systems including Unit Heaters, , Fan Coil Units, thermal comfort ventilation fans, and similar units for control of room environment conditions may be equipped with integral controls furnished and installed by the equipment manufacturer or field mounted. Refer to equipment specifications and as indicated in project documents. Application of standalone unitary controls is limited to at least those systems wherein remote monitoring, alarm and start-up are not necessary. Examples of such systems include:

1. NOT USED
2. NOT USED
3. NOT USED
4. NOT USED
5. Mechanical or electrical room heating and ventilation.

- I The direct-digital control system shall start and stop equipment, move (position) damper actuators and valve actuators, and vary speed of equipment to execute the mission of the control system. Use electricity as the motive force for all damper and valve actuators, unless use of pneumatics as motive force is specifically granted by the VA.

## 1.2 RELATED WORK

- A. NOT USED
- B. NOT USED
- C. NOT USED
- D. NOT USED
- E. NOT USED
- F. NOT USED
- G. NOT USED
- H. NOT USED
- I. NOT USED
- J. NOT USED.
- K. NOT USED
- L. NOT USED
- M. Section 21 05 11, Common Work Results for Fire Suppression.
- N. Section 21 10 00, Water-Based Fire-Suppression Systems.
- O. NOT USED
- P. NOT USED
- Q. NOT USED
- R. NOT USED
- S. NOT USED
- T. NOT USED
- U. NOT USED
- V. NOT UDRF
- W. NOT USED.
- X. NOT USED
- Y. NOT USRF
- Z. NOT USED
- AA. NOT USED
- BB. NOT USED
- CC. NOT USED
- DD. NOT USED

EE. Section 23 21 13, Hydronic Piping.

FF. Section 23 22 13, Steam and Condensate Heating Piping.

GG. Section 23 31 00, HVAC Ducts and Casings.

HH. Section 23 36 00, Air Terminal Units.

II. NOT USED

JJ. NOT USED

KK. NOT USED

LL. NOT USED

MM. Section 23 73 00, Indoor Central-Station Air-Handling Units.

NN. NOT USED

OO. Section 23 81 00, Decentralized Unitary HVAC Equipment.

PP. NOT USED

QQ. NOT USED

RR. NOT USED

SS. NOT USED

TT. NOT USED

UU. Section 26 05 11, Requirements for Electrical Installations.

VV. Section 26 05 21, Low-Voltage Electrical Power Conductors and Cables  
(600 Volts and Below).

WW. Section 26 05 26, Grounding and Bonding for Electrical Systems.

XX. Section 26 05 33, Raceway and Boxes for Electrical Systems.

YY. Section 26 09 23, Lighting Controls.

ZZ. Section 26 22 21, Specialty Transformers.

AAA. Section 26 27 26, Wiring Devices.

BBB. Section 26 29 11, Motor Starters.

CCC. NOT USED

DDD. Section 27 15 00, Communications Horizontal Cabling

EEE. Section 28 31 00, Fire Detection and Alarm.

## 1.2 DEFINITION

- A. Algorithm: A logical procedure for solving a recurrent mathematical problem; A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.
- B. NOT USED
- C. Analog: A continuously varying signal value (e.g., temperature, current, velocity etc).
- D. BACnet: A Data Communication Protocol for Building Automation and Control Networks , ANSI/ASHRAE Standard 135. This communications

protocol allows diverse building automation devices to communicate data over and services over a network.

- E. BACnet/IP: Annex J of Standard 135. It defines and allows for using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP sub-networks that share the same BACnet network number.
- F. BACnet Internetwork: Two or more BACnet networks connected with routers. The two networks may use different LAN technologies.
- G. BACnet Network: One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.
- H. BACnet Segment: One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.
- I. BACnet Broadcast Management Device (BBMD): A communications device which broadcasts BACnet messages to all BACnet/IP devices and other BBMDs connected to the same BACnet/IP network.
- J. BACnet Interoperability Building Blocks (BIBBs): BACnet Interoperability Building Blocks (BIBBs) are collections of one or more BACnet services. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet internetwork.
- K. BACnet Testing Laboratories (BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.
- L. Baud: It is a signal change in a communication link. One signal change can represent one or more bits of information depending on type of transmission scheme. Simple peripheral communication is normally one bit per Baud. (e.g., Baud rate = 78,000 Baud/sec is 78,000 bits/sec, if one signal change = 1 bit).
- M. Binary: A two-state system where a high signal level represents an "ON" condition and an "OFF" condition is represented by a low signal level.
- N. BMP or bmp: Suffix, computerized image file, used after the period in a DOS-based computer file to show that the file is an image stored as a series of pixels.
- O. Bus Topology: A network topology that physically interconnects workstations and network devices in parallel on a network segment.
- P. Control Unit (CU): Generic term for any controlling unit, stand-alone, microprocessor based, digital controller residing on secondary LAN or Primary LAN, used for local controls or global controls



- Q. Deadband: A temperature range over which no heating or cooling is supplied, i.e., 22-25 degrees C (72-78 degrees F), as opposed to a single point change over or overlap).
- R. Device: a control system component that contains a BACnet Device Object and uses BACnet to communicate with other devices.
- S. Device Object: Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.
- T. Device Profile: A specific group of services describing BACnet capabilities of a device, as defined in ASHRAE Standard 135-2008, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing which service and BIBBs are supported by the device.
- U. Diagnostic Program: A software test program, which is used to detect and report system or peripheral malfunctions and failures. Generally, this system is performed at the initial startup of the system.
- V. Direct Digital Control (DDC): Microprocessor based control including Analog/Digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices in order to achieve a set of predefined conditions.
- W. Distributed Control System: A system in which the processing of system data is decentralized and control decisions can and are made at the subsystem level. System operational programs and information are provided to the remote subsystems and status is reported back to the Engineering Control Center. Upon the loss of communication with the Engineering Control center, the subsystems shall be capable of operating in a stand-alone mode using the last best available data.
- X. Download: The electronic transfer of programs and data files from a central computer or operation workstation with secondary memory devices to remote computers in a network (distributed) system.

- Y. DXF: An AutoCAD 2-D graphics file format. Many CAD systems import and export the DXF format for graphics interchange.
- Z. Electrical Control: A control circuit that operates on line or low voltage and uses a mechanical means, such as a temperature sensitive bimetal or bellows, to perform control functions, such as actuating a switch or positioning a potentiometer.
- AA. Electronic Control: A control circuit that operates on low voltage and uses a solid-state components to amplify input signals and perform control functions, such as operating a relay or providing an output signal to position an actuator.
- BB. Engineering Control Center (ECC): The centralized control point for the intelligent control network. The ECC comprises of personal computer and connected devices to form a single workstation.
- CC. Ethernet: A trademark for a system for exchanging messages between computers on a local area network using coaxial, fiber optic, or twisted-pair cables.
- DD. Firmware: Firmware is software programmed into read only memory (ROM) chips. Software may not be changed without physically altering the chip.
- EE. Gateway: Communication hardware connecting two or more different protocols. It translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a gateway has BACnet on one side and non-BACnet (usually proprietary) protocols on the other side.
- FF. GIF: Abbreviation of Graphic interchange format.
- GG. Graphic Program (GP): Program used to produce images of air handler systems, fans, chillers, pumps, and building spaces. These images can be animated and/or color-coded to indicate operation of the equipment.
- HH. Graphic Sequence of Operation: It is a graphical representation of the sequence of operation, showing all inputs and output logical blocks.
- II. I/O Unit: The section of a digital control system through which information is received and transmitted. I/O refers to analog input (AI, digital input (DI), analog output (AO) and digital output (DO). Analog signals are continuous and represent temperature, pressure, flow rate etc., whereas digital signals convert electronic signals to digital pulses (values), represent motor status, filter status, on-off equipment etc.
- JJ. I/P: a method for conveying and routing packets of information over LAN paths. User Datagram Protocol (UDP) conveys information to "sockets"

without confirmation of receipt. Transmission Control Protocol (TCP) establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

- KK. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.
- LL. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- MM. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.
- NN. NOT USED
- OO. Native BACnet Device: A device that uses BACnet as its primary method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet system.
- PP. Network Number: A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.
- QQ. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.
- RR. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.
- SS. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.
- TT. Operating system (OS): Software, which controls the execution of computer application programs.
- UU. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.
- VV. Peripheral: Different components that make the control system function as one unit. Peripherals include monitor, printer, and I/O unit.

- WW. Peer-to-Peer: A networking architecture that treats all network stations as equal partners- any device can initiate and respond to communication with other devices.
- XX. PICS: Protocol Implementation Conformance Statement, describing the BACnet capabilities of a device. All BACnet devices have published PICS.
- YY. PID: Proportional, integral, and derivative control, used to control modulating equipment to maintain a setpoint.
- ZZ. Repeater: A network component that connects two or more physical segments at the physical layer.
- AAA. Router: a component that joins together two or more networks using different LAN technologies. Examples include joining a BACnet Ethernet LAN to a BACnet MS/TP LAN.
- BBB. Sensors: devices measuring state points or flows, which are then transmitted back to the DDC system.
- CCC. Thermostats : devices measuring temperatures, which are used in control of standalone or unitary systems and equipment not attached to the DDC system.

#### **1.4 QUALITY ASSURANCE**

##### **A. Criteria:**

1. Single Source Responsibility of subcontractor: The Contractor shall obtain hardware and software supplied under this Section and delegate the responsibility to a single source controls installation subcontractor. The controls subcontractor shall be responsible for the complete design, installation, and commissioning of the system. The controls subcontractor shall be in the business of design, installation and service of such building automation control systems similar in size and complexity.
2. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
3. The controls subcontractor shall provide a list of no less than five similar projects which have building control systems as specified in this Section. These projects must be on-line and functional such that the Department of Veterans Affairs (VA) representative would observe the control systems in full operation.

4. The controls subcontractor shall have in-place facility within 50 miles with technical staff, spare parts inventory for the next five (5) years, and necessary test and diagnostic equipment to support the control systems.
5. The controls subcontractor shall have minimum of three years' experience in design and installation of building automation systems similar in performance to those specified in this Section. Provide evidence of experience by submitting resumes of the project manager, the local branch manager, project engineer, the application engineering staff, and the electronic technicians who would be involved with the supervision, the engineering, and the installation of the control systems. Training and experience of these personnel shall not be less than three years. Failure to disclose this information will be a ground for disqualification of the supplier.
6. Provide a competent and experienced Project Manager employed by the Controls Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional engineering, technical and management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Controls Contractor.

B. Codes and Standards:

1. All work shall conform to the applicable Codes and Standards.
2. Electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.

### **1.5 PERFORMANCE**

A. The system shall conform to the following:

1. Graphic Display: The system shall display up to four (4) graphics on a single screen with a minimum of twenty (20) dynamic points per graphic. All current data shall be displayed within ten (10) seconds of the request.
2. Graphic Refresh: The system shall update all dynamic points with current data within eight (8) seconds. Data refresh shall be automatic, without operator intervention.
3. Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be

- two(2) seconds. Analog objects shall start to adjust within two (2) seconds.
4. Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or work-station will be current, within the prior six (6) seconds.
  5. Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed (10) seconds.
  6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every (5) seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
  7. Multiple Alarm Annunciations: All workstations on the network shall receive alarms within five (5) seconds of each other.
  8. Performance: Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every one (1) second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
  9. Reporting Accuracy: Listed below are minimum acceptable reporting end-to-end accuracies for all values reported by the specified system:

Measured Variable	Reported Accuracy
Space temperature	$\pm 0.5^{\circ}\text{C}$ ( $\pm 1^{\circ}\text{F}$ )
Ducted air temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Outdoor air temperature	$\pm 1.0^{\circ}\text{C}$ [ $\pm 2^{\circ}\text{F}$ ]
Dew Point	$\pm 1.5^{\circ}\text{C}$ [ $\pm 3^{\circ}\text{F}$ ]
Water temperature	$\pm 0.5^{\circ}\text{C}$ [ $\pm 1^{\circ}\text{F}$ ]
Relative humidity	$\pm 2\%$ RH
Water flow	$\pm 1\%$ of reading
Air flow (terminal)	$\pm 10\%$ of reading
Air flow (measuring stations)	$\pm 5\%$ of reading
Carbon Monoxide (CO)	$\pm 5\%$ of reading
Carbon Dioxide (CO <sub>2</sub> )	$\pm 50$ ppm
Air pressure (ducts)	$\pm 25$ Pa [ $\pm 0.1$ "w.c.]

Air pressure (space)	$\pm 0.3$ Pa [ $\pm 0.001$ "w.c.]
Water pressure	$\pm 2\%$ of full scale *Note 1
Electrical Power	$\pm 0.5\%$ of reading

Note 1: for both absolute and differential pressure

10. Control stability and accuracy: Control sequences shall maintain measured variable at setpoint within the following tolerances:

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	$\pm 50$ Pa ( $\pm 0.2$ in. w.g.)	0-1.5 kPa (0-6 in. w.g.)
Air Pressure	$\pm 3$ Pa ( $\pm 0.01$ in. w.g.)	-25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	$\pm 10\%$ of full scale	
Space Temperature	$\pm 1.0^{\circ}\text{C}$ ( $\pm 2.0^{\circ}\text{F}$ )	
Duct Temperature	$\pm 1.5^{\circ}\text{C}$ ( $\pm 3^{\circ}\text{F}$ )	
Humidity	$\pm 5\%$ RH	
Fluid Pressure	$\pm 10$ kPa ( $\pm 1.5$ psi)	0-1 MPa (1-150 psi)
Fluid Pressure	$\pm 250$ Pa ( $\pm 1.0$ in. w.g.)	0-12.5 kPa (0-50 in. w.g.) differential

11. Extent of direct digital control: control design shall allow for at least the points indicated on the points lists on the drawings.

#### 1.6 WARRANTY

- A. Labor and materials for control systems shall be warranted for a period as specified under Warranty in FAR clause 52.246-21.
- B. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no cost or reduction in service to the owner. The system includes all computer equipment, transmission equipment, and all sensors and control devices.
- C. The on-line support service shall allow the Controls supplier to dial out over telephone lines to or connect via (through password-limited access) VPN through the internet monitor and control the facility's building automation system. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekend and holidays. If the problem cannot be resolved with on-line support services, the Controls supplier shall dispatch the

qualified personnel to the job site to resolve the problem within 24 hours after the problem is reported.

- D. Controls and Instrumentation subcontractor shall be responsible for temporary operations and maintenance of the control systems during the construction period until final commissioning, training of facility operators and acceptance of the project by VA.

#### **1.7 SUBMITTALS**

- A. Submit shop drawings in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data for all components including the following:
  - 1. A wiring diagram for each type of input device and output device including DDC controllers, modems, repeaters, etc. Diagram shall show how the device is wired and powered, showing typical connections at the digital controllers and each power supply, as well as the device itself. Show for all field connected devices, including but not limited to, control relays, motor starters, electric or electronic actuators, and temperature pressure, flow and humidity sensors and transmitters.
  - 2. A diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and the associated point names.
  - 3. Control dampers and control valves schedule, including the size and pressure drop.
  - 4. Control air-supply components, and computations for sizing compressors, receivers and main air-piping, if pneumatic controls are furnished.
  - 5. Catalog cut sheets of all equipment used. This includes, but is not limited to software (by manufacturer and by third parties), DDC controllers, panels, peripherals, airflow measuring stations and associated components, and auxiliary control devices such as sensors, actuators, and control dampers. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted. Each submitted piece of literature and drawings should clearly reference the specification and/or drawings that it supposed to represent.



6. Sequence of operations for each HVAC system and the associated control diagrams. Equipment and control labels shall correspond to those shown on the drawings.
  7. Color prints of proposed graphics with a list of points for display.
  8. Furnish a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet-compliant device.
  9. Schematic wiring diagrams for all control, communication and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
  10. An instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number, and product data sheet number.
  11. Riser diagrams of wiring between central control unit and all control panels.
  12. Scaled plan drawings showing routing of LAN and locations of control panels, controllers, routers, gateways, ECC, and larger controlled devices.
  13. Construction details for all installed conduit, cabling, raceway, cabinets, and similar. Construction details of all penetrations and their protection.
  14. Quantities of submitted items may be reviewed but are the responsibility of the contractor administered by this Section of the technical specifications.
- C. Product Certificates: Compliance with Article, QUALITY ASSURANCE.
- D. Licenses: Provide licenses for all software residing on and used by the Controls Systems and transfer these licenses to the Owner prior to completion.
- E. As Built Control Drawings:
1. Furnish three (3) copies of as-built drawings for each control system. The documents shall be submitted for approval prior to final completion.
  2. Furnish one (1) stick set of applicable control system prints for each mechanical system for wall mounting. The documents shall be submitted for approval prior to final completion.

3. Furnish one (1) CD-ROM in CAD DWG and/or .DXF format for the drawings noted in subparagraphs above.

F. Operation and Maintenance (O/M) Manuals):

1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
2. Include the following documentation:
  - a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
  - b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
  - c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
  - d. Complete troubleshooting procedures and guidelines for all systems.
  - e. Complete operating instructions for all systems.
  - f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
  - g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
  - h. Licenses, guaranty, and other pertaining documents for all equipment and systems.

- G. Submit Performance Report to COTR prior to final inspection.

## 1.8 INSTRUCTIONS

- A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below.
  1. First Phase: Formal instructions to the VA facilities personnel for a total of 16 hours, given in multiple training sessions (each no

longer than four hours in length), conducted sometime between the completed installation and prior to the performance test period of the control system, at a time mutually agreeable to the Contractor and the VA.

2. Second Phase: This phase of training shall comprise of on the job training during start-up, checkout period, and performance test period. VA facilities personnel will work with the Contractor's installation and test personnel on a daily basis during start-up and checkout period. During the performance test period, controls subcontractor will provide 8 hours of instructions, given in multiple training sessions (each no longer than four hours in length), to the VA facilities personnel.
3. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.
4. Training shall be given by direct employees of the controls system subcontractor.

#### **1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)**

- A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35°C (65 to 90°F) at a relative humidity of 20 to 80% non-condensing.
- B. The CUs used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 65°C (-40 to 150°F).
- C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.
- D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

#### **1.10 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):  
Standard 135-10.....BACNET Building Automation and Control Networks
- C. American Society of Mechanical Engineers (ASME):

- B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings.  
 B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. American Society of Testing Materials (ASTM):

- B32-08.....Standard Specification for Solder Metal  
 B88-09.....Standard Specifications for Seamless Copper Water Tube  
 B88M-09.....Standard Specification for Seamless Copper Water Tube (Metric)  
 B280-08.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service  
 D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing

E. Federal Communication Commission (FCC):

Rules and Regulations Title 47 Chapter 1-2001 Part 15: Radio Frequency Devices.

F. Institute of Electrical and Electronic Engineers (IEEE):

- 802.3-11.....Information Technology-Telecommunications and Information Exchange between Systems-Local and Metropolitan Area Networks- Specific Requirements-Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access method and Physical Layer Specifications

G. National Fire Protection Association (NFPA):

- 70-11.....National Electric Code  
 90A-09.....Standard for Installation of Air-Conditioning and Ventilation Systems

H. Underwriter Laboratories Inc (UL):

- 94-10.....Tests for Flammability of Plastic Materials for Parts and Devices and Appliances  
 294-10.....Access Control System Units  
 486A/486B-10.....Wire Connectors  
 555S-11.....Standard for Smoke Dampers  
 916-10.....Energy Management Equipment  
 1076-10.....Proprietary Burglar Alarm Units and Systems

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Spare parts shall be available for at least five years after completion of this contract.

### **2.2 CONTROLS SYSTEM ARCHITECTURE**

- A. General

1. The Controls Systems shall consist of multiple Nodes and associated equipment connected by industry standard digital and communication network arrangements.
2. The ECC, building controllers and principal communications network equipment shall be standard products of recognized major manufacturers available through normal PC and computer vendor channels - not "Clones" assembled by a third-party subcontractor.
3. The networks shall, at minimum, comprise, as necessary, the following:
  - a. A fixed ECC and a portable operator's terminal.
  - b. Network computer processing, data storage and BACnet-compliant communication equipment including Servers and digital data processors.
  - c. BACnet-compliant routers, bridges, switches, hubs, modems, gateways, interfaces and similar communication equipment.
  - d. Active processing BACnet-compliant building controllers connected to other BACnet-compliant controllers together with their power supplies and associated equipment.
  - e. Addressable elements, sensors, transducers and end devices.
  - f. Third-party equipment interfaces and gateways as described and required by the Contract Documents.
  - g. Other components required for a complete and working Control Systems as specified.
- B. The Specifications for the individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the Contractor to achieve both compliance with all applicable codes, standards and to meet all requirements of the Contract Documents.
- C. Network Architecture
  1. The Controls communication network shall utilize BACnet communications protocol operating over a standard Ethernet LAN and operate at a minimum speed of 100 Mb/sec.
  2. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances and regulations. They may also utilize digital wireless technologies as appropriate to the application and if approved by the VA.
  3. All necessary telephone lines, ISDN lines and internet Service Provider services and connections will be provided by the VA.

D. Third Party Interfaces:

1. The contractor administered by this Section of the technical specifications shall include necessary hardware, equipment, software and programming to allow data communications between the controls systems and building systems supplied by other trades.
2. Other manufacturers and contractors supplying other associated systems and equipment shall provide their necessary hardware, software and start-up at their cost and shall cooperate fully with the contractor administered by this Section of the technical specifications in a timely manner and at their cost to ensure complete functional integration.

E. Servers:

1. Provide data storage server(s) to archive historical data including trends, alarm and event histories and transaction logs.
2. Equip these server(s) with the same software tool set that is located in the BACnet building controllers for system configuration and custom logic definition and color graphic configuration.
3. Access to all information on the data storage server(s) shall be through the same browser functionality used to access individual nodes. When logged onto a server the operator will be able to also interact with any other controller on the control system as required for the functional operation of the controls systems. The contractor administered by this Section of the technical specifications shall provide all necessary digital processor programmable data storage server(s).
4. These server(s) shall be utilized for controls systems application configuration, for archiving, reporting and trending of data, for operator transaction archiving and reporting, for network information management, for alarm annunciation, for operator interface tasks, for controls application management and similar. These server(s) shall utilize IT industry standard data base platforms which utilize a database declarative language designed for managing data in relational database management systems (RDBMS) such as SQL.

## 2.3 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator

interface communication shall conform to ANSI/ASHRAE Standard 135-2008, BACnet.

1. The Data link / physical layer protocol (for communication) acceptable to the VA throughout its facilities is Ethernet (ISO 8802-3) and BACnet/IP.
  2. NOT USED
  3. NOT USED
- B. Each controller shall have a communication port for connection to an operator interface.
- C. Project drawings indicate remote buildings or sites to be connected by a nominal 56,000 baud modem over voice-grade telephone lines. In each remote location a modem and field device connection shall allow communication with each controller on the internetwork as specified in Paragraph D.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each internetwork controller.
  2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute specified control system operation. An authorized operator shall be able to edit cross-controller links by typing a standard object address.
- E. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring. Expansion shall not require operator interface hardware additions or software revisions.
- F. ECCs and Controllers with real-time clocks shall use the BACnet Time Synchronization service. The system shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight savings and standard time as applicable.

#### **2.4 ENGINEERING CONTROL CENTER (ECC) - EXISTING**

## 2.5 PORTABLE OPERATOR'S TERMINAL (POT) - EXISTING

## 2.6 BACNET PROTOCOL ANALYZER

- A. For ease of troubleshooting and maintenance, provide a BACnet protocol analyzer. Provide its associated fittings, cables and appurtenances, for connection to the communications network. The BACnet protocol analyzer shall be able to, at a minimum: capture and store to a file all data traffic on all network levels; measure bandwidth usage; filter out (ignore) selected traffic.

## 2.7 NETWORK AND DEVICE NAMING CONVENTION

### A. Network Numbers

1. BACnet network numbers shall be based on a "facility code, network" concept. The "facility code" is the VAMC's or VA campus' assigned numeric value assigned to a specific facility or building. The "network" typically corresponds to a "floor" or other logical configuration within the building. BACnet allows 65535 network numbers per BACnet internet work.
2. The network numbers are thus formed as follows: "Net #" = "FFFNN" where:
  - a. FFF = Facility code (see below)
  - b. NN = 00-99 This allows up to 100 networks per facility or building

### B. Device Instances

1. BACnet allows 4194305 unique device instances per BACnet internet work. Using Agency's unique device instances are formed as follows: "Dev #" = "FFFNNDD" where
  - a. FFF and N are as above and
  - b. DD = 00-99, this allows up to 100 devices per network.
2. Note Special cases, where the network architecture of limiting device numbering to DD causes excessive subnet works. The device number can be expanded to DDD and the network number N can become a single digit. In NO case shall the network number N and the device number D exceed 4 digits.
3. Facility code assignments:
4. 000-400 Building/facility number
5. Note that some facilities have a facility code with an alphabetic suffix to denote wings, related structures, etc. The suffix will be ignored. Network numbers for facility codes above 400 will be assigned in the range 000-399.



### C. Device Names

1. Name the control devices based on facility name, location within a facility, the system or systems that the device monitors and/or controls, or the area served. The intent of the device naming is to be easily recognized. Names can be up to 254 characters in length, without embedded spaces. Provide the shortest descriptive, but unambiguous, name. For example, in building #123 prefix the number with a "B" followed by the building number, if there is only one chilled water pump "CHWP-1", a valid name would be "B123.CHWP.1.STARTSTOP". If there are two pumps designated "CHWP-1", one in a basement mechanical room (Room 0001) and one in a penthouse mechanical room (Room PH01), the names could be "B123.R0001.CHWP.1.STARTSTOP" or "B123.RPH01.CHWP.1.STARTSTOP". In the case of unitary controllers, for example a VAV box controller, a name might be "B123.R101.VAV". These names should be used for the value of the "Object\_Name" property of the BACnet Device objects of the controllers involved so that the BACnet name and the EMCS name are the same.

## 2.8 BACNET DEVICES

- A. All BACnet Devices - controllers, gateways, routers, actuators and sensors shall conform to BACnet Device Profiles and shall be BACnet Testing Laboratories (BTL) -Listed as conforming to those Device Profiles. Protocol Implementation Conformance Statements (PICSs), describing the BACnet capabilities of the Devices shall be published and available of the Devices through links in the BTL website.
  1. BACnet Building Controllers, historically referred to as NACs, shall conform to the BACnet B-BC Device Profile, and shall be BTL-Listed as conforming to the B-BC Device Profile. The Device's PICS shall be submitted.
  2. BACnet Advanced Application Controllers shall conform to the BACnet B-AAC Device Profile, and shall be BTL-Listed as conforming to the B-AAC Device Profile. The Device's PICS shall be submitted.
  3. BACnet Application Specific Controllers shall conform to the BACnet B-ASC Device Profile, and shall be BTL-Listed as conforming to the B-ASC Device Profile. The Device's PICS shall be submitted.
  4. BACnet Smart Actuators shall conform to the BACnet B-SA Device Profile, and shall be BTL-Listed as conforming to the B-SA Device Profile. The Device's PICS shall be submitted.

5. BACnet Smart Sensors shall conform to the BACnet B-SS Device Profile, and shall be BTL-Listed as conforming to the B-SS Device Profile. The Device's PICS shall be submitted.
6. BACnet routers and gateways shall conform to the BACnet B-OTH Device Profile, and shall be BTL-Listed as conforming to the B-OTH Device Profile. The Device's PICS shall be submitted.

## 2.9 CONTROLLERS

- A. General. Provide an adequate number of BTL-Listed B-BC building controllers and an adequate number of BTL-Listed B-AAC advanced application controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.
  1. The controller shall have sufficient memory to support its operating system, database, and programming requirements.
  2. The building controller shall share data with the ECC and the other networked building controllers. The advanced application controller shall share data with its building controller and the other networked advanced application controllers.
  3. The operating system of the controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
  4. Controllers that perform scheduling shall have a real-time clock.
  5. The controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
    - a. assume a predetermined failure mode, and
    - b. generate an alarm notification.
  6. The controller shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute and Initiate) and Write (Execute and Initiate) Property services.
  7. Communication.
    - a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.

- b. The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal.
- 8. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. Provide a system security password shall be available to prevent unauthorized use of the keypad and display.
- 9. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- 10. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- 11. The controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.
  - 1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
  - 2. Each B-ASC will contain sufficient I/O capacity to control the target system.
  - 3. Communication.
    - a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
    - b. NOT USED
    - c. NOT USED.
  - 4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-

removable, modular terminal strips or to a termination card connected by a ribbon cable.

5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.
6. Immunity to power and noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
7. Transformer. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type.

#### C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.
2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.
3. All control functions shall execute within the stand-alone control units via DDC algorithms. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters.
4. All controllers shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.
5. All DDC control loops shall be able to utilize any of the following control modes:
  - a. Two position (on-off, slow-fast) control.
  - b. Proportional control.

- c. Proportional plus integral (PI) control.
  - d. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
  - e. Automatic tuning of control loops.
6. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.
7. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the ECC or via a portable operator's terminal, when it is necessary, to access directly the programmable unit.
- a. NOT USED
  - b. Economizer: An economizer program shall be provided for VAV systems. This program shall control the position of air handler relief, return, and outdoors dampers. If the outdoor air dry bulb temperature and humidity fall below changeover set point the energy control center will modulate the dampers to provide 100 percent outdoor air. The operator shall be able to override the economizer cycle and return to minimum outdoor air operation at any time.
  - c. NOT USED
  - d. NOT USED
  - e. NOT USED
  - f. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's

response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.

- g. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.
- h. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

## **2.10 NOT USED**

## **2.11 SENSORS (AIR, WATER AND STEAM)**

- A. Sensors' measurements shall be read back to the DDC system, and shall be visible by the ECC.
- B. Temperature and Humidity Sensors shall be electronic, vibration and corrosion resistant for wall, immersion, and/or duct mounting. Provide all remote sensors as required for the systems.
  - 1. Temperature Sensors: thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.
    - a. Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear ft of sensing element for each sq ft of cooling coil face area.
    - b. Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
    - c. Space sensors shall be equipped with in-space User set-point adjustment, override switch, numerical temperature display on

sensor cover, and communication port. Match room thermostats. Provide a tooled-access cover.

- 1) Public space sensor: setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Do not provide in-space User set-point adjustment. Provide an opaque keyed-entry cover if needed to restrict in-space User set-point adjustment.
- 2) Psychiatric patient room sensor: sensor shall be flush with wall, shall not include an override switch, numerical temperature display on sensor cover, shall not include a communication port and shall not allow in-space User set-point adjustment. Setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Provide a stainless steel cover plate with an insulated back and security screws.
  - d. Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
  - e. Room security sensors shall have stainless steel cover plate with insulated back and security screws.
  - f. Wire: Twisted, shielded-pair cable.
  - g. Output Signal: 4-20 ma.
2. Humidity Sensors: Bulk polymer sensing element type.
  - a. Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of  $\pm 2$  to  $\pm 5$  percent RH, including hysteresis, linearity, and repeatability.
  - b. Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
  - c. 4-20 ma continuous output signal.
- C. Static Pressure Sensors: Non-directional, temperature compensated.
  1. 4-20 ma output signal.
  2. 0 to 5 inches w.g. for duct static pressure range.
  3. 0 to 0.25 inch w.g. for Building static pressure range.
- D. Water flow sensors:
  1. Type: Insertion vortex type with retractable probe assembly and 2 inch full port gate valve.
    - a. Pipe size: 3 to 24 inches.

- b. Retractor: ASME threaded, non-rising stem type with hand wheel.
  - c. Mounting connection: 2 inch 150 PSI flange.
  - d. Sensor assembly: Design for expected water flow and pipe size.
  - e. Seal: Teflon (PTFE).
- 2. Controller:
  - a. Integral to unit.
  - b. Locally display flow rate and total.
  - c. Output flow signal to BMCS: Digital pulse type.
- 3. Performance:
  - a. Turndown: 20:1
  - b. Response time: Adjustable from 1 to 100 seconds.
  - c. Power: 24 volt DC
- 4. Install flow meters according to manufacturer's recommendations.  
Where recommended by manufacturer because of mounting conditions, provide flow rectifier.
- E. Water Flow Sensors: shall be insertion turbine type with turbine element, retractor and preamplifier/transmitter mounted on a two-inch full port isolation valve; assembly easily removed or installed as a single unit under line pressure through the isolation valve without interference with process flow; calibrated scale shall allow precise positioning of the flow element to the required insertion depth within plus or minus 1 mm (0.05 inch); wetted parts shall be constructed of stainless steel. Operating power shall be nominal 24 VDC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 digit display, for wall or panel mounting.
  - 1. Performance characteristics:
    - a. Ambient conditions: -40°C to 60°C (-40°F to 140°F), 5 to 100% humidity.
    - b. Operating conditions: 850 kPa (125 psig), 0°C to 120°C (30°F to 250°F), 0.15 to 12 m per second (0.5 to 40 feet per second) velocity.
    - c. Nominal range (turn down ratio): 10 to 1.
    - d. Preamplifier mounted on meter shall provide 4-20 ma divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet). // Preamplifier for bi-directional flow measurement shall provide a directional contact closure from a relay mounted in the preamplifier //.



- e. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).
  - f. Ambient temperature effects, less than 0.005 percent calibrated span per °C (°F) temperature change.
  - g. RFI effect - flow meter shall not be affected by RFI.
  - h. Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.
- F. NOT USED
- G. Flow switches:
- 1. Shall be either paddle or differential pressure type.
    - a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.
    - b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.
- H. Current Switches: Current operated switches shall be self-powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

## 2.12 CONTROL CABLES

- A. General:
- 1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 27 05 26 and 26 05 26.
  - 2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
  - 3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
  - 4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
  - 5. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing.

- Minimum cable test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
- 6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.
  - B. Analogue control cabling shall be not less than No. 18 AWG solid, with thermoplastic insulated conductors as specified in Section 26 05 21.
  - C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 27 15 00.
    - 1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.
  - D. Optical digital communication fiber, if used, shall be Multimode or Singlemode fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode micron with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber and shall be as specified in Section 27 15 00. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

### **2.13 THERMOSTATS**

- A. Room thermostats controlling unitary standalone heating and cooling devices not connected to the DDC system shall have three modes of operation (heating - null or dead band - cooling). Thermostats for patient bedrooms shall have capability of being adjusted to eliminate null or dead band. Wall mounted thermostats shall have manufacturer's recommendation finish, setpoint range and temperature display and external adjustment:
  - 1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.

- a. Public Space Thermostat: Public space thermostat shall have a thermistor sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
  - b. NOT USED
  - c. NOT USED
  - d. Battery replacement without program loss.
- B. Strap-on thermostats shall be enclosed in a dirt-and-moisture proof housing with fixed temperature switching point and single pole, double throw switch.
  - C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element. Freezestats shall be manually-reset.
  - D. NOT USED.

#### **2.14 FINAL CONTROL ELEMENTS AND OPERATORS**

- A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.
- B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.
- C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.
  - 1. Leakage: maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/sq. ft.) at 50 mm (2 inches) differential pressure for other dampers.
  - 2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
  - 3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
  - 4. Bearing shall be nylon, bronze sleeve or ball type.

5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.
6. Maximum air velocity and pressure drop through free area the dampers:
  - a. Smoke damper in air handling unit: 305 meter per minute (1000 fpm).
  - b. Duct mounted damper: 600 meter per minute (2000 fpm).
  - c. Maximum static pressure loss: 50 Pascal (0.20 inches water gage).
- D. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and operators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.
- E. Control Valves:
  1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
  2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
  3. Valves 60 mm (2 1/2 inches) and larger shall be bronze or iron body with flanged connections.
  4. Brass or bronze seats except for valves controlling media above 100 degrees C (210 degrees F), which shall have stainless steel seats.
  5. Flow characteristics:
    - a. Three way modulating valves shall be globe pattern. Position versus flow relation shall be linear relation for steam or equal percentage for water flow control.
    - b. Two-way modulating valves shall be globe pattern. Position versus flow relation shall be linear for steam and equal percentage for water flow control.
    - c. Two-way 2-position valves shall be ball, gate or butterfly type.
  6. Maximum pressure drop:
    - a. Two position steam control: 20 percent of inlet gauge pressure.
    - b. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
    - c. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
  7. Two position water valves shall be line size.
- F. Damper and Valve Operators and Relays:

1. NOT USED
2. Electric operator shall provide full modulating control of dampers and valves. A linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct or externally in the duct or externally on the duct wall, or shall be furnished with a direct-coupled design. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
  - a. Minimum valve close-off pressure shall be equal to the system pump's dead-head pressure, minimum 50 psig for valves smaller than 4 inches.
3. Electronic damper operators: Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.
  - a. VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The motor shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.
4. See drawings for required control operation.

#### **2.15 AIR FLOW CONTROL**

- A. Airflow and static pressure shall be controlled via digital controllers with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be analog or pulse width modulating output signals. The controllers shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.
- B. NOT USED

C. Air Flow Measuring Station -- Electronic Thermal Type:

1. Air Flow Sensor Probe:

- a. Each air flow sensor shall contain two individual thermal sensing elements. One element shall determine the velocity of the air stream while the other element shall compensate for changes in temperature. Each thermal flow sensor and its associated control circuit and signal conditioning circuit shall be factory calibrated and be interchangeable to allow replacement of a sensor without recalibration of the entire flow station. The sensor in the array shall be located at the center of equal area segment of the duct and the number of sensors shall be adequate to accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.
- b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:

- a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a duct. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.
- b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.
- c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015" W.G.) at 1,000 meter per minute (3,000 FPM).

3. Electronics Panel:

- a. Electronics Panel shall consist of a surface mounted enclosure complete with solid-state microprocessor and software.

- b. Electronics Panel shall be A/C powered 24 VAC and shall have the capability to transmit signals of 0-5 VDC, 0-10 VCD or 4-20 ma for use in control of the HVAC Systems. The electronic panel shall have the capability to accept user defined scaling parameters for all output signals.
  - c. Electronics Panel shall have the capability to digitally display airflow in CFM and temperature in degrees F . The displays shall be provided as an integral part of the electronics panel. The electronic panel shall have the capability to totalize the output flow in CFM for two or more systems, as required. A single output signal may be provided which will equal the sum of the systems totalized. Output signals shall be provided for temperature and airflow. Provide remote mounted air flow or temperature displays where indicated on the plans.
  - d. Electronics Panel shall have the following:
    - 1) Minimum of 12-bit A/D conversion.
    - 2) Field adjustable digital primary output offset and gain.
    - 3) Airflow analog output scaling of 100 to 10,000 FPM.
    - 4) Temperature analog output scaling from -45°C to 70°C (-50°F to 160°F).
    - 5) Analog output resolution (full scale output) of 0.025%.
  - e. All readings shall be in I.P. units.
4. Thermal flow sensors and its electronics shall be installed as per manufacturer's instructions. The probe sensor density shall be as follows:

Probe Sensor Density	
Area (sq.ft.)	Qty. Sensors
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

- a. Complete installation shall not exhibit more than  $\pm 2.0\%$  error in airflow measurement output for variations in the angle of flow of up to 10 percent in any direction from its calibrated orientation. Repeatability of readings shall be within  $\pm 0.25\%$ .

- D. Static Pressure Measuring Station: shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the true input pressure:
1. Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional, and only multiple static pressure sensors positioned on an equal area basis connected to a network of headers are required.
  2. For systems with multiple major trunk supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected and this shall be the input signal to the controller.
  3. The controller shall receive the static pressure transmitter signal and CU shall provide a control output signal to the supply fan capacity control device. The control mode shall be proportional plus integral (PI) (automatic reset) and where required shall also include derivative mode.
  4. In systems with multiple static pressure transmitters, provide a switch located near the fan discharge to prevent excessive pressure during abnormal operating conditions. High-limit switches shall be manually-reset.
- E. Constant Volume Control Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its air flow signal and static pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.
- F. Airflow Synchronization:
1. Systems shall consist of an air flow measuring station for each supply and return duct, the CU and such relays, as required to



- provide a complete functional system that will maintain a constant flow rate difference between supply and return air to an accuracy of  $\pm 10\%$ . In systems where there is no suitable location for a flow measuring station that will sense total supply or return flow, provide multiple flow stations with a differential pressure transmitter for each station. Signals from the multiple transmitters shall be added through the CU such that the resultant signal is a true representation of total flow.
2. The total flow signals from supply and return air shall be the input signals to the CU. This CU shall track the return air fan capacity in proportion to the supply air flow under all conditions.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

##### **A. General:**

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to COTR for resolution before proceeding for installation.
2. Install equipment, piping, wiring /conduit parallel to or at right angles to building lines.
3. Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.
4. Mount control devices, tubing and conduit located on ducts and apparatus with external insulation on standoff support to avoid interference with insulation.
5. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
6. Run tubing and wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing.
7. Install equipment level and plum.

##### **A. Electrical Wiring Installation:**

1. All wiring cabling shall be installed in conduits. Install conduits and wiring in accordance with Specification Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Conduits carrying control wiring and cabling shall be dedicated to the control wiring and cabling: these conduits shall not carry power wiring. Provide

- plastic end sleeves at all conduit terminations to protect wiring from burrs.
2. Install analog signal and communication cables in conduit and in accordance with Specification Section 26 05 21. Install digital communication cables in conduit and in accordance with Specification Section 27 15 00, Communications Horizontal Cabling.
  3. Install conduit and wiring between operator workstation(s), digital controllers, electrical panels, indicating devices, instrumentation, miscellaneous alarm points, thermostats, and relays as shown on the drawings or as required under this section.
  4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
  5. Install all system components in accordance with local Building Code and National Electric Code.
    - a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
    - b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
    - c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
    - d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
  6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
  7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.

8. Grounding: ground electrical systems per manufacturer's written requirements for proper and safe operation.

C. Install Sensors and Controls:

1. Temperature Sensors:

- a. Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.
- b. Calibrate sensors to accuracy specified, if not factory calibrated.
- c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
- d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor.
- e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors from contact with metal casings and coils using insulated standoffs.
- f. Sensors used in mixing plenum, and hot and cold decks shall be of the averaging of type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- g. All pipe mounted temperature sensors shall be installed in wells.
- h. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.
- i. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

2. Pressure Sensors:

- a. Install duct static pressure sensor tips facing directly downstream of airflow.
- b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
- c. Install snubbers and isolation valves on steam pressure sensing devices.

### 3. Actuators:

- a. Mount and link damper and valve actuators according to manufacturer's written instructions.
- b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.
- c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.

### 4. Flow Switches:

- a. Install flow switch according to manufacturer's written instructions.
- b. Mount flow switch a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
- c. Assure correct flow direction and alignment.
- d. Mount in horizontal piping-flow switch on top of the pipe.

## D. Installation of network:

### 1. Ethernet:

- a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
- b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.

- 2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

## E. Installation of digital controllers and programming:

- 1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.

2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

### **3.2 SYSTEM VALIDATION AND DEMONSTRATION**

- A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of the controls and instrumentation system.
- B. Validation
  1. Prepare and submit for approval a validation test plan including test procedures for the performance verification tests. Test Plan shall address all specified functions of the ECC and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a test check list to be used by the Installer's agent to check and initial that each test has been successfully completed. Deliver test plan documentation for the performance verification tests to the owner's representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
  2. After approval of the validation test plan, installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.
- C. Demonstration

1. System operation and calibration to be demonstrated by the installer in the presence of the Architect or VA's representative on random samples of equipment as dictated by the Architect or VA's representative. Should random sampling indicate improper commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. NOT USED
5. Witnessed demonstration of ECC functions shall consist of:
  - a. Running each specified report.
  - b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
  - c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
  - d. Execute digital and analog commands in graphic mode.
  - e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
  - f. Demonstrate EMS performance via trend logs and command trace.
  - g. Demonstrate scan, update, and alarm responsiveness.
  - h. Demonstrate spreadsheet/curve plot software, and its integration with database.
  - i. Demonstrate on-line user guide, and help function and mail facility.
  - j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
  - k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
  - l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

----- END -----

**SECTION 23 21 13  
HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Water piping to connect HVAC equipment, including the following:
  - 1. Chilled water, heating hot water and drain piping.
  - 2. NOT USED
  - 3. NOT USED

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- C. Section 31 20 00, EARTH MOVING: Excavation and backfill.
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Section 07 12 00, BUILT-UP BITUMINOUS WATERPROOFING, and Section 07 13 52, MODIFIED BITUMINOUS SHEET WATERPROOFING.
- F. NOT USED.
- G. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for piping.
- H. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- I. NOT USED
- J. Section 23 07 11, HVAC INSULATION: Piping insulation.
- K. NOT USED
- L. Section 23 23 00, REFRIGERANT PIPING: Refrigerant piping and refrigerants.
- M. NOT USED
- N. NOT USED
- O. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

**1.3 QUALITY ASSURANCE**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.

C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be the same manufacturer as the grooved components.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

#### **1.4 SUBMITTALS**

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers .
2. Pipe and tubing, with specification, class or type, and schedule.
3. Pipe fittings, including miscellaneous adapters and special fittings.
4. Flanges, gaskets and bolting.
5. Grooved joint couplings and fittings.
6. Valves of all types.
7. Strainers.
8. Flexible connectors for water service.
9. Pipe alignment guides.
10. Expansion joints.
11. Expansion compensators.
12. All specified hydronic system components.
13. Water flow measuring devices.
14. Gages.
15. Thermometers and test wells.
16. Electric heat tracing systems.
17. Seismic bracing details for piping.

C. NOT USED

D. Submit the welder's qualifications in the form of a current (less than one year old) and formal certificate.

E. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

F. As-Built Piping Diagrams: Provide drawing as follows for chilled water, condenser water, and heating hot water system and other piping systems and equipment.



1. One wall-mounted stick file with complete set of prints. Mount stick file in the chiller plant or control room along with control diagram stick file.
2. One complete set of reproducible drawings.
3. One complete set of drawings in electronic Autocad and pdf format.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.
- B. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):
  - B1.20.1-83(R2006).....Pipe Threads, General Purpose (Inch)
  - B16.4-06.....Gray Iron Threaded FittingsB16.18-01       Cast  
Copper Alloy Solder joint Pressure fittings
  - B16.23-02.....Cast Copper Alloy Solder joint Drainage  
fittings
  - B40.100-05.....Pressure Gauges and Gauge Attachments
- C. American National Standards Institute, Inc./Fluid Controls Institute (ANSI/FCI):
  - 70-2-2006.....Control Valve Seat Leakage
- D. American Society of Mechanical Engineers (ASME):
  - B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
  - B16.3-2006.....Malleable Iron Threaded Fittings: Class 150 and  
300
  - B16.4-2006.....Gray Iron Threaded Fittings: (Class 125 and  
250)
  - B16.5-2003.....Pipe Flanges and Flanged Fittings: NPS ½  
through NPS 24 Metric/Inch Standard
  - B16.9-07.....Factory Made Wrought Butt Welding Fittings
  - B16.11-05.....Forged Fittings, Socket Welding and Threaded
  - B16.18-01.....Cast Copper Alloy Solder Joint Pressure  
Fittings
  - B16.22-01.....Wrought Copper and Bronze Solder Joint Pressure  
Fittings.
  - B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings
  - B16.39-06.....Malleable Iron Threaded Pipe Unions
  - B16.42-06.....Ductile Iron Pipe Flanges and Flanged Fittings

B31.1-08.....Power Piping

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

A47/A47M-99 (2004).....Ferritic Malleable Iron Castings

A53/A53M-07.....Standard Specification for Pipe, Steel, Black  
and Hot-Dipped, Zinc-Coated, Welded and  
Seamless

A106/A106M-08.....Standard Specification for Seamless Carbon  
Steel Pipe for High-Temperature Service

A126-04.....Standard Specification for Gray Iron Castings  
for Valves, Flanges, and Pipe Fittings

A183-03 ..... Standard Specification for Carbon Steel Track  
Bolts and Nuts

A216/A216M-08 ..... Standard Specification for Steel Castings,  
Carbon, Suitable for Fusion Welding, for High  
Temperature Service

A234/A234M-07 ..... Piping Fittings of Wrought Carbon Steel and  
Alloy Steel for Moderate and High Temperature  
Service

A307-07 ..... Standard Specification for Carbon Steel Bolts  
and Studs, 60,000 PSI Tensile Strength

A536-84 (2004) ..... Standard Specification for Ductile Iron Castings

A615/A615M-08 ..... Deformed and Plain Carbon Steel Bars for  
Concrete Reinforcement

A653/A 653M-08 ..... Steel Sheet, Zinc-Coated (Galvanized) or Zinc-  
Iron Alloy Coated (Galvannealed) By the Hot-Dip  
Process

B32-08 ..... Standard Specification for Solder Metal

B62-02 ..... Standard Specification for Composition Bronze or  
Ounce Metal Castings

B88-03 ..... Standard Specification for Seamless Copper Water  
Tube

B209-07 ..... Aluminum and Aluminum Alloy Sheet and Plate

C177-04 ..... Standard Test Method for Steady State Heat Flux  
Measurements and Thermal Transmission Properties  
by Means of the Guarded Hot Plate Apparatus

C478-09 ..... Precast Reinforced Concrete Manhole Sections

C533-07 ..... Calcium Silicate Block and Pipe Thermal  
Insulation

- C552-07 ..... Cellular Glass Thermal Insulation
- D3350-08 ..... Polyethylene Plastics Pipe and Fittings  
Materials
- C591-08 ..... Unfaced Preformed Rigid Cellular  
Polyisocyanurate Thermal Insulation
- D1784-08 ..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and  
Chlorinated Poly (Vinyl Chloride) (CPVC)  
Compound
- D1785-06 ..... Poly (Vinyl Chloride) (PVC) Plastic Pipe,  
Schedules 40, 80 and 120
- D2241-05 ..... Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe  
(SDR Series)
- F439-06 ..... Standard Specification for Chlorinated Poly  
(Vinyl Chloride) (CPVC) Plastic Pipe Fittings,  
Schedule 80
- F441/F441M-02 ..... Standard Specification for Chlorinated Poly  
(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules  
40 and 80
- F477-08 ..... Elastomeric Seals Gaskets) for Joining Plastic  
Pipe
- F. American Water Works Association (AWWA):
- C110-08.....Ductile Iron and Grey Iron Fittings for Water
- C203-02.....Coal Tar Protective Coatings and Linings for  
Steel Water Pipe Lines Enamel and Tape Hot  
Applied
- G. American Welding Society (AWS):
- B2.1-02.....Standard Welding Procedure Specification
- H. Copper Development Association, Inc. (CDA):
- CDA A4015-06.....Copper Tube Handbook
- I. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003.....Expansion Joint Manufacturer's Association  
Standards, Ninth Edition
- J. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
Industry, Inc.:
- SP-67-02a.....Butterfly Valves
- SP-70-06.....Gray Iron Gate Valves, Flanged and Threaded  
Ends

SP-71-05.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends

SP-80-08.....Bronze Gate, Globe, Angle and Check Valves

SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and  
Threaded Ends

SP-110-96.....Ball Valves Threaded, Socket-Welding, Solder  
Joint, Grooved and Flared Ends

SP-125-00.....Gray Iron and Ductile Iron In-line, Spring  
Loaded, Center-Guided Check Valves

K. National Sanitation Foundation/American National Standards Institute,  
Inc. (NSF/ANSI):

14-06.....Plastic Piping System Components and Related  
Materials

50-2009a.....Equipment for Swimming Pools, Spas, Hot Tubs  
and other Recreational Water Facilities -  
Evaluation criteria for materials, components,  
products, equipment and systems for use at  
recreational water facilities

61-2008.....Drinking Water System Components - Health  
Effects

L. Tubular Exchanger Manufacturers Association: TEMA 9th Edition, 2007

## **1.6 SPARE PARTS**

A. For mechanical pressed sealed fittings provide tools required for each  
pipe size used at the facility.

## **PART 2 - PRODUCTS**

### **2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES**

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR  
HVAC.

### **2.2 PIPE AND TUBING**

A. Chilled Water, Heating Hot Water, and Vent Piping:

1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
2. Copper water tube option: ASTM B88, Type K or L, hard drawn.

B. NOT USED

C. Cooling Coil Condensate Drain Piping:

1. From air handling units: Copper water tube, ASTM B88, Type M, or  
schedule 40 PVC plastic piping.
2. From fan coil or other terminal units: Copper water tube, ASTM B88,  
Type L for runouts and Type M for mains.

D. NOT USED.

E. Pipe supports, including insulation shields, for above ground piping:  
Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

### 2.3 FITTINGS FOR STEEL PIPE

- A. 50 mm (2 inches) and Smaller: Screwed or welded joints.
  - 1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
  - 2. Forged steel, socket welding or threaded: ASME B16.11.
  - 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
  - 4. Unions: ASME B16.39.
  - 5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4 inch) garden hose thread, with hose cap nut.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Contractor's option: Grooved mechanical couplings and fittings are optional.
  - 1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  - 2. Welding flanges and bolting: ASME B16.5:
    - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
      - 1) Contractor's option: Convolute, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Grooved Mechanical Pipe Couplings and Fittings (Contractor's Option): Grooved Mechanical Pipe Couplings and Fittings may be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections. All joints must be rigid type.
  - 1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held

- together by two or more track-head, square, or oval-neck bolts, ASTM A449 and A183.
2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
  3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

#### **2.4 FITTINGS FOR COPPER TUBING**

##### **A. Joints:**

1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

##### **B. Bronze Flanges and Flanged Fittings: ASME B16.24.**

##### **C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.**

#### **2.5 FITTINGS FOR PLASTIC PIPING**

- A. Schedule 40, socket type for solvent welding.
- B. Schedule 40 PVC drain piping: Drainage pattern.
- C. Chemical feed piping for condenser water treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F439.

#### **2.6 DIELECTRIC FITTINGS**

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 99 degrees C (210 degrees F).
- E. Contractor's option: On pipe sizes 2" and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

## 2.7 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

## 2.8 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Shut-Off Valves
  - 1. Ball Valves (Pipe sizes 2" and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
  - 2. Butterfly Valves (Pipe Sizes 2-1/2" and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS-SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Not permitted for direct buried pipe applications.
    - a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
    - b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
    - c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.

- 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
- 2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
- 3) 3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):
  - a) 50 mm (2 inches) and smaller: MSS-SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
  - b) 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

#### E. Globe and Angle Valves

##### 1. Globe Valves

- a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.
- b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves.

##### 2. Angle Valves:

- a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
- b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for angle.

#### F. Check Valves

##### 1. Swing Check Valves:

- a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
- b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-71 for check valves.

2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.



- a. Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
  - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- G. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
  - 1. Ball style valve.
  - 2. A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
  - 3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
  - 1. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
  - 2. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
  - 3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
  - 4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
- I. Manual Radiator/Convactor Valves: Brass, packless, with position indicator.

## 2.9 WATER FLOW MEASURING DEVICES

- A. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
- B. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.

- C. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.
- D. Self-Averaging Annular Sensor Type: Brass or stainless steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable so all sensing ports may be pointed down-stream when unit is not in use.
- E. Insertion Turbine Type Sensor: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- F. Flow Measuring Device Identification:
  - 1. Metal tag attached by chain to the device.
  - 2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate in l/m (gpm).
- G. Portable Water Flow Indicating Meters:
  - 1. Minimum 150 mm (6 inch) diameter dial, forged brass body, beryllium-copper bellows, designed for 1205 kPa (175 psig) working pressure at 121 degrees C (250 degrees F).
  - 2. Bleed and equalizing valves.
  - 3. Vent and drain hose and two 3000 mm (10 feet) lengths of hose with quick disconnect connections.
  - 4. Factory fabricated carrying case with hose compartment and a bound set of capacity curves showing flow rate versus pressure differential.
  - 5. Provide one portable meter for each range of differential pressure required for the installed flow devices.
- H. Permanently Mounted Water Flow Indicating Meters: Minimum 150 mm (6 inch) diameter, or 450 mm (18 inch) long scale, for 120 percent of design flow rate, direct reading in lps (gpm), with three valve manifold and two shut-off valves.

## **2.10 STRAINERS**

- A. Y Type.
  - 1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.
- B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

**2.11 FLEXIBLE CONNECTORS FOR WATER SERVICE****A. Flanged Spool Connector:**

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
  - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
  - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

**B. Mechanical Pipe Couplings:**

See other fittings specified under Part 2, PRODUCTS.

**2.12 EXPANSION JOINTS**

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- C. Bellows - Internally Pressurized Type:
  1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
  2. Internal stainless steel sleeve entire length of bellows.
  3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
  4. Welded ends.
  5. Design shall conform to standards of EJMA and ASME B31.1.
  6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
  7. Integral external cover.
- D. Bellows - Externally Pressurized Type:
  1. Multiple corrugations of Type 304 stainless steel.
  2. Internal and external guide integral with joint.

3. Design for external pressurization of bellows to eliminate squirm.
  4. Welded ends.
  5. Conform to the standards of EJMA and ASME B31.1.
  6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
  7. Integral external cover and internal sleeve.
- E. Expansion Compensators:
1. Corrugated bellows, externally pressurized, stainless steel or bronze.
  2. Internal guides and anti-torque devices.
  3. Threaded ends.
  4. External shroud.
  5. Conform to standards of EJMA.
- F. Expansion Joint (Contractor's Option): 2415 kPa (350 psig) maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with grooved ends, suitable for axial end movement to 75 mm (3 inch).
- G. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
- I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

## 2.13 HYDRONIC SYSTEM COMPONENTS

- A. NOT USED.
- B. NOT USED
- C. NOT USED
- D. NOT USED
- E. NOT USED

F. NOT USED

G. NOT USED

H. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F).

I. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.

J. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

#### **2.14 WATER FILTERS AND POT CHEMICAL FEEDERS**

See section 23 25 00, HVAC WATER TREATMENT, Article 2.2, CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS.

#### **2.15 GAGES, PRESSURE AND COMPOUND**

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.
  - 1. For condenser water suction (compound): Minus 100 kPa (30 inches Hg) to plus 700 kPa (100 psig).

#### **2.16 PRESSURE/TEMPERATURE TEST PROVISIONS**

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

B. Provide one each of the following test items to the COTR:

1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, -- 100 kPa (30 inches) Hg to 700 kPa (100 psig) range.
3. 0 - 104 degrees C (220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

#### **2.17 THERMOMETERS**

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges:
  1. Chilled Water and Glycol-Water: 0-38 degrees C (32-100 degrees F).
  2. Hot Water and Glycol-Water: -1 - 116 degrees C (30-240 degrees F).

#### **2.18 FIRESTOPPING MATERIAL**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

#### **2.19 NOT USED**

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - 1. NOT USED
  - 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC INSULATION.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

### **3.2 PIPE JOINTS**

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.
- D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- E. Solvent Welded Joints: As recommended by the manufacturer.

### **3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)**

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.



### 3.4 SEISMIC BRACING ABOVEGROUND PIPING

Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

### 3.5 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR. Tests may be either of those below, or a combination, as approved by the COTR.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

### 3.6 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
  - 1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the COTR.
  - 2. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe

joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.

3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

### **3.7 WATER TREATMENT**

- A. Install water treatment equipment and provide water treatment system piping.
- B. Close and fill system as soon as possible after final flushing to minimize corrosion.
- C. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- D. Utilize this activity, by arrangement with the COTR, for instructing VA operating personnel.

### **3.8 NOT USED**

### **3.9 OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -

**SECTION 23 22 13**  
**STEAM AND CONDENSATE HEATING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Steam, condensate and vent piping inside buildings.

**1.2 RELATED WORK**

- A. Excavation and backfill: Section 31 20 00, EARTH MOVING.
- B. NOT USED.
- C. Seismic restraints for piping: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- D. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. NOT USED
- F. Piping insulation: Section 23 07 11, HVAC INSULATION.
- G. NOT USED.
- H. NOT USED
- I. Heating Coils: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS and SECTION 23 31 00, HVAC DUCTS AND CASING.
- J. NOT USED
- K. Heating coils: Section 23 82 16, AIR COILS.
- L. Temperature and pressure sensors and valve operators: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Pipe and equipment supports. Submit calculations for variable spring and constant support hangers.
  - 2. Pipe and tubing, with specification, class or type, and schedule.
  - 3. Pipe fittings, including miscellaneous adapters and special fittings.
  - 4. Flanges, gaskets and bolting.
  - 5. Valves of all types.
  - 6. Strainers.
  - 7. Pipe alignment guides.
  - 8. Expansion joints.
  - 9. Expansion compensators.

10. Flexible ball joints: Catalog sheets, performance charts, schematic drawings, specifications and installation instructions.
11. All specified steam system components.
12. Gages.
13. Thermometers and test wells.
14. Electric heat tracing systems.
15. Seismic bracing details for piping.

C. NOT USED

- D. Coordination Drawings: Refer to Article, SUBMITTALS of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. As-Built Piping Diagrams: Provide drawing as follows for steam and steam condensate piping and other central plant equipment.
1. One wall-mounted stick file for prints. Mount stick file in the chiller plant or adjacent control room along with control diagram stick file.
  2. One set of reproducible drawings.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI):
- B1.20.1-83(R2006).....Pipe Threads, General Purpose (Inch)
  - B16.4-2006.....Gray Iron Threaded Fittings
- C. American Society of Mechanical Engineers (ASME):
- B16.1-2005.....Gray Iron Pipe Flanges and Flanged Fittings
  - B16.3-2006.....Malleable Iron Threaded Fittings
  - B16.9-2007.....Factory-Made Wrought Buttwelding Fittings
  - B16.11-2005.....Forged Fittings, Socket-Welding and Threaded
  - B16.14-91.....Ferrous Pipe Plugs, Bushings, and Locknuts with  
Pipe Threads
  - B16.22-2001.....Wrought Copper and Copper Alloy Solder-Joint  
Pressure Fittings
  - B16.23-2002.....Cast Copper Alloy Solder Joint Drainage Fittings
  - B16.24-2006.....Cast Copper Alloy Pipe Flanges and Flanged  
Fittings, Class 150, 300, 400, 600, 900, 1500  
and 2500
  - B16.39-98.....Malleable Iron Threaded Pipe Unions, Classes  
150, 250, and 300
  - B31.1-2007.....Power Piping
  - B31.9-2008.....Building Services Piping

B40.100-2005.....Pressure Gauges and Gauge Attachments  
 Boiler and Pressure Vessel Code: SEC VIII D1-2001, Pressure Vessels,  
 Division 1

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

A47-99.....Ferritic Malleable Iron Castings  
 A53-2007.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,  
 Welded and Seamless  
 A106-2008.....Seamless Carbon Steel Pipe for High-Temperature  
 Service  
 A126-2004.....Standard Specification for Gray Iron Castings  
 for Valves, Flanges, and Pipe Fittings  
 A181-2006.....Carbon Steel Forgings, for General-Purpose  
 Piping  
 A183-2003 ..... Carbon Steel Track Bolts and Nuts  
 A216-2008 ..... Standard Specification for Steel Castings,  
 Carbon, Suitable for Fusion Welding, for High  
 Temperature Service  
 A285-01 ..... Pressure Vessel Plates, Carbon Steel, Low-and-  
 Intermediate-Tensile Strength  
 A307-2007 ..... Carbon Steel Bolts and Studs, 60,000 PSI Tensile  
 Strength  
 A516-2006 ..... Pressure Vessel Plates, Carbon Steel, for  
 Moderate-and- Lower Temperature Service  
 A536-84(2004)e1 ..... Standard Specification for Ductile Iron Castings  
 B32-2008 ..... Solder Metal  
 B61-2008 ..... Steam or Valve Bronze Castings  
 B62-2009 ..... Composition Bronze or Ounce Metal Castings  
 B88-2003 ..... Seamless Copper Water Tube  
 F439-06 ..... Socket-Type Chlorinated Poly (Vinyl Chloride)  
 (CPVC) Plastic Pipe Fittings, Schedule 80  
 F441-02(2008) ..... Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic  
 Pipe, Schedules 40 and 80

E. American Welding Society (AWS):

A5.8-2004.....Filler Metals for Brazing and Braze Welding  
 B2.1-00.....Welding Procedure and Performance Qualifications

F. Manufacturers Standardization Society (MSS) of the Valve and Fitting  
 Industry, Inc.:

SP-67-95.....Butterfly Valves

SP-70-98.....Cast Iron Gate Valves, Flanged and Threaded Ends

SP-71-97.....Gray Iron Swing Check Valves, Flanged and  
Threaded Ends

SP-72-99.....Ball Valves with Flanged or Butt-Welding Ends  
for General Service

SP-78-98.....Cast Iron Plug Valves, Flanged and Threaded Ends

SP-80-97.....Bronze Gate, Globe, Angle and Check Valves

SP-85-94.....Cast Iron Globe and Angle Valves, Flanged and  
Threaded Ends

G. Military Specifications (Mil. Spec.):

MIL-S-901D-1989.....Shock Tests, H.I. (High Impact) Shipboard  
Machinery, Equipment, and Systems

H. National Board of Boiler and Pressure Vessel Inspectors (NB): Relieving Capacities of Safety Valves and Relief Valves

I. Tubular Exchanger Manufacturers Association: TEMA 18th Edition, 2000

## PART 2 - PRODUCTS

## 2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

## 2.2 PIPE AND TUBING

A. Steam Piping: Steel, ASTM A53, Grade B, seamless or ERW; A106 Grade B, Seamless; Schedule 40.

### B. Steam Condensate and Pumped Condensate Piping:

1. Concealed above ceiling, in wall or chase: Copper water tube ASTM B88, Type K, hard drawn.

2. All other locations: Copper water tube ASTM B88, Type K, hard drawn; or steel, ASTM A53, Grade B, Seamless or ERW, or A106 Grade B Seamless, Schedule 80.

C. Vent Piping: Steel, ASTM A53, Grade B, seamless or ERW; A106 Grade B, Seamless; Schedule 40, galvanized.

### 2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded.

1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.

2. Forged steel, socket welding or threaded: ASME B16.11.

3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron, except for steam and steam condensate piping. Provide 300 pound malleable iron, ASME B16.3 for steam and steam condensate piping. Cast iron fittings or piping is not acceptable for steam and steam condensate piping.

Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.

4. Unions: ASME B16.39.
5. Steam line drip station and strainer quick-couple blowdown hose connection: Straight through, plug and socket, screw or cam locking type for 15 mm (1/2 inch) ID hose. No integral shut-off is required.
- B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints.
  1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  2. Welding flanges and bolting: ASME B16.5:
    - a. Steam service: Weld neck or slip-on, raised face, with non-asbestos gasket. Non-asbestos gasket shall either be stainless steel spiral wound strip with flexible graphite filler or compressed inorganic fiber with nitrile binder rated for saturated and superheated steam service 750 degrees F and 1500 psi.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.

#### **2.4 FITTINGS FOR COPPER TUBING**

- A. Solder Joint:
  1. Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

#### **2.5 DIELECTRIC FITTINGS**

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 121 degrees C (250 degrees F) for steam condensate and as required for steam service.
- E. NOT USED.

#### **2.6 SCREWED JOINTS**

- A. Pipe Thread: ANSI B1.20.

- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

## 2.7 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2100 mm (7 feet) or more above the floor or operating platform.
- D. Shut-Off Valves
  - 1. Gate Valves:
    - a. 50 mm (2 inches) and smaller: MSS-SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
    - b. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke.
      - 1) High pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel solid disc and seats. Provide 25 mm (1 inch) factory installed bypass with globe valve on valves 100 mm (4 inches) and larger.
      - 2) All other services: MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- E. Globe and Angle Valves:
  - 1. Globe Valves:
    - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.
    - b. 65 mm (2 1/2 inches) and larger:
      - 1) Globe valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
      - 2) All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves.
  - 2. Angle Valves
    - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
    - b. 65 mm (2 1/2 inches) and larger:
      - 1) Angle valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system): Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260 degrees C (500



degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.

- 2) All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for angle valves.

#### F. Swing Check Valves

1. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 psig), 45 degree swing disc.
2. 65 mm (2-1/2 inches) and Larger:
  - a Check valves for high pressure steam 413 kPa (60 psig) and above nominal MPS system: Cast steel body, ASTM A216 grade WCB, flanged, OS&Y, 1034 kPa (150 psig) at 260 degrees C (500 degrees F), 11-1/2 to 13 percent chrome stainless steel disc and renewable seat rings.
  - b. All other services: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-71 for check valves.

#### G. NOT USED.

### 2.8 STRAINERS

- A. Basket or Y Type. Tee type is acceptable for gravity flow and pumped steam condensate service.
- B. High Pressure Steam: Rated 1034 kPa (150 psig) saturated steam.
  1. 50 mm (2 inches) and smaller: Iron, ASTM A116 Grade B, or bronze, ASTM B-62 body with screwed connections (250 psig).
  2. 65 mm (2-1/2 inches) and larger: Flanged cast steel or 1723 kPa (250 psig) cast iron.
- C. All Other Services: Rated 861 kPa (125 psig) saturated steam.
  1. 50 mm (2 inches) and smaller: Cast iron or bronze.
  2. 65 mm (2-1/2 inches) and larger: Flanged, iron body.
- D. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows:
  1. 75 mm (3 inches) and smaller: 20 mesh for steam and 1.1 mm (0.045 inch) diameter perforations for liquids.
  2. 100 mm (4 inches) and larger: 1.1 mm (0.045) inch diameter perforations for steam and 3.2 mm (0.125 inch) diameter perforations for liquids.

### 2.9 PIPE ALIGNMENT

- A. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.

## 2.10 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Minimum Service Requirements:
  - 1. Pressure Containment:
    - a. Steam Service 35-200 kPa (5-30 psig): Rated 345 kPa (50 psig) at 148 degrees C (298 degrees F).
    - b. Steam Service 214-850 kPa (31-125 psig): Rated 1025 kPa (150 psig) at 186 degrees C (366 degrees F).
    - c. Steam Service 869-1025 kPa (126-150 psig): Rated 1375 kPa (200 psig) at 194 degrees C (382 degrees F).
    - d. Condensate Service: Rated 690 kPa (100 psig) at 154 degrees C (310 degrees F).
  - 2. Number of Full Reverse Cycles without failure: Minimum 1000.
  - 3. Movement: As shown on drawings plus recommended safety factor of manufacturer.
- C. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- D. Bellows - Internally Pressurized Type:
  - 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
  - 2. Internal stainless steel sleeve entire length of bellows.
  - 3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
  - 4. Welded ends.
  - 5. Design shall conform to standards of EJMA and ASME B31.1.
  - 6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
  - 7. Integral external cover.
- E. Bellows - Externally Pressurized Type:
  - 1. Multiple corrugations of Type 304 stainless steel.
  - 2. Internal and external guide integral with joint.
  - 3. Design for external pressurization of bellows to eliminate squirm.
  - 4. Welded ends.
  - 5. Conform to the standards of EJMA and ASME B31.1.
  - 6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
  - 7. Integral external cover and internal sleeve.

- F. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.

## **2.11 FLEXIBLE BALL JOINTS**

- A. Design and Fabrication: One piece component construction, fabricated from steel with welded ends, designed for a working steam pressure of 1720 kPa (250 psig) and a temperature of 232 degrees C (450 degrees F). Each joint shall provide for 360 degrees rotation in addition to a minimum angular flexible movement of 30 degrees for sizes 6 mm (1/4 inch) to 150 mm (6 inch) inclusive, and 15 degrees for sizes 65 mm (2-1/2 inches) to 750 mm (30 inches). Joints through 350 mm (14 inches) shall have forged pressure retaining members; while size 400 mm (16 inches) through 760 mm (30 inches) shall be of one piece construction.
- B. Material:
1. Cast or forged steel pressure containing parts and bolting in accordance with Section II of the ASME Boiler Code or ASME B31.1. Retainer may be ductile iron ASTM A536, Grade 65-45-12, or ASME Section II SA 515, Grade 70.
  2. Gaskets: Steam pressure molded composition design for a temperature range of from minus 10 degrees C (50 degrees F) to plus 274 degrees C (525 degrees F).
- C. Certificates: Submit qualifications of ball joints in accordance with the following test data:
1. Low pressure leakage test: 41 kPa (6psig) saturated steam for 60 days.
  2. Flex cycling: 800 Flex cycles at 3445 kPa (500 psig) saturated steam.
  3. Thermal cycling: 100 saturated steam pressure cycles from atmospheric pressure to operating pressure and back to atmospheric pressure.
  4. Environmental shock tests: Forward certificate from a recognized test laboratory, that ball joints of the type submitted has passed shock testing in accordance with Mil. Spec MIL-S-901.
  5. Vibration: 170 hours on each of three mutually perpendicular axis at 25 to 125 Hz; 1.3 mm to 2.5 mm (0.05 inch to 0.1 inch) double amplitude on a single ball joint and 3 ball joint off set.

## **2.12 STEAM SYSTEM COMPONENTS**

- A. NOT USED
- B. NOT USED
- C. NOT USED

- D. Safety Valves and Accessories: Comply with ASME Boiler and Pressure Vessel Code, Section VIII. Capacities shall be certified by National Board of Boiler and Pressure Vessel Inspectors, maximum accumulation 10 percent. Provide lifting lever. Provide drip pan elbow where shown.
- E. NOT USED
- F. NOT USED
- G. Steam Trap: Each type of trap shall be the product of a single manufacturer. Provide trap sets at all low points and at 61 m (200 feet) intervals on the horizontal main lines.
1. Floats and linkages shall provide sufficient force to open trap valve over full operating pressure range available to the system. Unless otherwise indicated on the drawings, traps shall be sized for capacities indicated at minimum pressure drop as follows:
    - a. For equipment with modulating control valve: 1.7 kPa (1/4 psig), based on a condensate leg of 300 mm (12 inches) at the trap inlet and gravity flow to the receiver.
    - b. For main line drip trap sets and other trap sets at steam pressure: Up to 70 percent of design differential pressure. Condensate may be lifted to the return line.
  2. Trap bodies: Bronze, cast iron, or semi-steel, constructed to permit ease of removal and servicing working parts without disturbing connecting piping. For systems without relief valve traps shall be 5. Mechanism: Brass, stainless steel or corrosion resistant alloy. rated for the pressure upstream of the PRV supplying the system.
  3. Balanced pressure thermostatic elements: Phosphor bronze, stainless steel or monel metal.
  4. Valves and seats: Suitable hardened corrosion resistant alloy.
  6. Floats: Stainless steel.
  7. Inverted bucket traps: Provide bi-metallic thermostatic element for rapid release of non-condensables.
- H. Thermostatic Air Vent (Steam): Brass or iron body, balanced pressure bellows, stainless steel (renewable) valve and seat, rated 861 kPa (125 psig) working pressure, 20 mm (3/4 inch) screwed connections. Air vents shall be balanced pressure type that responds to steam pressure-temperature curve and vents air at any pressure.
- I. NOT USED
- J. NOT USED
- K. NOT USED

- L. Steam Hose and Accessories: Hose shall be sufficiently flexible to be placed in a 100 mm (4 feet) diameter coil.
1. Furnish and install in the mechanical room housing each PRV station a 7500 mm (25 feet) length of 13 mm (1/2 inch) ID steam hose, rated 861 kPa (125 psig) and a hose rack. In one end of the hose install a quick-couple device, suitable for steam service, to match corresponding devices in the PRV blowdown connections.
  2. Hose storage rack: Wall-mounted, steel, iron or aluminum, semi-circular shape, with capacity to store 7500 mm (25 feet) of 13 mm (1/2 inch) ID steam hose.
- M. NOT USED.
- N. NOT USED.

### 2.13 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.1, Accuracy Grade 1A, (pressure, vacuum, or compound), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass, lever handle union cock. Provide brass/bronze pressure snubber for gages in water service. Provide brass pigtail syphon for steam gages.
- C. Range of Gages: For services not listed provide range equal to at least 130 percent of normal operating range:

Low pressure steam and steam condensate to 103 kPa(15 psig)	0 to 207 kPa (30 psig).
Medium pressure steam and steam condensate nominal 413 kPa (60 psig)	0 to 689 kPa (100 psig).
High pressure steam and steam condensate nominal 620 kPa to 861 kPa (90 to 125 psig)	0 to 1378 kPa (200 psig).
Pumped condensate, steam condensate, gravity or vacuum (30" HG to 30 psig)	0 to 415 kPa (60 psig)

### 2.14 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Provide one each of the following test items to the COTR:
1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
  2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, 762 mm (30 inches) Hg to 689 kPa (100 psig) range.

3. 0 - 104 degrees C (32-220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

## **2.15 FIRESTOPPING MATERIAL**

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

## **2.16 NOT USED**

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Install convertors and other heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope steam, condensate and drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - 1. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- I. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
- J. Where copper piping is connected to steel piping, provide dielectric connections.
- K. Pipe vents to the exterior. Where a combined vent is provided, the cross sectional area of the combined vent shall be equal to sum of individual vent areas. Slope vent piping one inch in 40 feet (0.25 percent) in direction of flow. Provide a drip trap elbow on relief valve outlets if the vent rises to prevent backpressure. Terminate vent minimum 0.3 M (12 inches) above the roof or through the wall minimum 2.5 M (8 feet) above grade with down turned elbow.

### **3.2 PIPE JOINTS**

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.

### **3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)**

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding packing.

#### **3.4 STEAM TRAP PIPING**

- A. Install to permit gravity flow to the trap. Provide gravity flow (avoid lifting condensate) from the trap where modulating control valves are used. Support traps weighing over 11 kg (25 pounds) independently of connecting piping.

#### **3.5 SEISMIC BRACING**

- A. Provide in accordance with Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

#### **3.6 LEAK TESTING**

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the COTR in accordance with the specified requirements. Testing shall be performed in accordance with the specification requirements.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Avoid excessive pressure on mechanical seals and safety devices.

#### **3.7 FLUSHING AND CLEANING PIPING SYSTEMS**

- A. Steam, Condensate and Vent Piping: No flushing or chemical cleaning required. Accomplish cleaning by pulling all strainer screens and cleaning all scale/dirt legs during start-up operation.

#### **3.8 OPERATING AND PERFORMANCE TEST AND INSTRUCTION**

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -



**SECTION 23 31 00  
HVAC DUCTS AND CASINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Ductwork and accessories for HVAC including the following:
  - 1. Supply air, return air, outside air, exhaust, and relief systems.
  - 2. Exhaust duct with HEPA filters for Negative Pressure Isolation Room .
  - 3. NOT USED.
- B. Definitions:
  - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
  - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
  - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - 4. Exposed Duct: Exposed to view in a finished room, exposed to weather.

**1.2 RELATED WORK**

- A. Fire Stopping Material: Section 07 84 00, FIRESTOPPING.
- B. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS and VENTS.
- C. NOT USED.
- D. NOT USED.
- E. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- F. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- G. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- H. Duct Insulation: Section 23 07 11, HVAC INSULATION
- I. NOT USED
- J. Terminal Units: Section 23 36 00, AIR TERMINAL UNITS.
- K. NOT USED
- L. Supply Air Fans: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- M. Return Air and Exhaust Air Fans: Section 23 34 00, HVAC FANS.
- N. Air Filters and Filters' Efficiencies: Section 23 40 00, HVAC AIR CLEANING DEVICES.

- O. Duct Mounted Instrumentation: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- P. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.
- Q. Smoke Detectors: Section 28 31 00, FIRE DETECTION and ALARM.

### **1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Rectangular ducts:
    - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
    - b. Duct liner.
    - c. Sealants and gaskets.
    - d. Access doors.
  - 2. Round and flat oval duct construction details:
    - a. Manufacturer's details for duct fittings.
    - b. Duct liner.
    - c. Sealants and gaskets.
    - d. Access sections.
    - e. Installation instructions.
  - 3. Volume dampers, back draft dampers.
  - 4. Upper hanger attachments.
  - 5. Fire dampers, fire doors, and smoke dampers with installation instructions.
  - 6. Sound attenuators, including pressure drop and acoustic performance.

- 7. Flexible ducts and clamps, with manufacturer's installation instructions.
- 8. Flexible connections.
- 9. Instrument test fittings.
- 10 Details and design analysis of alternate or optional duct systems.
- 11 COMMON WORK RESULTS FOR HVAC.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11  
- Common Work Results for HVAC.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):  
ASCE7-05.....Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials (ASTM):  
A167-99(2009).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip  
A653-09.....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process  
A1011-09a.....Standard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength  
B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate  
C1071-05e1.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)  
E84-09a.....Standard Test Method for Surface Burning Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):  
90A-09.....Standard for the Installation of Air Conditioning and Ventilating Systems  
96-08.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
  - 2nd Edition - 2005.....HVAC Duct Construction Standards, Metal and Flexible
  - 1st Edition - 1985.....HVAC Air Duct Leakage Test Manual
  - 6th Edition - 2003.....Fibrous Glass Duct Construction Standards
- F. Underwriters Laboratories, Inc. (UL):
  - 181-08.....Factory-Made Air Ducts and Air Connectors
  - 555-06 .....Standard for Fire Dampers
  - 555S-06 .....Standard for Smoke Dampers

## **PART 2 - PRODUCTS**

### **2.1 DUCT MATERIALS AND SEALANTS**

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
- C. NOT USED
- D. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
  - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
  - 2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
  - 3. Gaskets in Flanged Joints: Soft neoprene.
- E. Approved factory made joints may be used.

### **2.2 DUCT CONSTRUCTION AND INSTALLATION**

- A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:
- B. Duct Pressure Classification:
  - 0 to 50 mm (2 inch)

> 50 mm to 75 mm (2 inch to 3 inch)

> 75 mm to 100 mm (3 inch to 4 inch)

Show pressure classifications on the floor plans.

C. Seal Class: All ductwork shall receive Class A Seal

D. NOT USED.

E. NOT USED.

F. NOT USED

G. NOT USED

H. NOT USED

I. NOT USED

J. NOT USED

K. NOT USED

L. Duct for Negative Pressure Up to 750 Pa (3 inch W.G.): Provide for exhaust duct between HEPA filters and exhaust fan inlet.

1. Round Duct: Galvanized steel, spiral lock seam construction with standard slip joints.

2. Rectangular Duct: Galvanized steel, minimum 1.0 mm (20 gage), Pittsburgh lock seam, companion angle joints 32 mm by 3.2 mm (1-1/4 by 1/8 inch) minimum at not more than 2.4 m (8 feet) spacing. Approved pre-manufactured joints are acceptable in lieu of companion angles.

M. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.

1. Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.

3. NOT USED

4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13.

Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the COTR.

N. NOT USED

- O. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.
- P. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- Q. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.
- R. NOT USED

### **2.3 NOT USED**

### **2.4 DUCT ACCESS DOORS, PANELS AND SECTIONS**

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
  - 1. Each duct mounted coil and humidifier.
  - 2. Each fire damper (for link service), smoke damper and automatic control damper.
  - 3. Each duct mounted smoke detector.
  - 4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.
- B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
  - 1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
  - 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

### **2.5 FIRE DAMPERS**

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- C. Minimum requirements for fire dampers:

1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
2. Submit manufacturer's installation instructions conforming to UL rating test.

## **2.6 SMOKE DAMPERS**

- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch W.G.).
- B. Maximum air leakage, closed damper: 0.32 cubic meters /min/square meter (4.0 CFM per square foot) at 750 Pa (3 inch W.G.) differential pressure.
- C. Minimum requirements for dampers:
  1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
  2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
  3. Blades: Galvanized steel, parallel type preferably, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
  4. Shafts: Galvanized steel.
  5. Bearings: Nylon, bronze sleeve or ball type.
  6. Hardware: Zinc plated.
  7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

## **2.7 COMBINATION FIRE AND SMOKE DAMPERS**

Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

## **2.8 NOT USED**

## 2.9 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).
- D. Application Criteria:
  - 1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
  - 2. Maximum working velocity: 1200 m/min (4000 feet per minute).
  - 3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.
- E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

## 2.10 FLEXIBLE DUCT CONNECTIONS

Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to insure that no vibration is transmitted.



**2.11 SOUND ATTENUATING UNITS**

- A. Casing, not less than 1.0 mm (20 gage) galvanized sheet steel, or 1.3 mm (18 gage) aluminum fitted with suitable flanges to make clean airtight connections to ductwork. Sound-absorbent material faced with glass fiber cloth and covered with not less than 0,6 mm (24 gage) or heavier galvanized perforated sheet steel, or 0.85 mm (22 gage) or heavier perforated aluminum. Perforations shall not exceed 4 mm (5/32-inch) diameter, approximately 25 percent free area. Sound absorbent material shall be long glass fiber acoustic blanket meeting requirements of NFPA 90A.
- B. Entire unit shall be completely air tight and free of vibration and buckling at internal static pressures up to 2000 Pa (8 inches W.G.) at operating velocities.
- C. Pressure drop through each unit: Not to exceed indicated value at design air quantities indicated.
- D. Submit complete independent laboratory test data showing pressure drop and acoustical performance.
- E. Cap open ends of attenuators at factory with plastic, heavy duty paper, cardboard, or other appropriate material to prevent entrance of dirt, water, or any other foreign matter to inside of attenuator. Caps shall not be removed until attenuator is installed in duct system.

**2.12 PREFABRICATED ROOF CURBS**

Galvanized steel or extruded aluminum 300 mm (12 inches) above finish roof service, continuous welded corner seams, treated wood nailer, 40 mm (1-1/2 inch) thick, 48 kg/cubic meter (3 pound/cubic feet) density rigid mineral fiberboard insulation with metal liner, built-in cant strip (except for gypsum or tectum decks). For surface insulated roof deck, provide raised cant strip (recessed mounting flange) to start at the upper surface of the insulation. Curbs shall be constructed for pitched roof or ridge mounting as required to keep top of curb level.

**2.13 FIRESTOPPING MATERIAL**

Refer to Section 07 84 00, FIRESTOPPING.

**2.14 SEISMIC RESTRAINT FOR DUCTWORK**

Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

**2.15 DUCT MOUNTED THERMOMETER (AIR)**

- A. Stem Type Thermometers: ASTM E1, 7 inch scale, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass or polycarbonate window, brass stem, 2 percent of scale accuracy to ASTM E77 scale calibrated in degrees Fahrenheit.

**B. Thermometer Supports:**

1. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
2. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

**2.16 DUCT MOUNTED TEMPERATURE SENSOR (AIR)**

Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

**2.17 INSTRUMENT TEST FITTINGS**

- A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.
- B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

**2.18 NOT USED****2.19 NOT USED****2.20 NOT USED****PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC , particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
  1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
  2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must

- be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
  4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.
- D. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the COTR. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the COTR.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:
1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
  2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
  3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by

experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.

4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- I. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- J. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.
- K. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by COTR. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

### **3.2 DUCT LEAKAGE TESTS AND REPAIR**

- A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
- B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the COTR on ductwork constructed to the 500 Pa (2" WG) duct pressure classification. In no case shall the leakage testing of ductwork constructed above the 500 Pa (2" WG) duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.
- C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the COTR and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the COTR and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring

it into compliance and shall retest it until acceptable leakage is demonstrated to the COTR.

G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.

H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

### **3.3 NOT USED**

### **3.4 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

### **3.5 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

- - - E N D - - -



**SECTION 23 34 00**  
**HVAC FANS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Fans for heating, ventilating and air conditioning.
- B. Product Definitions: AMCA Publication 99, Standard 1-66.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- F. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- I. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- J. Section 23 82 16, AIR COILS.
- K. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

**1.3 QUALITY ASSURANCE**

- A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fans and power ventilators shall be listed in the current edition of AMCA 261, and shall bear the AMCA performance seal.
- C. Operating Limits for Centrifugal Fans: AMCA 99 (Class I, II, and III).
- D. Fans and power ventilators shall comply with the following standards:
  - 1. Testing and Rating: AMCA 210.
  - 2. Sound Rating: AMCA 300.
- E. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Performance Criteria:
  - 1. The fan schedule shall show the design air volume and static pressure. Select the fan motor HP by increasing the fan BHP by 10 percent to account for the drive losses and field conditions.
  - 2. Select the fan operating point as follows:
    - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point
    - b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency

- G. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.
- H. Corrosion Protection:
  - 1. Except for fans in fume hood exhaust service, all steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturers paint and paint system shall meet the minimum specifications of: ASTM D1735 water fog; ASTM B117 salt spray; ASTM D3359 adhesion; and ASTM G152 and G153 for carbon arc light apparatus for exposure of non-metallic material.
  - 2. Fans for general purpose fume hoods, or chemical hoods, and radioisotope hoods shall be constructed of materials compatible with the chemicals being transported in the air through the fan.
- I. Spark resistant construction: If flammable gas, vapor or combustible dust is present in concentrations above 20% of the Lower Explosive Limit (LEL), the fan construction shall be as recommended by AMCA's Classification for Spark Resistant Construction. Drive set shall be comprised of non-static belts for use in an explosive.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturers Literature and Data:
  - 1. Fan sections, motors and drives.
  - 2. Not used
  - 3. Prefabricated roof curbs.
  - 4. Power roof and wall ventilators.
  - 5. NOT USED.
  - 6. NOT USED.
  - 7. NOT USED.
  - 8. Vane axial fans.
  - 9. NOT USED.
  - 10. NOT USED
- C. Certified Sound power levels for each fan.
- D. Motor ratings types, electrical characteristics and accessories.
- E. Roof curbs.
- F. Belt guards.
- G. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- H. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.



**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Movement and Control Association International, Inc. (AMCA):
- 99-86.....Standards Handbook
  - 210-06.....Laboratory Methods of Testing Fans for  
Aerodynamic Performance Rating
  - 261-09.....Directory of Products Licensed to bear the AMCA  
Certified Ratings Seal - Published Annually
  - 300-08.....Reverberant Room Method for Sound Testing of  
Fans
- C. American Society for Testing and Materials (ASTM):
- B117-07a.....Standard Practice for Operating Salt Spray (Fog)  
Apparatus
  - D1735-08.....Standard Practice for Testing Water Resistance  
of Coatings Using Water Fog Apparatus
  - D3359-08.....Standard Test Methods for Measuring Adhesion by  
Tape Test
  - G152-06.....Standard Practice for Operating Open Flame  
Carbon Arc Light Apparatus for Exposure of Non-  
Metallic Materials
  - G153-04.....Standard Practice for Operating Enclosed Carbon  
Arc Light Apparatus for Exposure of Non-Metallic  
Materials
- D. National Fire Protection Association (NFPA):
- NFPA 96-08.....Standard for Ventilation Control and Fire  
Protection of Commercial Cooking Operations
- E. National Sanitation Foundation (NSF):
- 37-07.....Air Curtains for Entrance Ways in Food and Food  
Service Establishments
- F. Underwriters Laboratories, Inc. (UL):
- 181-2005.....Factory Made Air Ducts and Air Connectors

**1.6 EXTRA MATERIALS**

- A. Provide one additional set of belts for all belt-driven fans.

**PART 2 - PRODUCTS****2.1 FAN SECTION (CABINET FAN)**

Refer to specification Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.

## 2.2 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.
- B. Fan arrangement, unless noted or approved otherwise:
  - 1. DWD1 fans: Arrangement 3.
  - 2. NOT USED
- C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.
  - 1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 12.5 mm (1/2 inches) wire mesh screens for fan inlets without duct connections.
  - 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.
  - 3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class.
  - 4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 50,000 hours, and an average fatigue life of 200,000 hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.
  - 5. Belts: Oil resistant, non-sparking and non-static.
  - 6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
  - 7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15HP, fixed pitch for use with motors larger than 15HP. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
  - 8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION for specifications. Provide protective sheet metal enclosure for fans located outdoors.
  - 9. Furnish variable speed fan motor controllers where shown on the drawings. Refer to Section, MOTOR STARTERS. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for controller/motor combination requirements.
- D. NOT USED
- E. NOT USED

F. NOT USED

G. NOT USED

H. NOT USED

### **2.3 POWER ROOF VENTILATOR**

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Type: Centrifugal fan, backward inclined blades. Provide down-blast or up-blast type as indicated.
- C. Construction: Steel or aluminum, completely weatherproof, for curb mounting, exhaust cowl or entire drive assembly readily removable for servicing, aluminum bird screen on discharge, UL approved safety disconnect switch, conduit for wiring, vibration isolators for wheel, motor and drive assembly. Provide self acting back draft damper. Provide electric motor operated damper where indicated.
- D. Motor and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Bearings shall be pillow block ball type with a minimum L-50 life of 200,000 hours. Motor shall be located out of air stream.
- E. Prefabricated Roof Curb: As specified in paragraph 2.3 of this section.
- F. NOT USED

### **2.4 NOT USED**

### **2.5 NOT USED**

### **2.6 NOT USED**

### **2.7 NOT USED**

### **2.8 VANE AXIAL FANS**

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. The requirements for AMCA listing and seal are waived.
- B. Fan Housings: Hot rolled steel, one-piece design, incorporating integral guide vanes, motor mounts, bolted access hatch and end flanges. Provide welded steel, flanged inlet and outlet cones for ducted connection. Provide mounting legs or suspension brackets as required for support. Guide vanes shall straighten the discharge air pattern to provide linear flow.
- C. Impeller: Heat treated cast aluminum alloy incorporating airfoil blades. Impellers shall be balanced statically and dynamically prior to installation on the shaft and as an integral unit prior to shipment.
- D. Variable Pitch Type: Pitch of all blades shall be continuously and simultaneously adjustable throughout the complete pitch range while the

impeller is operating at full speed. Blade pitch adjustment shall be accomplished by a factory furnished, mounted, adjusted and tested pneumatic operator with positive positioner relay. Signal pressure shall be 100 kPa (15 psig) and operating pressure shall be 450 kPa to 550 kPa (65 to 80 psig).

- E. Fan Drive: Direct drive or belt drive as scheduled, arrangement 4, with motor located inside fan housing on discharge side of impeller, NEMA C motor mounting, bearings B-10 with average operating life of 200,000 hours, motor wiring leads and bearing lubrication lines extended to outside of housing. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION for motor specifications.

## **2.9 NOT USED**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Align fan and motor sheaves to allow belts to run true and straight.
- C. Bolt equipment to curbs with galvanized lag bolts.
- D. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

### **3.2 PRE-OPERATION MAINTENANCE**

- A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
- C. Clean fan interiors to remove foreign material and construction dirt and dust.

### **3.3 START-UP AND INSTRUCTIONS**

- A. Verify operation of motor, drive system and fan wheel according to the drawings and specifications.
- B. Check vibration and correct as necessary for air balance work.
- C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

- - - E N D - - -

**SECTION 23 36 00**  
**AIR TERMINAL UNITS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Air terminal units.

**1.2 RELATED WORK**

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.
- D. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.
- G. Section 23 82 16, AIR COILS: Heating and Cooling Coils pressure ratings.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Air Terminal Units: Submit test data.
  - 2. NOT USED
- C. NOT USED
- D. Certificates:
  - 1. Compliance with paragraph, QUALITY ASSURANCE.
  - 2. Compliance with specified standards.
- E. Operation and Maintenance Manuals: Submit in accordance with paragraph, INSTRUCTIONS, in Section 01 00 00, GENERAL REQUIREMENTS.

## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (AHRI)/(ARI):  
 880-08.....Air Terminals Addendum to ARI 888-98  
   incorporated into standard posted 15<sup>th</sup> December  
   2002
- C. National Fire Protection Association (NFPA):  
 90A-09.....Standard for the Installation of Air  
   Conditioning and Ventilating Systems
- D. Underwriters Laboratories, Inc. (UL):  
 181-08.....Standard for Factory-Made Air Ducts and Air  
   Connectors
- E. American Society for Testing and Materials (ASTM):  
 C 665-06.....Standard Specification for Mineral-Fiber  
   Blanket Thermal Insulation for Light Frame  
   Construction and Manufactured Housing

## 1.6 GUARANTY

In accordance with the GENERAL CONDITIONS

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Coils:
  - 1. NOT USED.
  - 2. All Air-Handling Units: Provide aluminum fins and copper coils for all hot water reheat coils.
  - 3. Water Heating Coils:
    - a. ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).
    - b. Capacity: As indicated, based on scheduled entering water temperature.
    - c. Headers: Copper or Brass.
    - d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
    - e. Tubes: Copper, arrange for counter-flow of heating water.
    - f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 GPM).
    - g. Provide vent and drain connection at high and low point, respectively of each coil.

h. Coils shall be guaranteed to drain.

4. NOT USED

- B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.
- C. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.
- D. Dampers with internal air volume control: See section 23 31 00 HVAC DUCTS and CASINGS.
- E. Terminal Sound Attenuators: See Section 23 31 00 (HVAC DUCTS AND CASINGS).

**2.2 AIR TERMINAL UNITS (BOXES)**

- A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is not permitted. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.
- B. Capacity and Performance: The Maximum Capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (3,000 CFM).
- C. Sound Power Levels:  
Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41 (Noise and Vibration Control for HVAC Piping and Equipment). Equipment schedule (...) shall show the sound power levels in all octave bands. Terminal sound attenuators shall be provided, as required, to meet the intent of the design.
- D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating

rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.

1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTM C 665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 IN) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.
  2. Access panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
  3. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inch WG), with all outlets sealed shut and inlets fully open.
  4. Octopus connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are not permitted in the Surgical Suite.
- E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.
1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG).
- F. Provide multi-point velocity pressure sensors with external pressure taps.
1. Provide direct reading air flow rate table pasted to box.



- G. Provide static pressure tubes.
- H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.
- I. NOT USED

### **2.3 NOT USED**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Handle and install units in accordance with manufacturer's written instructions.
- C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls. See VA Standard Detail.

### **3.2 OPERATIONAL TEST**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

- - - E N D - - -



**SECTION 23 37 00**  
**AIR OUTLETS AND INLETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Roof Curbs
- B. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

**1.2 RELATED WORK**

- A. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.
- B. NOT USED.
- C. NOT USED.
- D. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- E. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- F. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- G. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Fire Safety Code: Comply with NFPA 90A.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Air intake/exhaust hoods.
  - 2. Diffusers, registers, grilles and accessories.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Diffusion Council Test Code:
  - 1062 GRD-84.....Certification, Rating, and Test Manual 4<sup>th</sup> Edition
- C. American Society of Civil Engineers (ASCE):
  - ASCE7-05.....Minimum Design Loads for Buildings and Other Structures

- D. American Society for Testing and Materials (ASTM):
  - A167-99 (2004).....Standard Specification for Stainless and  
Heat-Resisting Chromium-Nickel Steel Plate,  
Sheet and Strip
  - B209-07.....Standard Specification for Aluminum and  
Aluminum-Alloy Sheet and Plate
- E. National Fire Protection Association (NFPA):
  - 90A-09.....Standard for the Installation of Air  
Conditioning and Ventilating Systems
- F. Underwriters Laboratories, Inc. (UL):
  - 181-08.....UL Standard for Safety Factory-Made Air Ducts  
and Connectors

## **PART 2 - PRODUCTS**

### **2.1 GRAVITY INTAKE/EXHAUST VENTILATORS (ROOF MOUNTED)**

- A. Aluminum, ASTM B209, louvered, spun, or fabricated using panel sections with roll-formed edges, 13 mm (1/2 inch) mesh aluminum welded wire bird screen, with gravity or motorized dampers where shown, accessible interior, designed for wind velocity specified in Paragraph 3.3.
  - 1. NOT USED
  - 2. NOT USED
  - 3. Low Silhouette Intake/Exhaust Ventilator: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 1.60 mm (14 Gauge) marine alloy aluminum, bolted to a minimum 3.25 mm (8 Gauge) aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 13 mm (1/2 inch) mesh shall be mounted across the relief opening.
- B. See ventilator schedule on the drawings. Sizes shown on the drawings designate throat size. Area of ventilator perimeter opening shall be not less than the throat area.
- C. Dampers for Gravity Ventilators without Duct Connection: Construct damper of the same material as the ventilator and of the design to completely close opening or remain wide open. Hold damper in closed position by a brass chain and catch. Extend chains 300 mm (12 inches) below and engage catch when damper is closed.
- D. NOT USED
- E. Provide Roof Curb by unit manufacturer. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC for additional requirements.

## 2.2 EQUIPMENT SUPPORTS

Refer to Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

## 2.3 AIR OUTLETS AND INLETS

### A. Materials:

1. Steel
2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.

B. Performance Test Data: In accordance with Air Diffusion Council Code 1062GRD. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.

### C. Air Supply Outlets:

1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.
  - a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
  - b. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
  - c. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.
  - d. NOT USED
2. NOT USED
3. NOT USED
4. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
  - a. Margin: Flat, 30 mm (1-1/4 inches) wide.
  - b. Bar spacing: 20 mm (3/4 inch) maximum.

- c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.
- 5. Supply Grilles: Same as registers but without the opposed blade damper.
- 6. NOT USED
- 7. NOT USED
- D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
  - 1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
  - 2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
  - 3. Perforated Face Type: To match supply units.
  - 4. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 30 mm (1-1/4 inch) margin.
  - 5. NOT USED
  - 6. NOT USED
  - 7. NOT USED
- E. NOT USED
- F. NOT USED
- G. NOT USED

#### **2.4 NOT USED**

#### **2.5 NOT USED**

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC, particularly regarding coordination with other trades and work in existing buildings.
- B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by COTR. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

#### **3.2 NOT USED**

#### **3.3 TESTING, ADJUSTING AND BALANCING (TAB)**

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

### **3.4 OPERATING AND PERFORMANCE TESTS**

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

- - - E N D - - -





**SECTION 23 40 00**  
**HVAC AIR CLEANING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Air filters for heating, ventilating and air conditioning.
- B. Definitions: Refer to ASHRAE Standard 52.2 for definitions of face velocity, net effective filtering area, media velocity, initial resistance (pressure drop), MERV (Minimum Efficiency Reporting Value), PSE (Particle Size Efficiency), particle size ranges for each MERV number, dust holding capacity and explanation of electrostatic media based filtration products versus mechanical filtration products. Refer to ASHRAE Standard 52.2 Appendix J for definition of MERV-A.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- B. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Filter housing and racks.
- C. NOT USED.
- D. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

**1.3 QUALITY ASSURANCE**

- A. Air Filter Performance Report for Extended Surface Filters:
  - 1. Submit a test report for each Grade of filter being offered. The report shall not be more than three (3) years old and prepared by using test equipment, method and duct section as specified by ASHRAE Standard 52.2 for type filter under test and acceptable to COTR, indicating that filters comply with the requirements of this specification. Filters utilizing partial or complete synthetic media will be tested in compliance with pre-conditioning steps as stated in Appendix J. All testing is to be conducted on filters with a nominal 24 inch by 24 inch face dimension. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.
  - 2. NOT USED
  - 3. Guarantee Performance: The manufacturer shall supply ASHRAE 52.2 test reports on each filter type submitted. Any filter supplied will be required to maintain the minimum efficiency shown on the ASHRAE Standard 52.2 report throughout the time the filter is in service.

- Within the first 6-12 weeks of service a filter may be pulled out of service and sent to an independent laboratory for ASHRAE Standard 52.2 testing for initial efficiency only. If this filter fails to meet the minimum level of efficiency shown in the previously submitted reports, the filter manufacturer/distributor shall take back all filters and refund the owner all monies paid for the filters, cost of installation, cost of freight and cost of testing.
- B. Filter Warranty for Extended Surface Filters: Guarantee the filters against leakage, blow-outs, and other deficiencies during their normal useful life, up to the time that the filter reaches the final pressure drop. Defective filters shall be replaced at no cost to the Government.
  - C. Comply with UL Standard 900 for flame test.
  - D. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency,

#### **1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
  - 1. Extended surface filters.
  - 2. Holding frames. Identify locations.
  - 3. Side access housings. Identify locations, verify insulated doors.
  - 4. Not used.
  - 5. Magnehelic gages.
  - 6. Not used.
- C. Air Filter performance reports.
- D. Suppliers warranty.
- E. Field test results for HEPA filters as per paragraph 2.3.E.3.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
  - 52.2-2007.....Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size, including Appendix J
- C. American Society of Mechanical Engineers (ASME):
  - NQA-1-2008.....Quality Assurance Requirements for Nuclear Facilities Applications
- D. Underwriters Laboratories, Inc. (UL):
  - 900;Revision 15 July 2009      Test Performance of Air Filter Units

**PART 2 - PRODUCTS****2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED**

- A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01 00 00, GENERAL REQUIREMENTS, provide one complete set of additional filters to the COTR.
- B. The COTR will direct whether these additional filters will either be installed as replacements for dirty units or turned over to VA for future use as replacements.

**2.2 EXTENDED SURFACE AIR FILTERS**

- A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the contaminant load limit is reached as indicated by maximum (final) pressure drop.
- B. Filter Classification: UL listed and approved conforming to UL Standard 900.
- C. HVAC Filter Types

HVAC Filter Types Table 2.2C				
MERV Value ASHRAE 52.2	MERV-A Value ASHRAE 62.2 Appendix J	Application	Particle Size	Thickness /Type
8	8-A	Pre-Filter	3 to 10 Microns	50 mm (2-inch) Throwaway
11	11-A	After-Filter	1 to 3 Microns	150 mm (6-inch) or 300 mm (12-inch) Rigid Cartridge
14	14-A	After-Filter	0.3 to 1 Microns	150 mm (6-inch) or 300 mm (12-inch) Rigid Cartridge

D. NOT USED

**2.3 MEDIUM EFFICIENCY PLEATED PANEL PRE-FILTERS (2"; MERV 8; UL 900 CLASS 2):**

- A. Construction: Air filters shall be medium efficiency ASHRAE pleated panels consisting of cotton and synthetic or 100% virgin synthetic media, self-supporting media with required media stabilizers, and beverage board enclosing frame. Filter media shall be lofted to a uniform depth and formed into a uniform radial pleat. The media stabilizers shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on

all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.

- B. Performance: The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2. It shall also have a MERV-A of 8 when tested per Appendix J of the same standard. The media shall maintain or increase in efficiency over the life of the filter. Pertinent tolerances specified in Section 7.4 of the Air-Conditioning and Refrigeration Institute (ARI) Standard 850-93 shall apply to the performance ratings. All testing is to be conducted on filters with a nominal 24" x 24" face dimension.

Minimum Efficiency Reporting (MERV)	8
Dust Holding Capacity (Grams)	105
Nominal Size (Width x Height x Depth)	24x24x2
Rated Air Flow Capacity (Cubic Feet per Minute)	2,000
Rated Air Flow Rate (Feet per Minute)	500
Final Resistance (Inches w.g.)	1.0
Maximum Recommended Change-Out Resistance (Inches w.g.)	0.66
Rated Initial Resistance (Inches w.g.)	0.33

- C. The filters shall be approved and listed by Underwriters' Laboratories, Inc. as Class 2 when tested according to U. L. Standard 900 and CAN 4-5111.

#### **2.4 HIGH EFFICIENCY EXTENDED SURFACE (INTERMEDIATE/AFTER (FINAL)) CARTRIDGE FILTERS (12"; MERV 14/11; UL 900 CLASS 2):**

- A. Construction: Air filters shall consist of 8 pleated media packs assembled into 4 V-banks within a totally plastic frame. The filters shall be capable of operating at temperatures up to 80 degrees C (176 degrees F). The filters must either fit without modification or be adaptable to the existing holding frames. The molded end panels are to be made of high impact polystyrene plastic. The center support members shall be made of ABS plastic. No metal components are to be used.
- B. Media: The media shall be made of micro glass fibers with a water repellent binder. The media shall be a dual density construction, with coarser fibers on the air entering side and finer fibers on the air leaving side. The media shall be pleated using separators made of continuous beads of low profile thermoplastic material. The media packs shall be bonded to the structural support members at all points of

contact, this improves the rigidity as well as eliminates potential air bypass in the filter

- C. Performance: Filters of the size, air flow capacity and nominal efficiency (MERV) shall meet the following rated performance specifications based on the ASHRAE 52.2-1999 test method. Where applicable, performance tolerance specified in Section 7.4 of the Air-Conditioning and Refrigeration Institute (ARI) Standard 850-93 shall apply to the performance ratings. All testing is to be conducted on filters with a nominal 24"x24" header dimension.

Minimum Efficiency Reporting Value (MERV)	14	13	11
Gross Media Area (Sq. Ft.)	197	197	197
Dust Holding Capacity (Grams)	486	430	465
Nominal Size (Width x Height x Depth)	24x24x12	24x24x12	24x24x12
Rated Air Flow Capacity (cubic feet per minute)	2,000	2,000	2,000
Rated Air Flow Rate (feet per minute)	500	500	500
Final Resistance (inches w.g.)	2.0	2.0	2.0
Maximum Recommended Change-Out Resistance (Inches w.g.)	0.74	0.68	0.54
Rated Initial Resistance (inches w.g.)	0.37	0.34	0.27

**2.5 NOT USED**

**2.6 NOT USED**

**2.7 NOT USED**

**2.8 NOT USED**

**2.9 NOT USED**

**2.10 NOT USED**

#### **2.11 INSTRUMENTATION**

- A. Magnehelic Differential Pressure Filter Gages: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage), three inch for HEPA) range. Gauges shall be flush-mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment.
- B. DDC static (differential) air pressure measuring station. Refer to Specification Section 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- C. Provide one DDC sensor across each extended surface filter. Provide Petcocks for each gauge or sensor.
- D. Provide one common filter gauge for two-stage filter banks with isolation valves to allow differential pressure measurement.

**2.12 HVAC EQUIPMENT FACTORY FILTERS**

- A. Manufacturer standard filters within fabricated packaged equipment should be specified with the equipment and should adhere to industry standard.
- B. Cleanable filters are not permitted.
- C. Automatic Roll Type filters are not permitted.

**2.13 NOT USED****PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install supports, filters and gages in accordance with manufacturer's instructions.
- B. NOT USED.

**3.2 START-UP AND TEMPORARY USE**

- A. Clean and vacuum air handling units and plenums prior to starting air handling systems.
- B. Replace Pre-filters and install clean filter units prior to final inspection as directed by the COTR.

**3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - E N D - - -

**SECTION 23 73 00**  
**INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Air handling units including integral components specified herein.
- B. Definitions: Air Handling Unit (AHU): A factory fabricated and tested assembly of modular sections consisting of housed-centrifugal fan with V-belt drive, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

**1.2 RELATED WORK**

- A. Seismic restraints for equipment: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- B. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Sound and vibration requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- D. Piping and duct insulation: Section 23 07 11, HVAC INSULATION.
- E. Piping and valves: Section 23 21 13 / 23 22 13, HYDRONIC PIPING / STEAM AND CONDENSATE HEATING PIPING.
- F. Heating and cooling coils and pressure requirements: Section 23 82 16, AIR COILS.
- G. Return and exhaust fans: Section 23 34 00, HVAC FANS.
- H. Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining, and air leakage: Section 23 31 00, HVAC DUCTS and CASINGS.
- I. Air filters and filters' efficiency: Section 23 40 00, HVAC AIR CLEANING DEVICES.
- J. HVAC controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- K. Testing, adjusting and balancing of air and water flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- L. Types of motors: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.
- M. Types of motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- N. General Commissioning: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS
- O. HVAC Commissioning: Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS

### 1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Air Handling Units Certification
  - 1. Air Handling Units with Housed Centrifugal Fans: The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
  - 2. NOT USED
- C. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.
- D. Performance Criteria:
  - 1. The fan BHP shall include all system effects for all fans and v-belt drive losses for housed centrifugal fans.
  - 2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
  - 3. Select the fan operating point as follows:
    - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
    - b. Air Foil, Backward Inclined, or Tubular Fans Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
  - 4. Operating Limits: AMCA 99 and Manufacturer's Recommendations.
- E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.

### 1.4. SUBMITTALS:

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for all air handling units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:
  - 1. Submittals for AHUs shall include fans, drives, motors, coils, humidifiers, sound attenuators, mixing box with outside/return air dampers, filter housings, and all other related accessories. The contractor shall provide custom drawings showing total air handling unit assembly including dimensions, operating weight, access sections, diffusion plates, flexible connections, door swings, controls penetrations, electrical disconnect, lights, , switches, wiring, utility connection points, unit support system, vibration



- isolators, drain pan, pressure drops through each component (filter, coil etc.).
2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version used by the VA at the time of submission.
  3. Submit sound power levels in each octave band for the inlet and discharge of the fan and at entrance and discharge of AHUs at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
  4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute).
  5. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.
- E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.
1. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.
  2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for

replacement through available access without adversely affecting other sections.

3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site (see section 2.1.A4).
4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)/(ARI):
  - 410-01.....Standard for Forced-Circulation Air-Heating and Air-Cooling Coils
  - 430-09.....Central Station Air Handling Units
- C. Air Movement and Control Association International, Inc. (AMCA):
  - 210-07.....Laboratory Methods of Testing Fans for Rating
- D. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):
  - 170-2008.....Ventilation of Health Care Facilities
- E. American Society for Testing and Materials (ASTM):
  - ASTM B117-07a.....Standard Practice for Operating Salt Spray (Fog) Apparatus
  - ASTM D1654-08.....Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
  - ASTM D1735-08.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
  - ASTM D3359-08.....Standard Test Methods for Measuring Adhesion by Tape Test
- F. Military Specifications (Mil. Spec.):
  - MIL-P-21035B-2003.....Paint, High Zinc Dust Content, Galvanizing Repair (Metric)
- G. National Fire Protection Association (NFPA):
  - NFPA 90A.....Standard for Installation of Air Conditioning and Ventilating Systems, 2009

H. Energy Policy Act of 2005 (P.L.109-58)

## **PART 2 - PRODUCTS**

### **2.1 AIR HANDLING UNITS**

#### **A. General:**

1. AHUs shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Casing shall be fabricated as specified in section 2.1.C.2. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units, subject to VA approval, may be used in place of galvanized steel. The unit manufacturer shall provide published documentation confirming that the structural rigidity of aluminum air-handling units is equal or greater than the specified galvanized steel.
2. The contractor and the AHU manufacturer shall be responsible for ensuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
3. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested, and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
4. The AHU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a factory-trained and qualified local representative at the job site to supervise the assembly and to assure that the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation to the Contracting Officer that the local representative has provided services of similar magnitude and complexity on jobs of comparable size. If a local representative

cannot be provided, the manufacturer shall provide a factory representative.

5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 PA (8 inch WG) or higher.

B. Base:

1. Provide a heavy duty steel base for supporting all major AHU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap and steam coil condensate return trap as shown on drawings.
2. AHUs shall be completely self-supporting for installation on concrete housekeeping pad, steel support pedestals, or suspended as shown on drawings.
3. The AHU bases not constructed of galvanized steel shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: AHU casing shall be constructed as solid double wall, galvanized steel insulated panels without any perforations, integral of or attached to a structural frame. The thickness of insulation, mode of application and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU located in the non-conditioned spaces.
2. Casing Construction:

Table 2.1.C.2

Outer Panel	0.8 mm (22 Gage) Minimum
Inner Panel	0.8 mm (22 Gage) Minimum
Insulation	Foam

Thickness	50 mm (2 inch) Minimum
Density	48 kg/m <sup>3</sup> (3.0 lb/ft <sup>3</sup> ) Minimum
Total R Value	2.3 m <sup>2</sup> .K/W (13.0 ft <sup>2</sup> .°F.hr/Btu) Minimum

### 3. Casing Construction (Contractor's Option):

Table 2.1.C.3

Outer Panel	1.3 mm (18 Gage) Minimum
Inner Panel	1.0 mm (20 Gage) Minimum
Insulation	Fiberglass
Thickness	50 mm (2 inch) Minimum
Density	24 kg/m <sup>3</sup> (1.5 lb/ft <sup>3</sup> ) Minimum
Total R Value	1.4 m <sup>2</sup> .K/W (8.0 ft <sup>2</sup> .°F.hr/Btu) Minimum

4. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
5. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
6. Access Doors: Provide in each access section and where shown on drawings. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inch) thick with same double wall construction as the unit casing. Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, humidifier coil section shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.
  - a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 lb) weight hung on latch side of door.
  - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside.

Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening.

Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inch WG).

- c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.

- 7. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

D. NOT USED

E. Floor:

- 1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 lbs per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
- 2. Where indicated, furnish and install floor drains, flush with the floor, with nonferrous grate cover and stub through floor for external connection.

- F. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double-wall, double sloping type, and fabricated from stainless (304) with at least 50 mm (2 inch) thick insulation sandwiched between the inner and outer surfaces. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be

placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

1. An intermediate, stainless-steel (304) condensate drip pan with copper downspouts shall be provided on stacked cooling coils. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
3. Installation, including frame, shall be designed and sealed to prevent blow-by.

G. Housed Centrifugal Fan Sections:

1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air foil or backward inclined type as indicated on drawings, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B (10) life of not less than 50,000 hours and an L (50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
2. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
3. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing

in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).

H. Fan Motor, Drive, and Mounting Assembly (Housed Centrifugal Fans):

1. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12 (General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
2. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide additional drive(s) if required during balancing, to achieve desired airflow.

I. NOT USED

J. NOT USED

K. NOT USED

- L. Mixing Boxes: Mixing box shall consist of casing and outdoor air and return air dampers in opposed blade arrangement with damper linkage for automatic operation. Coordinate damper operator with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Dampers shall be of ultra-low leak design with metal compressible bronze jamb seals and extruded vinyl edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 1.6 cubic meters/min/square meter (5 CFM per square foot) at 250 Pa (1 inch WG) and 2.8 cubic meters/min/square meter (9 CFM per square foot) at 995 Pa (4 inch WG) Electronic operators shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

M. NOT USED

- N. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.

1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install



filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown on drawings) required for AHU testing.

2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.
- O. Diffuser Section: Furnish a diffuser segment with perforated diffuser plate immediately downstream of supply fan to assure uniform distribution of leaving air across the face of the downstream after-filters to create uniform velocity profiles across the entire opening. Bolt or weld diffuser plate to a sturdy steel support frame so that it remains rigid. Manufacturer shall include any diffuser section pressure loss in excess of diffuser plate and this value shall be included in unspecified internal losses when selecting fan.
- P. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.
1. NOT USED.
  2. NOT USED
  3. Water Coils.
  4. NOT USED
  5. NOT USED
- Q. NOT USED
- R. Sound Attenuators: Refer to Drawings, Specification Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, and Section 23 31 00, HVAC DUCTS AND CASINGS, for additional unit mounted sound attenuator requirements. AHU sound attenuators shall be factory installed as an integral part of AHU.
- S. Discharge Section:  
Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.
- T. Electrical and Lighting: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.

1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, mixing box, and any section over 300 mm (12 inch) wide. A switch shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.
2. Install compatible 100 watt bulb in each light fixture.
3. NOT USED
4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. Coordinate with Division 26, ELECTRICAL.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install air handling unit in conformance with ARI 435.
- B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.
- C. Install seismic restraints for roof top units. Refer to specification Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- D. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class ( $C_L$ ) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- E. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.

#### **3.2 STARTUP SERVICES**

- A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.

- C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

### **3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

- - - E N D - - -



**SECTION 23 81 00**  
**DECENTRALIZED UNITARY HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies split-systems.
- B. Definitions:
  - 1. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions (Btu hour/Watt).
  - 2. Seasonal Energy Efficiency Ratio (EER): The ratio of the total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period (Btu hour/Watt).
  - 3. Unitary: A Unitary Air Conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function as well.
  - 4. Where such equipment is provided in more than one assembly the separated assemblies are to be designed to be used together and the requirements of rating are based upon use of matched assemblies.

**1.2 RELATED WORK**

- A. Section 01 00 00, GENERAL REQUIREMENTS: Requirements for pre-test of equipment: Seismic requirements for non-structural equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT: Requirements for different types of vibration isolators and noise ratings in the occupied areas.
- D. Section 23 07 11, HVAC INSULATION: Requirements for piping insulation.
- E. NOT USED.
- F. Section 23 36 00, AIR TERMINAL UNITS and Section 23 82 00, CONVECTION HEATING and COOLING UNITS: Requirements for other similar units.
- G. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for air handling units using chilled water and hot water coils.
- H. NOT USED.
- I. Section 23 40 00, HVAC AIR CLEANING DEVICES: Requirements for air filtration.

J. Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

K. NOT USED

L. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: Requirements for testing and adjusting air balance.

### **1.3 QUALITY ASSURANCE**

A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

B. Safety Standards: ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

### **1.4 SUBMITTALS**

A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES

B. Manufacturer's literature and data:

1. Sufficient information, including capacities, pressure drops and piping connections clearly presented, shall be included to determine compliance with drawings and specifications for units noted below:

a. Unitary air conditioners:

1) NOT USED

2) Split systems

3) NOT USED

b. NOT USED

c. NOT USED

d. NOT USED

2. Unit Dimensions required clearances, operating weights accessories and start-up instructions.

3. Electrical requirements, wiring diagrams, interlocking and control wiring showing factory installed and portions to be field installed.

4. Mounting and flashing of the roof curb to the roofing structure with coordinating requirements for the roof membrane system.

C. Certification: Submit proof of specified ARI Certification.

D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance (COP).

E. Operating and Maintenance Manual: Submit three copies of Operating and Maintenance manual to COTR three weeks prior to final inspection.

F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - A-A-50502-90..... Air conditioner (Unitary Heat Pump) Air to Air (3000-300,000 Btu)
- C. Military Specifications (Mil. Specs.):
  - MIL-PRF-26915D-06.....Primer Coating, for Steel Surfaces
- D. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
  - 210/240-08.....Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - 270-08.....Sound Rating of Outdoor Unitary Equipment
  - 310/380-04.....Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
  - 340/360-07.....Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
  - 520-04.....Performance Rating of Positive Displacement Condensing Units
- E. Air Movement and Control Association (AMCA):
  - 210-07.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
  - 410-96.....Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans
- F. American National Standards Institute (ANSI):
  - S12.51-02(R2007).....Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Method for Reverberation Rooms (same as ISO 3741:1999)
- G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
  - 2008 Handbook.....HVAC Systems and Equipment
  - 15-10.....Safety Standard for Refrigeration Systems (ANSI)
- H. American Society of Testing and Materials (ASTM):
  - B117-09.....Standard Practice for Operating Salt Spray (Fog) Apparatus
- I. American Society of Civil Engineers (ASCE)
  - ASCE 7-10.....Minimum Design Loads for Buildings and Other Structures
- J. National Electrical Manufacturer's Association (NEMA):
  - MG 1-09 (R2010).....Motors and Generators (ANSI)

ICS 1-00 (R2005, R2008).Industrial Controls and Systems: General  
Requirements

K. National Fire Protection Association (NFPA) Publications:

90A-09.....Standard for the Installation of Air-  
Conditioning and Ventilating Systems

**PART 2 - PRODUCTS**

**2.1 NOT USED**

**2.2 NOT USED**

**2.3 SPLIT-SYSTEM AIR CONDITIONERS**

- A. Description: Factory assembled and tested, wall-mounted unit, with an air-cooled remote condensing unit, and field-installed refrigeration piping.
- B. NOT USED
- C. NOT USED
- D. Wall-Mounting, Evaporator-Fan Components:
  - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
  - 3. Drain Pan and Drain Connection: Comply with ASHRAE 62.1-2007.
  - 4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
  - 5. NOT USED
  - 6. Fan: Direct drive, centrifugal fan.
  - 7. Fan Motors: Comply with requirements in Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION EQUIPMENT for multi-tapped, multi-speed motors with internal thermal protection and permanent lubrication.
  - 8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.
- E. NOT USED
- F. Air-Cooled, Compressor-Condenser Components:
  - 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Service valves, fittings, and gage ports shall be brass and located outside of the casing.
  - 2. Compressor: Hermetically sealed scroll with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal-



and current-sensitive overload devices, start capacitor, relay, and contactor.

3. Compressor motor with manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
4. Refrigerant: R-410A unless otherwise indicated.
5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
6. Fan: Aluminum, propeller type, directly connected to motor.
7. Motor: Permanently lubricated, with integral thermal-overload protection.
8. Low Ambient Kit: Permit operation down to minus 18 deg C (0 deg F).
9. Mounting Base: Polyethylene.
10. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

G. NOT USED

**2.4 NOT USED**

**2.5 NOT USED**

**2.6 NOT USED**

**2.7 NOT USED**

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to ARI Guideline B.
- B. NOT USED C. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.]
- D. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- E. NOT USED.
- F. Install vibration spring isolators under base of self contained unit, with minimum static deflection of 25 mm (1 inch) unless otherwise indicated. Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT
- G. NOT USED.
- H. NOT USED.
- I. Install roof-mounting compressor-condenser components on equipment supports specified in Section 07 72 00, ROOF ACCESSORIES. Anchor units to supports with removable, cadmium-plated fasteners.

- J. Install seismic restraints.
- K. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 25 mm (1 inch) unless otherwise indicated. Refer to Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- L. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- M. Install wall sleeves in finished wall assembly and weatherproof. Install and anchor wall sleeves to withstand, without damage seismic forces as required by code.

### **3.2 CONNECTIONS**

- A. Verify condensate drainage requirements.
- B. NOT USED.
- C. Install piping adjacent to units to allow service and maintenance.
- D. NOT USED
- E. NOT USED.
- F. NOT USED.
- G. NOT USED.
- H. Install normal-weight, 20.7-MPa (3000-psi), compressive strength (28-day) concrete mix inside roof curb, 100 mm (4 inches) thick.
- I. Ground equipment and install power wiring, switches, and controls for split systems.
- J. Connect refrigerant piping to coils with shutoff valves on the suction and liquid lines at the coil and a union or flange at each connection at the coil and condenser.
- K. NOT USED.
- L. NOT USED.
- M. NOT USED
- N. NOT USED.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections: After installing units and after electrical circuitry has been energized, test units for compliance with requirements. Inspect for and remove shipping bolts, blocks, and tie-down straps. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.

**3.4 INSTRUCTIONS**

Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

**3.5 STARTUP AND TESTING**

The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COTR and Commissioning Agent. Provide a minimum of 7 days prior notice.

**3.6 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

**3.7 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

---END---



**SECTION 23 82 16**  
**AIR COILS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

Heating and cooling coils for air handling unit and duct applications

**1.2 RELATED WORK**

- A. NOT USED.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Section 23 31 00, HVAC DUCTS AND CASINGS
- D. Section 23 36 00, AIR TERMINAL UNITS: Reheat coils for VAV/CV terminals.
- E. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- F. NOT USED
- G. NOT USED
- H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.
- I. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS

**1.3 QUALITY ASSURANCE**

- A. Refer to paragraph, QUALITY ASSURANCE, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Unless specifically exempted by these specifications, heating and cooling coils shall be tested, rated, and certified in accordance with AHRI Standard 410 and shall bear the AHRI certification label.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data for Heating and Cooling Coils: Submit type, size, arrangements and performance details. Present application ratings in the form of tables, charts or curves.
- C. Provide installation, operating and maintenance instructions.
- D. Certification Compliance: Evidence of listing in current ARI Directory of Certified Applied Air Conditioning Products.
- E. Coils may be submitted with Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS, Section 23 36 00, AIR TERMINAL UNITS, or Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.
- F. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning and Refrigeration Institute (AHRI):  
Directory of Certified Applied Air Conditioning Products  
AHRI 410-01.....Forced-Circulation Air-Cooling and Air-Heating Coils
- C. American Society for Testing and Materials (ASTM):  
B75/75M-02.....Standard Specifications for Seamless Copper Tube
- D. National Fire Protection Association (NFPA):  
70-11.....National Electric Code
- E. National Electric Manufacturers Association (NEMA):  
250-11.....Enclosures for Electrical Equipment (1,000 Volts Maximum)
- F. Underwriters Laboratories, Inc. (UL):  
1996-09.....Electric Duct Heaters

## PART 2 - PRODUCTS

### 2.1 HEATING AND COOLING COILS

- A. Conform to ASTM B75 and AHRI 410.
- B. NOT USED.
- C. NOT USED
- D. Tubes: Minimum 16 mm (0.625 inch) tube diameter; Seamless copper tubing.
- E. Fins: 0.1397 mm (0.0055 inch) aluminum or 0.1143 mm (0.0045 inch) copper mechanically bonded or soldered or helically wound around tubing.
- F. Headers: Copper, welded steel or cast iron. Provide seamless copper tubing or resistance welded steel tube for volatile refrigerant coils.
- G. "U" Bends, Where Used: Machine die-formed, silver brazed to tube ends.
- H. Coil Casing: 1.6 mm (16 gage) galvanized steel with tube supports at 1200 mm (48 inch) maximum spacing. Construct casing to eliminate air bypass and moisture carry-over. Provide duct connection flanges.
- I. Pressures kPa (PSIG):

Pressure	Water Coil	Steam Coil	Refrigerant Coil
Test	2070 (300)	1725 (250)	2070 (300)
Working	1380 (200)	520 (75)	1725 (250)

- J. Protection: Unless protected by the coil casing, provide cardboard, plywood, or plastic material at the factory to protect tube and finned surfaces during shipping and construction activities.

- K. Vents and Drain: Coils that are not vented or drainable by the piping system shall have capped vent/drain connections extended through coil casing.
- L. Cooling Coil Condensate Drain Pan: Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITSM. Steam Distributing Coils: Conform to ASTM B75 and ARI 410. Minimum 9.5 mm (3/8-inch) steam distributing tubing installed concentrically in 25 mm (one-inch) OD condensing coil tubes.
- M. NOT USED
- N. NOT USED
- O. Dampers: Interlocking opposed blades to completely isolate coil from air flow when unit is in bypass position; 1.6 mm (16 gage) steel, coated with factory applied corrosion resistant baked enamel finish. Provide damper linkage and electric operators. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

## **2.2 REHEAT COILS, DUCT MOUNTED**

The coils shall be continuous circuit booster type for steam or hot water as shown on drawings. Use the same coil material as listed in Paragraphs 2.1.

## **2.3 WATER COILS**

- A. Use the same coil material as listed in Paragraphs 2.1.
- B. Drainable Type (Self Draining, Self Venting); Manufacturer standard:
  - 1. Cooling, all types.
  - 2. Heating or preheat.
  - 3. NOT USED.
- C. NOT USED

## **2.4 NOT USED**

## **2.5 NOT USED.**

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Follow coil manufacturer's instructions for handling, cleaning, installation and piping connections.
- B. Comb fins, if damaged. Eliminate air bypass or leakage at coil sections.

## **3.2 STARTUP AND TESTING**

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COTR and Commissioning Agent. Provide a minimum of 7 days prior notice.

**3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

**3.4 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

- - - E N D - - -



**SECTION 26 05 11**  
**REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

**1.2 MINIMUM REQUIREMENTS**

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

**1.3 TEST STANDARDS**

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
  - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that

- maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
  3. Certified: Materials and equipment which:
    - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
    - b. Are periodically inspected by a NRTL.
    - c. Bear a label, tag, or other record of certification.
  4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

#### **1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
  1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
  2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.5 APPLICABLE PUBLICATIONS**

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

**1.6 MANUFACTURED PRODUCTS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

**1.7 VARIATIONS FROM CONTRACT REQUIREMENTS**

- A. Where the Government or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

**1.8 MATERIALS AND EQUIPMENT PROTECTION**

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
  - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.

2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
3. Damaged equipment shall be repaired or replaced, as determined by the Resident Engineer.
4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### **1.9 WORK PERFORMANCE**

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J - General Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
  1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
  2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the Resident Engineer and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
  3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Resident Engineer.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of

the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.

- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

#### **1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
  - 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
  - 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
- D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

#### **1.11 EQUIPMENT IDENTIFICATION**

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

- B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.
- C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:
  - 1. Nominal system voltage.
  - 2. Arc flash boundary (inches).
  - 3. Available arc flash incident energy at the corresponding working distance (calories/cm<sup>2</sup>).
  - 4. Required PPE category and description.
  - 5. limited approach distance (inches), restricted approach distance (inches).
  - 6. Equipment/bus name, date prepared, and manufacturer name and address.

#### **1.12 SUBMITTALS**

- A. Submit to the Resident Engineer in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system

or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. Submit each section separately.

E. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

F. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions

covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

4. The manuals shall include:

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
- b. A control sequence describing start-up, operation, and shutdown.
- c. Description of the function of each principal item of equipment.
- d. Installation instructions.
- e. Safety precautions for operation and maintenance.
- f. Diagrams and illustrations.
- g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
- h. Performance data.
- i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
- j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

- 1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
- 2. Each type of conduit coupling, bushing, and termination fitting.
- 3. Conduit hangers, clamps, and supports.
- 4. Duct sealing compound.
- 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.



**1.13 SINGULAR NUMBER**

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

**1.15 ACCEPTANCE CHECKS AND TESTS**

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

**1.16 WARRANTY**

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

**1.17 INSTRUCTION**

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.
- C. A training schedule shall be developed and submitted by the Contractor and approved by the Resident Engineer at least 30 days prior to the planned training.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION (NOT USED)**

---END---



**SECTION 26 05 19**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

**1.2 RELATED WORK**

- A. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-resistant rated construction.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

- A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

**1.5 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit the following data for approval:
      - 1) Electrical ratings and insulation type for each conductor and cable.
      - 2) Splicing materials and pulling lubricant.
  2. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

## 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
- B. American Society of Testing Material (ASTM):
  - D2301-10.....Standard Specification for Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
  - D2304-10.....Test Method for Thermal Endurance of Rigid  
Electrical Insulating Materials
  - D3005-10.....Low-Temperature Resistant Vinyl Chloride  
Plastic Pressure-Sensitive Electrical  
Insulating Tape
- C. National Electrical Manufacturers Association (NEMA):
  - WC 70-09.....Power Cables Rated 2000 Volts or Less for the  
Distribution of Electrical Energy
- D. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10.....Thermoset-Insulated Wires and Cables
  - 83-08.....Thermoplastic-Insulated Wires and Cables
  - 467-07.....Grounding and Bonding Equipment
  - 486A-486B-03.....Wire Connectors
  - 486C-04.....Splicing Wire Connectors
  - 486D-05.....Sealed Wire Connector Systems
  - 486E-09.....Equipment Wiring Terminals for Use with  
Aluminum and/or Copper Conductors
  - 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cables
  - 514B-04.....Conduit, Tubing, and Cable Fittings

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.

B. All conductors shall be copper.

C. Single Conductor and Cable:

1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
2. No. 8 AWG and larger: Stranded.
3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

E. Color Code:

1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
2. No. 8 AWG and larger: Color-coded using one of the following methods:
  - a. Solid color insulation or solid color coating.
  - b. Stripes, bands, or hash marks of color specified.
  - c. Color using 19 mm (0.75 inches) wide tape.
4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the Resident Engineer.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

## 2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:

1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
  2. The integral insulator shall have a skirt to completely cover the stripped conductors.
  3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.
  4. All bolts, nuts, and washers used with splices shall be //zinc-plated//cadmium-plated// steel.
- D. Above Ground Splices for 250 kcmil and Larger:
1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
  2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
  3. Splice and insulation shall be product of the same manufacturer.
- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

### **2.3 CONNECTORS AND TERMINATIONS**

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated steel.

**2.4 CONTROL WIRING**

- A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

**2.5 WIRE LUBRICATING COMPOUND**

- A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
- B. Shall not be used on conductors for isolated power systems.

**PART 3 - EXECUTION****3.1 GENERAL**

- A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
- B. Install all conductors in raceway systems.
- C. Splice conductors only in outlet boxes, junction boxes, pullboxes, or handholes.
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
  - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
  - 2. Use nonmetallic pull ropes.
  - 3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.

- 4. All conductors in a single conduit shall be pulled simultaneously.
- 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

### **3.2 INSTALLATION IN MANHOLES (NOT USED)**

### **3.3 SPLICE AND TERMINATION INSTALLATION**

- A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
- B. Where the Government determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Government.

### **3.4 CONDUCTOR IDENTIFICATION**

- A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

### **3.5 FEEDER CONDUCTOR IDENTIFICATION**

- A. In each interior pullbox install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

### **3.6 EXISTING CONDUCTORS**

- A. Unless specifically indicated on the plans, existing conductors shall not be reused.

### **3.7 CONTROL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
- B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

### **3.8 CONTROL WIRING IDENTIFICATION**

- A. Install a permanent wire marker on each wire at each termination.



- B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- C. Wire markers shall retain their markings after cleaning.
- D. In each handhole, install embossed brass tags to identify the system served and function.

### **3.10 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests: Inspect physical condition.
  - 2. Electrical tests:
    - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
    - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
    - c. Perform phase rotation test on all three-phase circuits.

---END---



**SECTION 26 05 26**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- H. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.
- K. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.
- O. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Lightning protection.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
  - 2. Test Reports:
    - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Resident Engineer.
  - 3. Certifications:

- a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
  - B1-07.....Standard Specification for Hard-Drawn Copper Wire
  - B3-07.....Standard Specification for Soft or Annealed Copper Wire
  - B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-83.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 70E-12.....National Electrical Safety Code
  - 99-12.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10 .....Thermoset-Insulated Wires and Cables
  - 83-08 .....Thermoplastic-Insulated Wires and Cables
  - 467-07 .....Grounding and Bonding Equipment

## **PART 2 - PRODUCTS**

### **2.1 GROUNDING AND BONDING CONDUCTORS**

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors

shall be stranded for final connection to motors, transformers, and vibrating equipment.

C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

## **2.2 GROUND RODS (NOT USED)**

## **2.3 CONCRETE ENCASED ELECTRODE (NOT USED)**

## **2.4 GROUND CONNECTIONS**

A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

B. Above Grade:

1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2. Connection to Building Steel: Exothermic-welded type connectors.

3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

## **2.5 EQUIPMENT RACK AND CABINET GROUND BARS**

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

## **2.6 GROUND TERMINAL BLOCKS**

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

## **2.7 GROUNDING BUS BAR**

- A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:
  - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.
- D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

### **3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS (NOT USED)**

### **3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

- C. Panelboards and other electrical equipment:
  - 1. Connect the equipment grounding conductors to the ground bus.
  - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
- D. Transformers:
  - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.

### **3.5 RACEWAY**

- A. Conduit Systems:
  - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
  3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
  4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with an equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
  2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
  2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
  3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
  4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to

the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
- I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

### **3.6 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT (NOT USED)**

### **3.7 CORROSION INHIBITORS**

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.8 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

### **3.9 LIGHTNING PROTECTION SYSTEM**

- A. Bond the lightning protection system to the electrical grounding electrode system.

### **3.10 MAIN ELECTRICAL ROOM GROUNDING (NOT USED)**

### **3.11 EXTERIOR LIGHT POLES (NOT USED)**

### **3.12 GROUND RESISTANCE (NOT USED)**

### **3.13 GROUND ROD INSTALLATION (NOT USED)**

### **3.14 ACCEPTANCE CHECKS AND TESTS (NOT USED)**

---END---



**SECTION 26 05 33  
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- C. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 92 00, JOINT SEALANTS: Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- E. Section 09 91 00, PAINTING: Identification and painting of conduit and other devices.
- F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Conduits bracing.
- G. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- H. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Size and location of main feeders.
    - b. Size and location of panels and pull-boxes.
    - c. Layout of required conduit penetrations through structural elements.

- d. Submit the following data for approval:
  - 1) Raceway types and sizes.
  - 2) Conduit bodies, connectors and fittings.
  - 3) Junction and pull boxes, types and sizes.
- 2. Certifications: Two weeks prior to final inspection, submit the following:
  - a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
  - C80.1-05.....Electrical Rigid Steel Conduit
  - C80.3-05.....Steel Electrical Metal Tubing
  - C80.6-05.....Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
  - 1-05.....Flexible Metal Conduit
  - 5-11.....Surface Metal Raceway and Fittings
  - 6-07.....Electrical Rigid Metal Conduit - Steel
  - 50-95.....Enclosures for Electrical Equipment
  - 360-13.....Liquid-Tight Flexible Steel Conduit
  - 467-13.....Grounding and Bonding Equipment
  - 514A-13.....Metallic Outlet Boxes
  - 514B-12.....Conduit, Tubing, and Cable Fittings
  - 514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes  
and Covers
  - 651-11.....Schedule 40 and 80 Rigid PVC Conduit and  
Fittings

- 651A-11.....Type EB and A Rigid PVC Conduit and HDPE  
Conduit
- 797-07.....Electrical Metallic Tubing
- 1242-06.....Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):
- TC-2-13.....Electrical Polyvinyl Chloride (PVC) Tubing and  
Conduit
- TC-3-13.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing
- FB1-12.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable
- FB2.10-13.....Selection and Installation Guidelines for  
Fittings for use with Non-Flexible Conduit or  
Tubing (Rigid Metal Conduit, Intermediate  
Metallic Conduit, and Electrical Metallic  
Tubing)
- FB2.20-12.....Selection and Installation Guidelines for  
Fittings for use with Flexible Electrical  
Conduit and Cable
- F. American Iron and Steel Institute (AISI):
- S100-2007.....North American Specification for the Design of  
Cold-Formed Steel Structural Members

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
- B. Conduit:
1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
  2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
  4. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
  5. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.

- 6. Flexible Metal Conduit: Shall conform to UL 1.
- 7. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
- 9. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:

- a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
- b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
- c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
- d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
- e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

3. Electrical Metallic Tubing Fittings:

- a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
- b. Only steel or malleable iron materials are acceptable.
- c. Compression Couplings and Connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
- d. Indent-type connectors or couplings are prohibited.
- e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

4. Flexible Metal Conduit Fittings:

- a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp-type, with insulated throat.
- 5. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
- 7. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
- 8. Expansion and Deflection Couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
  - 1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
  - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  - 3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
  - 4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:

1. UL-50 and UL-514A.
2. Rustproof cast metal where required by the NEC or shown on drawings.
3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.

F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

### **PART 3 - EXECUTION**

#### **3.1 PENETRATIONS**

A. Cutting or Holes:

1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Resident Engineer prior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the Resident Engineer where working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

#### **3.2 INSTALLATION, GENERAL**

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
  1. In complete mechanically and electrically continuous runs before pulling in cables or wires.

2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
  3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
  4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  5. Cut conduits square, ream, remove burrs, and draw up tight.
  6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
  7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
  8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
  9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
  10. Conduit installations under fume and vent hoods are prohibited.
  11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
  12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
  13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
  2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
  3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
  2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Resident Engineer.

### 3.3 CONCEALED WORK INSTALLATION

#### A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only:
  - a. Where shown on the structural drawings.
  - b. As approved by the Resident Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
  - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

#### B. Above Furred or Suspended Ceilings and in Walls:

2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.



**3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.
- D. Align and run conduit parallel or perpendicular to the building lines.
- E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- G. Surface Metal Raceways: Use only where shown on drawings.
- H. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
  - 2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

**3.5 DIRECT BURIAL INSTALLATION (NOT USED)****3.6 HAZARDOUS LOCATIONS (NOT USED)****3.7 WET OR DAMP LOCATIONS**

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

### 3.8 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

### 3.9 EXPANSION JOINTS

- A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits 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 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper bonding jumper installed.

### 3.10 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.

- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
    - b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
    - c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.11 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush-mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.

- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
- I. On all branch circuit junction box covers, identify the circuits with black marker.

- - - E N D - - -

**SECTION 26 05 73  
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the overcurrent protective device coordination study, indicated as the study in this section.
- B. A short-circuit and selective coordination study shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- F. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
  - 2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.
  - 3. Certifications: Two weeks prior to final inspection, submit the following.
    - a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced. Publications are referenced in the text by designation only.

- B. Institute of Electrical and Electronics Engineers (IEEE):
- 242-01.....Protection and Coordination of Industrial and  
Commercial Power Systems
  - 399-97.....Industrial and Commercial Power Systems  
Analysis
  - 1584a-04.....Guide for Performing Arc-Flash Hazard  
Calculations

## 1.6 STUDY REQUIREMENTS

- A. The study shall include one line diagram, short-circuit and ground fault analysis, and protective coordination plots for all overcurrent protective devices.
- B. One Line Diagram:
1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
  2. Show the following specific information:
    - a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
    - b. Relay, circuit breaker, and fuse ratings.
    - c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
    - d. Voltage at each bus.
    - e. Identification of each bus, matching the identification on the drawings.
    - f. Conduit, conductor, and busway material, size, length, and X/R ratios.
- C. Short-Circuit Study:
1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in developing the calculations shall be described in the introductory remarks of the study.
  2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.

3. Present the results of the short-circuit study in a table. Include the following:
  - a. Device identification.
  - b. Operating voltage.
  - c. Overcurrent protective device type and rating.
  - d. Calculated short-circuit current.

D. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
2. The following specific information shall also be shown on the coordination curves:
  - a. Device identification.
  - b. Potential transformer and current transformer ratios.
  - c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
  - d. Applicable circuit breaker or protective relay characteristic curves.
  - e. No-damage, melting, and clearing curves for fuses.
  - f. Transformer in-rush points.
3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
  - a. Device identification.
  - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
  - c. Fuse rating and type.

## 1.7 ANALYSIS

- A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

**1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS**

- A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

---END---



**SECTION 26 08 00****COMMISSIONING OF ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

**1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and

resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

----- END -----

**SECTION 26 09 23  
LIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation and connection of the lighting controls.

**1.2 RELATED WORK**

- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General requirements that are common to more than one section of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 26 24 16, PANELBOARDS: Panelboard enclosure and interior bussing used for lighting control panels.
- F. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.
- G. Section 26 51 00, INTERIOR LIGHTING: Luminaire ballast and drivers used in control of lighting systems.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit the following information for each type of lighting controls.
    - b. Material and construction details.
    - c. Physical dimensions and description.
    - d. Wiring schematic and connection diagram.
    - e. Installation details.
  - 2. Manuals:
    - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data

sheets, wiring diagrams, and information for ordering replacement parts.

- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the Contractor that the lighting control systems have been properly installed and tested.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Green Seal (GS):
  - GC-12-03.....Occupancy Sensors
- C. National Electrical Manufacturer's Association (NEMA):
  - C136.10-10.....American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
  - ICS-1-08.....Standard for Industrial Control and Systems General Requirements
  - ICS-2-05.....Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
  - ICS-6-11.....Standard for Industrial Controls and Systems Enclosures
- D. National Fire Protection Association (NFPA):
  - 70-14.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 20.....Standard for General-Use Snap Switches
  - 773-95.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting
  - 773A-06.....Nonindustrial Photoelectric Switches for Lighting Control

- 98-04.....Enclosed and Dead-Front Switches
- 916-07.....Standard for Energy Management Equipment  
Systems
- 917-06.....Clock Operated Switches
- 924-06.....Emergency Lighting and Power Equipment (for use  
when controlling emergency circuits).

## **PART 2 - PRODUCTS**

### **2.1 ELECTRONIC TIME SWITCHES (NOT USED)**

### **2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES (NOT USED)**

### **2.3 OUTDOOR PHOTOELECTRIC SWITCHES (NOT USED)**

### **2.4 TIMER SWITCHES (NOT USED)**

### **2.5 CEILING-MOUNTED PHOTOELECTRIC SWITCHES**

- A. Solid-state, light-level sensor unit, with separate relay unit.
  - 1. Sensor Output: Contacts rated to operate the associated relay.  
Sensor shall be powered from the relay unit.
  - 2. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
  - 3. Monitoring Range: 108 to 2152 lx (10 to 200 fc), with an adjustment for turn-on and turn-off levels.
  - 4. Time Delay: Adjustable from 5 to 300 seconds, with deadband adjustment.
  - 5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

### **2.6 SKYLIGHT PHOTOELECTRIC SENSORS (NOT USED)**

### **2.7 INDOOR OCCUPANCY SENSORS**

- A. Wall- or ceiling-mounting, solid-state units with a power supply and relay unit, suitable for the environmental conditions in which installed.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a 1 to 15 minute adjustable time delay for turning lights off.
  - 2. Sensor Output: Contacts rated to operate the connected relay.  
Sensor shall be powered from the relay unit.
  - 3. Relay Unit: Dry contacts rated for 20A ballast load at 120 volt and 277 volt, for 13A tungsten at 120 volt, and for 1 hp at 120 volt.
  - 4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.

- b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
- 6. Bypass Switch: Override the on function in case of sensor failure.
- 7. Manual/automatic selector switch.
- 8. Automatic Light-Level Sensor: Adjustable from 21.5 to 2152 lx (2 to 200 fc); keep lighting off when selected lighting level is present.
- 9. Faceplate for Wall-Switch Replacement Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.
- B. Dual-technology Type: Ceiling mounting; combination PIR and Microphonic detection methods, field-selectable.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 150 mm (6-inch) minimum movement of any portion of a human body that presents a target of not less than 232 sq. cm (36 sq. in), and detect a person of average size and weight moving not less than 305 mm (12 inches) in either a horizontal or a vertical manner at an approximate speed of 305 mm/s (12 inches/s).
- C. Detection Coverage: Shall be sufficient to provide coverage as required by sensor locations shown on drawing.

## **2.8 INDOOR VACANCY SENSOR SWITCH**

- A. Wall mounting, solid-state units with integral sensor and switch.
  - 1. Operation: Manually turn lights on with switch and sensor detects vacancy to turn lights off.
  - 2. Switch Rating: 120/277 volt, 1200 watts at 277 volt, 800 watts at 120 volt unit.
  - 3. Mounting:
    - a. Sensor: Suitable for mounting in a standard switch box.
    - b. Time-Delay and Sensitivity Adjustments: Integral with switch and accessible for reprogramming without removing switch.
  - 4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 5. Switch: Manual operation to turn lights on and override lights off.
  - 6. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.



**2.9 OUTDOOR MOTION SENSOR (PIR) (NOT USED)****2.10 LIGHTING CONTROL SYSTEM - RELAY PANEL TYPE (NETWORK)(NOT USED)**

A. .

**2.11 LIGHTING CONTROL SYSTEM - RELAY PANEL TYPE (STAND ALONE)**

## A. System Description:

1. The lighting control system shall be with lighting relay panels.  
Lighting control devices connect to the relay panels and communicate via the panel controller. System includes all interfaces and wiring, relay panels, control modules, input modules, panel processors, relays, photocells, switches, dimmers, time clock, and occupancy sensors.
2. System shall include the capability of BACnet IP communication with other systems as described. System communication protocol shall be compatible with the existing building automation system.
3. Panel Controller shall provide programmable operation of lights connected via system relays and controlled with system devices. System software shall provide control of relays and control devices, time and sequence scheduling, timed out and blink light operation and monitoring and reporting of system events and components.  
Initial programming shall be as shown on plans and schedules.

- B. Panel Controller: Comply with UL 508; programmable, solid-state, astronomic 365-day control unit with non-volatile memory, mounted in preassembled relay panel with low-voltage-controlled, latching-type, single-pole lighting circuit relays. Controller shall be capable of receiving inputs from control devices and other sources. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays.
- C. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.
- D. Directory: Identifies each relay as to load controlled.
- E. System Power Supply: Transformer and full-wave rectifier with filtered dc output for panel, controllers and control devices. Feed from an equipment emergency circuit at a minimum.
- F. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125 volt AC for tungsten filaments and 20 A, 277 volt AC for electronic ballasts, 50,000 cycles at rated capacity.

- G. Control Devices: All occupancy sensors (Ultrasonic, IR and Dual Technology type), photocells, switches and timers shall be provided with system and designed to operate on system network. Supplemental power packs shall be provided as required for multiple control devices. This equipment shall be identified in shop drawing submission.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.
- B. Aim outdoor photoelectric sensor according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle turn-on.
- C. Aiming for wall-mounted and ceiling-mounted motion sensor switches shall be per manufacturer's recommendations.
- D. Set occupancy sensor "on" duration to 10 minutes.
- E. Locate photoelectric sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the available light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.
- G. Program lighting control panels per schedule on drawings.

#### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations.
- B. Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.
- C. Test for full range of dimming ballast and dimming controls capability. Observe for visually detectable flicker over full dimming range.
- D. Test occupancy sensors for proper operation. Observe for light control over entire area being covered.
- E. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized technician who will verify all adjustments and sensor placements.

#### **3.3 FOLLOW-UP VERIFICATION**

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function in the presence of Resident Engineer.

**3.4 INSTRUCTION**

- A. Furnish the services of a factory-trained technician for one 8-hour training period for instructing personnel in the maintenance and operation of the lighting control system on the dates requested by the Resident Engineer.
- B. Contractor shall submit written instructions on training and maintenance as reviewed in training session.

- - - E N D - - -



**SECTION 26 22 00**  
**LOW-VOLTAGE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

**1.2 RELATED WORK**

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- D. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- E. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1. Shop Drawings:

- a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.

- 1) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the transformers.
- 2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the transformers conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the transformers have been properly installed, adjusted, and tested.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
  - IBC-12.....International Building Code
- C. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
- D. National Electrical Manufacturers Association (NEMA):
  - TP1-02.....Guide for Determining Energy Efficiency for  
Distribution Transformers
  - TR1-00.....Transformers, Regulators, and Reactors
- E. Underwriters Laboratories, Inc. (UL):
  - UL 506-08.....Standard for Specialty Transformers
  - UL 1561-11.....Dry-Type General Purpose and Power Transformers
- F. United States Department of Energy
  - 10 CFR Part 431.....Energy Efficiency Program for Certain  
Commercial and Industrial Equipment

**PART 2 - PRODUCTS****2.1 TRANSFORMERS**

- A. Unless otherwise specified, transformers shall be in accordance with NEMA, NEC, UL and as shown on the drawings.
- B. Transformers shall have the following features:
1. Self-cooled by natural convection, isolating windings, indoor dry-type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
  2. Rating and winding connections shall be as shown on the drawings.
  3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
  4. Copper windings.
  5. Insulation systems:
    - a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
    - b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
  6. Core and coil assemblies:
    - a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
    - b. Cores shall be grain-oriented, non-aging, and silicon steel.
    - c. Coils shall be continuous windings without splices except for taps.
    - d. Coil loss and core loss shall be minimized for efficient operation.
    - e. Primary and secondary tap connections shall be brazed or pressure type.
    - f. Coil windings shall have end filters or tie-downs for maximum strength.
  7. Certified sound levels, determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB

51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.
9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
  - a. Comprised of not less than code gauge steel.
  - b. Outdoor enclosures shall be NEMA 3R.
  - c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
  - d. Ventilation openings shall prevent accidental access to live components.
  - e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98



112.5	98.2
150	98.3
225	98.5
300	98.6
500	98.7
750	98.8

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.
- B. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer's instructions, and as shown on drawings.
- C. In seismic areas, transformers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- E. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).
- F. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform tests in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical and mechanical condition.
    - c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
    - d. Perform specific inspections and mechanical tests as recommended by manufacturer.
    - e. Verify correct equipment grounding.
    - f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

### 3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

---END---

**SECTION 26 24 16**  
**PANELBOARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of panelboards.

**1.2 RELATED WORK**

- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- H. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY: Short circuit and coordination study, and requirements for a coordinated electrical system.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
  2. Manuals:
    - a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data

sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.

- 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
- 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
  - IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
  - PB 1-11.....Panelboards
  - 250-08.....Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 70E-12.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
  - 50-95.....Enclosures for Electrical Equipment
  - 67-09.....Panelboards
  - 489-09.....Molded Case Circuit Breakers and Circuit Breaker Enclosures

**PART 2 - PRODUCTS****2.1 GENERAL REQUIREMENTS**

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Neutral bus shall be 100% rated, mounted on insulated supports.
- H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
- J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.
- K. Series-rated panelboards are not permitted.

**2.2 ENCLOSURES AND TRIMS**

- A. Enclosures:
  - 1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
  - 2. Enclosures shall not have ventilating openings.

3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

1. Hinged "door-in-door" type.
2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush or surface type as shown on the drawings.

### **2.3 MOLDED CASE CIRCUIT BREAKERS**

- A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
  1. 120/208 V Panelboard: 10,000 A symmetrical.
  2. 120/240 V Panelboard: 10,000 A symmetrical.
  3. 277/480 V Panelboard: 14,000 A symmetrical.
- D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x.
- E. Circuit breaker features shall be as follows:
  1. A rugged, integral housing of molded insulating material.
  2. Silver alloy contacts.
  3. Arc quenchers and phase barriers for each pole.
  4. Quick-make, quick-break, operating mechanisms.
  5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.

6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.
10. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory accordingly.

#### **2.4 SURGE PROTECTIVE DEVICES (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. In seismic areas, panelboards shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- D. Install a printed schedule of circuits in each panelboard after approval by the Resident Engineer. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
- E. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- F. Provide blank cover for each unused circuit breaker mounting space.
- I. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

#### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  1. Visual Inspection and Tests:

- a. Compare equipment nameplate data with specifications and approved shop drawings.
- b. Inspect physical, electrical, and mechanical condition.
- c. Verify appropriate anchorage and required area clearances.
- d. Verify that circuit breaker sizes and types correspond to approved shop drawings.
- e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
- f. Vacuum-clean enclosure interior. Clean enclosure exterior.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

---END---



**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
  - 2. Manuals:
    - a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.

- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
- 3. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the wiring devices conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 99-12.....Health Care Facilities
- C. National Electrical Manufacturers Association (NEMA):
  - WD 1-10.....General Color Requirements for Wiring Devices
  - WD 6-08 .....Wiring Devices - Dimensional Specifications
- D. Underwriter's Laboratories, Inc. (UL):
  - 5-11.....Surface Metal Raceways and Fittings
  - 20-10.....General-Use Snap Switches
  - 231-07.....Power Outlets
  - 467-07.....Grounding and Bonding Equipment
  - 498-07.....Attachment Plugs and Receptacles
  - 943-11.....Ground-Fault Circuit-Interrupters
  - 1449-07.....Surge Protective Devices
  - 1472-96.....Solid State Dimming Controls

## **PART 2 - PRODUCTS**

### **2.1 RECEPTACLES**

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
  - 1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.

2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
- B. Duplex Receptacles: Hospital-grade, single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
  1. Bodies shall be ivory in color.
  2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
  3. Duplex Receptacles on Emergency Circuit:
    - a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
  4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, hospital-grade, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring.
    - a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or - 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
    - b. Ground Fault Interrupter Duplex Receptacles (not hospital-grade) shall be the same as ground fault interrupter hospital-grade receptacles except for the hospital-grade listing.
  5. Safety Type Duplex Receptacles:
    - a. Bodies shall be ivory in color.
      - 1) Shall permit current to flow only while a standard plug is in the proper position in the receptacle.
      - 2) Screws exposed while the wall plates are in place shall be the tamperproof type.
  6. Duplex Receptacles (not hospital grade): Shall be the same as hospital grade duplex receptacles except for the hospital grade listing and as follows.
    - a. Bodies shall be ivory nylon.

- C. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

## **2.2 TOGGLE SWITCHES**

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be ivory in color unless otherwise specified or shown on the drawings.
  - 1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
  - 2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self grounding mounting strap with break-off plaster ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
  - 3. Switches shall be rated 20 amperes at 120-277 Volts AC.

## **2.3 MANUAL DIMMING CONTROL**

- A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
- B. Manual dimming controls shall be fully compatible with LED dimming driver and be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
- C. Provide single-pole or three-way, as shown on the drawings.
- D. Manual dimming control and faceplates shall be ivory in color unless otherwise specified.

## **2.4 WALL PLATES**

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
- B. Color shall be ivory unless otherwise specified.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

- D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- E. Duplex Receptacles on Emergency Circuit: Wall plates shall be red nylon with the word "EMERGENCY" engraved in 6 mm (1/4 inch) white letters.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.
- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multigang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

### 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Inspect physical and electrical condition.
    - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
    - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
    - d. Test GFCI receptacles.
  - 2. Healthcare Occupancy Tests:
    - a. Test hospital grade receptacles for retention force per NFPA 99.

---END---

**SECTION 26 29 11  
MOTOR CONTROLLERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of motor controllers, including all low- and medium-voltage motor controllers and manual motor controllers, indicated as motor controllers in this section, and low-voltage variable speed motor controllers.
- B. Motor controllers, whether furnished with the equipment specified in other sections or otherwise (with the exception of elevator motor controllers specified in Division 14 and fire pump controllers specified in Division 21), shall meet this specification and all related specifications.

**1.2 RELATED WORK**

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint for nonstructural components.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, weights, mounting details, materials, overcurrent protection devices, overload

relays, sizes of enclosures, wiring diagrams, starting characteristics, interlocking, and accessories.

- c. Certification from the manufacturer that representative motor controllers have been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

## 2. Manuals:

- a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
    - 1) Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
    - 2) Wiring diagrams shall indicate internal wiring for each item of equipment and interconnections between the items of equipment.
    - 3) Elementary schematic diagrams shall be provided for clarity of operation.
    - 4) Include the catalog numbers for the correct sizes of overload relays for the motor controllers.
  - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the manufacturer that the motor controllers conform to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the motor controllers have been properly installed, adjusted, and tested.

## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
  - 519-92.....Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems



- C37.90.1-02.....Standard Surge Withstand Capability (SWC) Tests  
for Relays and Relay Systems Associated with  
Electric Power Apparatus
- C. International Code Council (ICC):
- IBC-12.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
- ICS 1-08.....Industrial Control and Systems: General  
Requirements
- ICS 1.1-09.....Safety Guidelines for the Application,  
Installation and Maintenance of Solid State  
Control
- ICS 2-05.....Industrial Control and Systems Controllers,  
Contactors, and Overload Relays Rated 600 Volts
- ICS 4-05.....Industrial Control and Systems: Terminal Blocks
- ICS 6-06.....Industrial Control and Systems: Enclosures
- ICS 7-06.....Industrial Control and Systems: Adjustable-  
Speed Drives
- ICS 7.1-06.....Safety Standards for Construction and Guide for  
Selection, Installation, and Operation of  
Adjustable-Speed Drive Systems
- MG 1 Part 31.....Inverter Fed Polyphase Motor Standards
- E. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- F. Underwriters Laboratories Inc. (UL):
- 508A-07.....Industrial Control Panels
- 508C-07.....Power Conversion Equipment
- UL 1449-06.....Surge Protective Devices

## **PART 2 - PRODUCTS**

### **2.1 MOTOR CONTROLLERS**

- A. Motor controllers shall comply with IEEE, NEMA, NFPA, UL, and as shown on the drawings.
- B. Motor controllers shall be separately enclosed, unless part of another assembly. For installation in motor control centers, provide plug-in, draw-out type motor controllers up through NEMA size 4. NEMA size 5 and above require bolted connections.
- C. Motor controllers shall be combination type, with magnetic controller per Paragraph 2.3 below and with motor circuit protector disconnecting

means, with external operating handle with lock-open padlocking positions and ON-OFF position indicator.

3. Motor Circuit Protectors:

- a. Magnetic trip only.
- b. Bolt-on type with a minimum interrupting rating as indicated on the drawings.
- c. Equipped with automatic, adjustable magnetic trip. Magnetic trip shall be adjustable up to 1300% of the motor full load amperes.

D. Enclosures:

1. Enclosures shall be NEMA-type rated 1, 3R, or 12 as indicated on the drawings or as required per the installed environment.
2. Enclosure doors shall be interlocked to prevent opening unless the disconnecting means is open. A "defeater" mechanism shall allow for inspection by qualified personnel with the disconnect means closed. Provide padlocking provisions.
3. All metal surfaces shall be thoroughly cleaned, phosphatized, and factory primed prior to applying light gray baked enamel finish.

E. Motor control circuits:

1. Shall operate at not more than 120 Volts.
2. Shall be grounded, except where the equipment manufacturer recommends that the control circuits be isolated.
3. For each motor operating over 120 Volts, incorporate a separate, heavy duty, control transformer within each motor controller enclosure.
4. Incorporate primary and secondary overcurrent protection for the control power transformers.

F. Overload relays:

1. Thermal type. Devices shall be NEMA type.
2. One for each pole.
3. External overload relay reset pushbutton on the door of each motor controller enclosure.
4. Overload relays shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
5. Thermal overload relays shall be tamperproof, not affected by vibration, manual reset, sensitive to single-phasing, and shall have selectable trip classes of 10, 20 and 30.

- G. Hand-Off-Automatic (H-O-A) switch is required unless specifically stated on the drawings as not required for a particular controller. H-O-A switch shall be operable without opening enclosure door. H-O-A switch is not required for manual motor controllers.
- H. Incorporate into each control circuit a 120 Volt, electronic time-delay relay (ON delay), minimum adjustable range from 0.3 to 10 minutes, with transient protection. Time-delay relay is not required where H-O-A switch is not required.
- I. Unless noted otherwise, equip each motor controller with not less than two normally open (N.O.) and two normally closed (N.C.) auxiliary contacts.
- J. Provide green (RUN) and red (STOP) pilot lights.
- K. Motor controllers incorporated within equipment assemblies shall also be designed for the specific requirements of the assemblies.
- L. Additional requirements for specific motor controllers, as indicated in other specification sections, shall also apply.

## **2.2 MANUAL MOTOR CONTROLLERS**

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Manual motor controllers shall have the following features:
  - 1. Controllers shall be general-purpose Class A, manually operated type with full voltage controller for induction motors, rated in horsepower.
  - 2. Units shall include thermal overload relays, on-off operator, red pilot light, normally open auxiliary contacts.
- C. Fractional horsepower manual motor controllers shall have the following features:
  - 1. Controllers shall be general-purpose Class A, manually operated type with full voltage controller for fractional horsepower induction motors.
  - 2. Units shall include thermal overload relays, red pilot light, and toggle operator.

## **2.3 MAGNETIC MOTOR CONTROLLERS**

- A. Shall be in accordance with applicable requirements of 2.1 above.
- B. Controllers shall be general-purpose, Class A magnetic controllers for induction motors rated in horsepower. Minimum NEMA size 0.
- C. Where combination motor controllers are used, combine controller with protective or disconnect device in a common enclosure.

- D. Provide phase loss protection for each controller, with contacts to de-energize the controller upon loss of any phase.
- E. Unless otherwise indicated, provide full voltage non-reversing across-the-line mechanisms for motors less than 75 HP, closed by coil action and opened by gravity. For motors 75 HP and larger, provide reduced-voltage or variable speed controllers as shown on the drawings. Equip controllers with 120 VAC coils and individual control transformer unless otherwise noted.

#### **2.4 REDUCED VOLTAGE MOTOR CONTROLLERS**

- A. Shall be in accordance with applicable portions of 2.1 above.
- B. Shall have closed circuit transition.
- C. Shall limit inrush currents to not more than 70 percent of the locked rotor current.
- D. Provide phase loss protection for each motor controller, with contacts to de-energize the motor controller upon loss of any phase.

#### **2.5 MEDIUM-VOLTAGE MOTOR CONTROLLERS (NOT USED)**

#### **2.6 LOW-VOLTAGE VARIABLE SPEED MOTOR CONTROLLERS (VSMC)**

- A. VSMC shall be in accordance with applicable portions of 2.1 above.
- B. VSMC shall be electronic, with adjustable frequency and voltage, three phase output, capable of driving standard NEMA B three-phase induction motors at full rated speed. The control technique shall be pulse width modulation (PWM), where the VSMC utilizes a full wave bridge design incorporating diode rectifier circuitry. Silicon controlled rectifiers or other control techniques are not acceptable.
- C. VSMC shall be suitable for variable torque loads, and shall be capable of providing sufficient torque to allow the motor to break away from rest upon first application of power.
- D. VSMC shall be capable of operating within voltage parameters of plus 10 to minus 15 percent of line voltage, and be suitably rated for the full load amps of the maximum watts (HP) within its class.
- E. Minimum efficiency shall be 95 percent at 100 percent speed and 85 percent at 50 percent speed.
- F. The displacement power factor of the VSMC shall not be less than 95 percent under any speed or load condition.
- G. VSMC current and voltage harmonic distortion shall not exceed the values allowed by IEEE 519.
- H. Operating and Design Conditions:

1. Elevation: 1,500 feet Above Mean Sea Level (AMSL)
  2. Temperatures: Maximum +90°F Minimum -10°F
  3. Relative Humidity: 95%
  4. VSMC Location: Air conditioned space
- I. VSMC shall have the following features:
1. Isolated power for control circuits.
  2. Manually resettable overload protection for each phase.
  3. Adjustable current limiting circuitry to provide soft motor starting. Maximum starting current shall not exceed 200 percent of motor full load current.
  4. Independent acceleration and deceleration time adjustment, manually adjustable from 2 to 2000 seconds. Set timers to the equipment manufacturer's recommended time in the above range.
  5. Control input circuitry that will accept 4 to 20 mA current or 0-10 VDC voltage control signals from an external source.
  6. Automatic frequency adjustment from 1 Hz to 300 Hz.
  7. Circuitry to initiate an orderly shutdown when any of the conditions listed below occur. The VSMC shall not be damaged by any of these electrical disturbances and shall automatically restart when the conditions are corrected. The VSMC shall be able to restart into a rotating motor operating in either the forward or reverse direction and matching that frequency.
    - a. Incorrect phase sequence.
    - b. Single phasing.
    - c. Overvoltage in excess of 10 percent.
    - d. Undervoltage in excess of 15 percent.
    - e. Running overcurrent above 110 percent (VSMC shall not automatically reset for this condition.)
    - f. Instantaneous overcurrent above 150 percent (VSMC shall not automatically reset for this condition).
    - g. Short duration power outages of 12 cycles or less (i.e., distribution line switching, generator testing, and automatic transfer switch operations.)
  8. Provide automatic shutdown upon receiving a power transfer warning signal from an automatic transfer switch. VSMC shall automatically restart motor after the power transfer.
  9. Automatic Reset/Restart: Attempt three restarts after VSMC fault or on return of power after an interruption and before shutting down

- for manual reset or fault correction, with adjustable delay time between restart attempts.
10. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
  11. Bidirectional Autospeed Search: Capable of starting VSMC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to VSMC, motor, or load.
- J. VSMC shall include an input circuit breaker which will disconnect all input power, interlocked with the door so that the door cannot be opened with the circuit breaker in the closed position.
- K. VSMC shall include a 5% line reactor and a RFI/EMI filter.
- L. Surge Suppression: Provide three-phase protection against damage from supply voltage surges in accordance with UL 1449.
- M. VSMC shall include front-accessible operator station, with sealed keypad and digital display, which allows complete programming, operating, monitoring, and diagnostic capabilities.
1. Typical control functions shall include but not be limited to:
    - a. HAND-OFF-AUTOMATIC-RESET, with manual speed control in HAND mode.
    - b. NORMAL-BYPASS.
    - c. NORMAL-TEST, which allows testing and adjusting of the VSMC while in bypass mode.
  2. Typical monitoring functions shall include but not be limited to:
    - a. Output frequency (Hz).
    - b. Motor speed and status (run, stop, fault).
    - c. Output voltage and current.
  3. Typical fault and alarm functions shall include but not be limited to:
    - a. Loss of input signal, under- and over-voltage, inverter overcurrent, motor overload, critical frequency rejection with selectable and adjustable deadbands, instantaneous line-to-line and line-to-ground overcurrent, loss-of-phase, reverse-phase, and short circuit.
    - b. System protection indicators indicating that the system has shutdown and will not automatically restart.
- N. VSMC shall include two N.O. and two N.C. dry contacts rated 120 Volts, 10 amperes, 60 Hz.

- O. Hardware, software, network interfaces, gateways, and programming to control and monitor the VSMC by control systems specified in other specification sections, including but not limited to Divisions 22 and 23.
- P. Network communications ports: As required for connectivity to control systems specified in other specification sections, including but not limited to Divisions 22 and 23.
- Q. Communications protocols: As required for communications with control systems specified in other specification sections, including but not limited to Divisions 22 and 23.
- R. Bypass controller: Provide contactor-style bypass, arranged to bypass the inverter.
  - 1. Inverter Output Contactor and Bypass Contactor: Load-break NEMA-rated contactor.
  - 2. Motor overload relays.
  - 3. HAND-OFF-AUTOMATIC bypass control.
- S. Bypass operation: Transfers motor between inverter output and bypass circuit, manually, automatically, or both. VSMC shall be capable of stable operation (starting, stopping, and running), and control by fire alarm and detection systems, with motor completely disconnected from the inverter output. Transfer between inverter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.
- T. Inverter Isolating Switch: Provide non-load-break switch arranged to isolate inverter and permit safe troubleshooting and testing of the inverter, both energized and de-energized, while motor is operating in bypass mode. Include padlockable, door-mounted handle mechanism.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install motor controllers in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. In seismic areas, motor controllers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Install manual motor controllers in flush enclosures in finished areas.
- D. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and electronic overload relay pickup and trip ranges.

- E. Program variable speed motor controllers per the manufacturer's instructions and in coordination with other trades so that a complete and functional system is delivered.
- F. Adjust trip settings of circuit breakers and motor circuit protectors with adjustable instantaneous trip elements. Initially adjust at six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficiency motors if required). Where these maximum settings do not allow starting of a motor, notify Resident Engineer before increasing settings.
- G. Set the taps on reduced-voltage autotransformer controllers at 65 percent of line voltage.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform manufacturer's required field tests in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.
    - c. Verify appropriate anchorage, required area clearances, and correct alignment.
    - d. Verify that circuit breaker, motor circuit protector, and fuse sizes and types correspond to approved shop drawings.
    - e. Verify overload relay ratings are correct.
    - f. Vacuum-clean enclosure interior. Clean enclosure exterior.
    - g. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
    - h. Test all control and safety features of the motor controllers.
    - i. For low-voltage variable speed motor controllers, final programming and connections shall be by a factory-trained technician. Set all programmable functions of the variable speed motor controllers to meet the requirements and conditions of use.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the motor



controllers are in good operating condition and properly performing the intended functions.

#### **3.4 SPARE PARTS**

- A. Two weeks prior to the final inspection, provide one complete set of spare fuses for each motor controller.

#### **3.5 INSTRUCTION**

- A. Furnish the services of a factory-trained technician for two 4-hour training periods for instructing personnel in the maintenance and operation of the motor controllers, on the dates requested by the Resident Engineer.

---END---



**SECTION 26 29 21**  
**ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

**1.2 RELATED WORK**

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of non-structural components.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit the following data for approval:
      - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
    - c. Certification from the manufacturer that representative enclosed switches and circuit breakers have been seismically tested to

International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

2. Manuals:

- a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
  - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
  - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
- b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.

3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
  - IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):
  - FU 1-07.....Low Voltage Cartridge Fuses
  - KS 1-06.....Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 98-07.....Enclosed and Dead-Front Switches

248-00.....Low Voltage Fuses

489-09.....Molded Case Circuit Breakers and Circuit  
Breaker Enclosures

## **PART 2 - PRODUCTS**

### **2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
  - 1. Switch mechanism shall be the quick-make, quick-break type.
  - 2. Copper blades, visible in the open position.
  - 3. An arc chute for each pole.
  - 4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
  - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
  - 6. Fuse holders for the sizes and types of fuses specified.
  - 7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
  - 8. Ground lugs for each ground conductor.
  - 9. Enclosures:
    - a. Shall be the NEMA types shown on the drawings.
    - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
    - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

### **2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS**

- A. Shall be the same as fused switches, but without provisions for fuses.

### **2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES (NOT USED)**

### **2.4 MOTOR RATED TOGGLE SWITCHES**

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

## **2.5 CARTRIDGE FUSES (NOT USED)**

## **2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS**

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. In seismic areas, enclosed switches and circuit breakers shall be adequately anchored and braced per details on structural contract drawings to withstand the seismic forces at the location where installed.
- C. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

## **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.
    - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
    - d. Vacuum-clean enclosure interior. Clean enclosure exterior.

## **3.3 SPARE PARTS**

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Resident Engineer.

---END---

**SECTION 26 41 00**  
**FACILITY LIGHTNING PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing and installation of a complete UL master labeled lightning protection system.

**1.2 RELATED WORK**

- A. Section 07 60 00, FLASHING AND SHEET METAL: Penetrations through the roof.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.
- D. Section 26 42 00 CATHODIC PROTECTION: Requirements for protection of buried ferrous equipment from galvanic corrosion.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Show locations of air terminals, connections to required metal surfaces, down conductors, and grounding means.
    - c. Show the mounting hardware and materials used to attach air terminals and conductors to the structure.
  - 2. Certifications: Two weeks prior to final inspection, submit the following.
    - a. Certification by the manufacturer that the lightning protection system conforms to the requirements of the drawings and specifications.
    - b. Certification by the Contractor that the lightning protection system has been properly installed and inspected.

- c. Certification that the lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 780-11.....Standard for the Installation of Lightning Protection Systems
- C. Underwriters Laboratories, Inc. (UL):
  - 96-05.....Lightning Protection Components
  - 96A-07.....Installation Requirements for Lightning Protection Systems
  - 467-07.....Standard for Grounding and Bonding Equipment

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Lightning protection components shall conform to NFPA 780 and UL 96, for use on Class I structures. Aluminum materials are not allowed.
  - 1. Class I conductors: Copper.
  - 2. Class I air terminals: Solid copper, 460 mm (18 inches) long, not less than 9.5 mm (3/8 inch) diameter, with sharp nickel-plated points.
  - 5. Ground plates: Solid copper, not less than 20 gauge.
  - 6. Bonding plates: Bronze, 50 square cm (8 square inches).
  - 7. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
  - 8. Down conductor guards: Stiff copper or brass.
  - 9. Anchors and fasteners: Bronze bolt and clamp type shall be used for all applications except for membrane roof. Adhesive type are allowed only for attachment to membrane roof materials, using adhesive that is compatible with the membrane material.
  - 10. Connectors: Bronze clamp-type connectors shall be used for roof conductor splices, and the connection of the roof conductor to air



terminals and bonding plates. Crimp-type connectors are not allowed.

11. Exothermic welds: Exothermic welds shall be used for splicing the roof conductor to the down conductors, splices of the down conductors, and for connection of the down conductors to ground rods, ground plates, and the ground ring.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be coordinated with the roofing manufacturer and installer.
- B. Install the conductors as inconspicuously as practical.
- C. Install the down conductors within the concealed cavity of exterior walls where practical. Run the down conductors to the exterior at elevations below the finished grade.
- D. Where down conductors are subject to damage or are accessible near grade, protect with down conductor guards to 2.4 m (8 feet) above grade. Bond down conductor guards to down conductor at both ends.
- E. Make connections of dissimilar metal with bimetallic type fittings to prevent electrolytic action.
- F. Install ground rods and ground plates not less than 600 mm (2 feet) deep and a distance not less than 900 mm (3 feet) nor more than 2.5 m (8 feet) from the nearest point of the structure. Exothermically weld the down conductors to ground rods and ground plates in the presence of the Resident Engineer.
- G. Bond down conductors to metal main water piping where applicable.
- H. Bond down conductors to building structural steel.
- I. Connect roof conductors to all metallic projections and equipment above the roof as indicated on the drawings.
- J. Connect exterior metal surfaces, located within 900 mm (3 feet) of the conductors, to the conductors to prevent flashovers.
- K. Maintain horizontal or downward coursing of main conductor and ensure that all bends have at least an 200 mm (8 inches) radius and do not exceed 90 degrees.
- L. Conductors shall be rigidly fastened every 900 mm (3 feet) along the roof and down to the building to ground.
- M. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or

other braces permanently and rigidly attached to the building or structure.

- N. Install air terminal bases, cable holders and other roof-system supporting means without piercing membrane or metal roofs.
- O. Use through-roof connectors for penetration of the roof system. Flashing shall be provided by roofing contractor in accordance with Section 07 60 00, FLASHING AND SHEET METAL.
- P. Down conductors coursed on or in reinforced concrete columns or on structural steel columns shall be connected to the reinforcing steel or the structural steel member at its upper and lower extremities. In the case of long vertical members an additional connection shall be made at intervals not exceeding 30 M (100 feet).
- Q. A counterpoise or ground ring, where shown, shall be of No. 1/0 copper cable having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 600 mm (2 feet) deep at a distance not less than 900 mm (3 feet) nor more than 2.5 M (8 feet) from the nearest point of the structure.
- R. On construction utilizing post tensioning systems to secure precast concrete sections, the post tension rods shall not be used as a path for lightning to ground.
- S. Where shown, use the structural steel framework or reinforcing steel as the down conductor.
  - 1. Weld or bond the non-electrically-continuous sections together and make them electrically continuous.
  - 2. Verify the electrical continuity by measuring the ground resistances to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings.
  - 3. Connect the air terminals together with an exterior conductor connected to the structural steel framework at not more than 18 m (60 foot) intervals.
  - 4. Install ground connections to earth at not more than 18 m (60 foot) intervals around the perimeter of the building.
  - 5. Weld or braze bonding plates to cleaned sections of the steel and connect the conductors to the plates.
  - 6. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to UL 96A.

- U. Where the drawings show the new lightning protection system connected to an existing lightning protection system with or without a UL master label, the new portion of the lightning protection system requires UL inspection and a Letter of Findings.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Test the ground resistance to earth by standard methods, and conform to the ground resistance requirements specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- B. A UL representative shall inspect the lightning protection system. Obtain and install a UL numbered master label for each of the lightning protection systems at the location directed by the UL representative and the Resident Engineer.

---END---



**SECTION 26 42 00  
CATHODIC PROTECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies complete galvanic sacrificial anode type cathodic protection systems for underground steel tanks and piping. The section also includes devices to electrically isolate the system being protected.
- B. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water, Fire Protection, and Gas lines, their connectors and //lines under the slab or floor foundation. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing a utility service pipe shall have a test station.

**1.2 RELATED WORK**

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
- E. Section 26 05 06, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground faults.
- F. Section 26 41 00 FACILITY LIGHTNING PROTECTION: Requirements for personnel safety and to provide a low impedance path to ground for lightning caused surges.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The Contractor shall be regularly engaged in the installation and testing of cathodic protection systems. Contractor's personnel shall be experienced, and shall be supervised by an engineer who is accredited as a Corrosion Specialist or Cathodic Protection Specialist

by the National Association of Corrosion Engineers (NACE) International.

#### 1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Submit sufficient information to demonstrate compliance with drawings and specifications.

1. Design Submittal: For cathodic protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the corrosion engineer responsible for their preparation.
  - a. Conduct site tests necessary for design, including soil resistivity, close-interval potential surveys, testing during construction, interference testing, and training of Owner's personnel.
  - b. Provide system design calculations, stating the maximum recommended anode current output density, and the rate of gaseous production, if any, at that current density.
2. Furnish catalog cuts and shop drawings for the following items:
  - a. Anodes.
  - b. Cable and wire.
  - c. Test stations.
  - d. Terminal boxes.
  - e. Isolating flanges, unions, coatings, casing seals.
  - f. Exothermic welding devices.
  - g. Cable splice kits.
  - h. Layout drawings, wiring diagrams.
  - i. Test instruments.
  - j. Dielectric tape.
  - k. Test connection points.
3. Detail drawings consisting of a complete list of equipment and material and complete wiring and schematic diagrams, as well as any other details required to demonstrate that the system will function properly.
4. Designer's accreditation as a Corrosion Specialist or Cathodic Protection Specialist by NACE International.
5. Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, casing and

interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.

6. Operation and Maintenance Manual:
  - a. Basic system operation.
  - b. Instructions for dielectric connections, interference and sacrificial-anode bonds; and precautions to ensure safe conditions during repair of pipe, tank or other metallic systems.
  - c. Locations of all anodes, test stations, and insulating joints.
  - d. Structure-to-reference cell potentials.
  - e. Recommendations for maintenance testing, including instructions for pipe-to-reference cell potential measurements and frequency of testing.
  - f. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
7. Certifications: Two weeks prior to final inspection, submit the following.
  - a. Certification by the manufacturer that the cathodic protection system conforms to the requirements of the drawings and specifications.
  - b. Certification by the Contractor that the Cathodic protection system has been properly installed and adjusted.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - B8-11.....Concentric-Lay-Stranded Copper Conductors,  
Hard, Medium-Hard, or Soft
  - B843-07.....Magnesium Alloy Anodes for Cathodic Protection
  - D1248-12.....Polyethylene Plastic Extrusion Materials for  
Wire and Cable
  - F1182-07.....Anodes, Sacrificial Zinc Alloy

G57-12.....Field Measurement of Soil Resistivity Using the  
Wenner Four-Electrode Method

C. American Society of Mechanical Engineers (ASME):

B16-98.....Pipes and Fittings

D. National Association of Corrosion Engineers (NACE) International:

RP0169-02.....Control of External Corrosion on Underground or  
Submerged Metallic Piping Systems

RP0285-02.....Corrosion Control of Underground Storage Tank  
Systems by Cathodic Protection

SPEC WRITER NOTE: Delete between // ----  
// if not applicable to project. Also  
delete any other item or paragraph not  
applicable to the section and renumber  
the paragraphs.

## PART 2 - PRODUCTS

### 2.1 ANODES

A. Type: Type II, factory-packed in cloth bag or box containing prepared  
backfill mixture, with lead wires.

B. Construction:

1. Alloy Specifications:

SPEC WRITER NOTE: The chemical  
composition listed is for high potential  
anodes in accordance with ASTM B 843.  
Should Type I anodes be considered  
suitable, provide appropriate chemical  
composition. Specify chemical  
composition which will provide adequate  
and economical service.

Element	Percent of Weight
Aluminum	0.010 Max.
Manganese	0.50 - 1.30
Zinc	0.05 Max.
Silicon	0.50 Max.
Copper	0.02 Max.
Nickel	0.001 Max.
Iron	0.03 Max.
Other	0.30 Max.
Magnesium	Remainder

2. Core: Galvanized steel.



3. Lead Wire: Factory installed, No. 12 solid copper, 3 M (10 feet) long, with TW or THWN insulation.
4. Lead Wire Attachment to Core: Silver solder the lead wire to the anode core, and seal the connection with an epoxy sealing compound. Dielectric material shall extend past the connection and cover the lead wire insulation by not less than 12 mm (1/2 inch).
5. Packaging: Permeable cloth bag or box with backfill mixture completely surrounding anode 12 mm (1/2 inch) minimum.
  - a. Components:

Hydrated Gypsum	75 percent
Powdered Bentonite	20 percent
Anhydrous Sodium Sulphate	5 percent

- b. Center the anode in the firmly packed backfill using spacers.

## 2.2 INSULATED CABLE

- A. Single conductor, stranded, annealed copper, Type HMWPE (high molecular weight polyethylene) insulation.
- B. Construction:
  1. Thickness of insulation:

AWG-SIZE	mm (inches)
No. 8	2.8 (7/64)
No. 6	2.8 (7/64)
No. 4	2.8 (7/64)
No. 2	2.8 (7/64)
No. 1	3.2 (8/64)
No. 1/0	3.2 (8/64)

2. Insulation: ASTM D1248, Type 1, Class C, Category 5, Grade E5.
  3. Conductors: ASTM B8.
- C. Lead wires terminating at a junction box or test station shall have a cable identification tag.

## 2.3 CABLE CONNECTIONS

- A. Connections between cables and tank, pipes, casings, or structures shall be exothermic welding process. Connections between cables and between cables and leads shall be corrosion-resistant split bolts.

- B. Insulation of Cable-to-Cable Connections: Epoxy-resin splice kits with two-part resin, mold, sealing mastic.
- C. Coating of Cable Connections to Protected Structures: Field-applied coating similar to that on the protected structure.

#### **2.4 CABLE AND WIRE IDENTIFICATION TAGS**

- A. Laminated plastic material with black letters on a yellow background  
Stainless steel material with engraved letters. Print letters and numbers a minimum of 5 mm (3/16 inch) in size. Provide identifier legend in accordance with the drawings.

#### **2.5 TEST STATIONS**

- A. Type: Weatherproof, located at grade, or aboveground if so shown on the drawings. Enclosed terminals for anode leads, test leads, leads attached to protected system, and connection points for test instruments.
- B. Construction:
  1. Housing: The unit shall be of standard design, manufactured for use as a cathodic protection test station, complete with locking cover, terminal board, shunts, and brass or stainless steel hardware.
  2. Provide terminal boards for anode junction boxes, bonding boxes, and test stations made of phenolic plastic. Insulated terminal boards shall have the required number of terminals (one terminal required for each conductor). Install solderless copper lugs and copper bus bars, shunts, and variable resistors on the terminal board as indicated. Test station terminal connections shall be permanently tagged to identify each termination of conductors (e.g. identify the conductors connected to the protected structure, anodes, and reference electrodes). Conductors shall be permanently identified by means of tags to indicate termination.

#### **2.6 PERMANENT REFERENCE ELECTRODES (NOT USED)**

#### **2.7 DIELECTRIC TAPE**

- A. Vinyl plastic electrical tape, 0.18 to 0.25 mm (7 - 10 mils) thick, pressure-sensitive adhesive.

#### **2.8 WARNING TAPE**

- A. 50 mm (2 inches) wide, detectable with metal detector, mylar-encased aluminum, orange color, imprinted "Cathodic Protection Cable Below" or similar.

#### **2.9 DIELECTRIC INSULATION**

- A. Rubber-based, 3 mm (0.125 inch) thick.

**PART 3 - EXECUTION****3.1 INSTALLATION****B. Cables and Anode Leads:**

2. Continuity Bonds: Use cable to connect adjacent protected structures, and protected structures separated by non-welded connectors. Provide 25 percent additional length as slack to allow differential movement of protected systems.
3. Connections: Provide clean, bright, bare metal surface at all connection points. Connect anode lead wire(s) directly to the protected structure(s) by use of exothermic welds. Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright surface. Weld connections using exothermic kit(s) in accordance with the kit manufacturer's instructions. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 908 g (2 pound) hammer. Cover connections with an electrically insulating coating which is compatible with the existing coating on the structure. Allow sufficient slack in the lead wire to compensate for movement during backfilling operation.
4. Warning Tape: Install 150 mm (6 inches) below grade, directly above cables.

**D. Anchor terminal board firmly 600 mm (2 feet) minimum above grade for above grade units. Connect all anodes and protected structure to the test stations.****E. Dielectric Insulation:**

1. General: Provide complete dielectric insulation between protected and unprotected systems and between protected systems and structures which could ground the cathodic protection. Required insulation points include all pipe entrances to buildings, manholes, and pits.
2. Flanges: Install in locations open to view after completion of construction. Provide insulating gaskets, insulating sleeves on all bolts, insulating washers under bolt heads and nuts.
3. Unions: Install in locations open to view after completion of construction. Unions not permitted in pipe sizes over 50 mm (2 inches).
4. Wall Penetration Seals: Install in space between pipes and wall sleeves at building and manhole walls.

5. Coatings: Completely coat all pipe or conduit areas that are in contact with concrete.

F. Permanent Reference Electrode Calibration and Installation:

1. Provide copper copper-sulfate reference electrode(s) as indicated on the drawings.
2. Prior to installation, soak the prepackaged reference electrode in a container of potable water for 30 minutes.
3. Calibrate the permanent reference electrode in the presence of the Resident Engineer by measuring the potential difference between the permanent reference electrode and an independent (portable) calibrated reference electrode placed in the water adjacent to the permanent reference electrode. Potential differences between the two electrodes of the same generic type should not exceed 10 millivolts when the sensing windows of the two electrodes being compared are not more than 2 mm (1/16 inch) apart but not touching. Zinc permanent reference electrodes should be within the range of 1000 to 1150 millivolts when calibrated with an independent (portable) calibrated copper-copper sulfate reference electrode with the two electrodes being not more than 2 mm (1/16 inch) apart but not touching. Permanent reference electrodes not within these potential differences shall be removed and replaced at the Contractor's expense. The testing provision shall also apply to replacement reference electrodes as well.

### 3.2 RECONDITIONING OF SURFACES (NOT USED)

### 3.3 FIELD QUALITY CONTROL

- A. Provide system with a calculated design life exceeding 40 years.
- B. Pre-construction Survey: The Corrosion Specialist shall perform a soil resistivity survey using the Wenner Four-Pin Method as described in ASTM G57. Survey entire length of proposed protected system at the structure depth. Also survey native-state structure-to-soil potential, soil pH, and presence of stray currents.
- C. Calculations: The Corrosion Specialist shall perform engineering calculations to verify the design of the system shown. Inform the Government of any recommended changes in the system design shown.
- D. Field Inspections During Construction: The corrosion specialist shall inspect the work at least twice to ascertain that there is no grounding, short circuits, coating damage, and that installation is in accordance with requirements.

E. Final Inspection:

1. Performed by Corrosion Specialist; witnessed by Resident Engineer.
2. Test Instruments:
  - a. Digital Volt-Ammeter with impedance of 7-10 mega-ohms/volt.
  - b. Saturated copper-copper sulfate reference electrode.
  - c. Other instruments as required.
3. Procedures: Conform to NACE RP0169.
4. Test Results Required for Acceptance:
  - a. Potential of minus 0.85 volt between protected structure and reference electrode.
  - b. Minimum shift of minus 300 millivolts upon application of protective current. Voltage measured between protected structure and reference electrode.
  - c. Minimum shift of minus 100 millivolts upon interruption of protective current. Voltage measured between protected structure and reference electrode.
  - d. Amperage value sufficient that anode life 40 years can be calculated. Provide calculations.
5. Test Report: Submit a complete report to Resident Engineer showing all test measurements, calculations, list of instruments used. All structure-to-electrolyte measurements, including initial potentials and anode outputs, shall be recorded on applicable forms. Identification of test locations, test station and anode test stations shall coordinate with the as-built drawings and be provided on system drawings included in the report. The contractor shall locate, correct, and report to the Resident Engineer any short circuits encountered during the checkout of the installed cathodic protection system.
6. One Year Warranty Period Testing: The Contractor shall inspect, test, and adjust the cathodic protection system semi-annually for one year, 2 interim inspections total, to ensure its continued conformance with the criteria outlined below. The performance period for these tests shall commence upon the completion of all cathodic protection work, including changes required to correct deficiencies identified during initial testing, and preliminary acceptance of the cathodic protection system by the Resident Engineer. Copies of the One Year Warranty Period Cathodic Protection System Field Test

Report, including field data, and certified by the Contractor's corrosion engineer shall be submitted to the Resident Engineer.

#### **3.4 AS-BUILT DRAWINGS**

- A. Provide one set of reproducible drawings showing dimensioned locations of all anodes, cables, test stations, and anode weights. Provide identification of test stations and anodes keyed to test reports.

#### **3.5 INSTRUCTION**

- A. During the warranty testing and at a time designated by the Resident Engineer, make available the services of a technician regularly employed or authorized by the manufacturer of the cathodic protection system for instructing Government personnel in the proper operation, maintenance, safety, and emergency procedures of the cathodic protection system. The period of instruction shall be not less than two but not more than four hours. The field instructions shall cover all of the items contained in the operation and maintenance manual.

---END---

**SECTION 26 51 00**  
**INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

**1.2 RELATED WORK**

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.
- B. Section 02 41 00, DEMOLITION: Removal and disposal of lamps and ballasts.
- D. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirement for seismic restraint for nonstructural components.
- E. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- F. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- G. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- H. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
- a. Submit the following information for each type of lighting fixture designated on the LUMINAIRE SCHEDULE, arranged in order of lighting fixture designation.
  - b. Material and construction details, include information on housing and optics system.
  - c. Physical dimensions and description.
  - d. Wiring schematic and connection diagram.

- e. Installation details.
  - f. Energy efficiency data.
  - g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
  - h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
  - i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
  - j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.
2. Manuals:
- a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
  - b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.
- a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

#### **1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):
  - C78.1-91.....Fluorescent Lamps - Rapid-Start Types -  
Dimensional and Electrical Characteristics
  - C78.376-01.....Chromaticity of Fluorescent Lamps
- C. American Society for Testing and Materials (ASTM):
  - C635-07.....Manufacture, Performance, and Testing of Metal  
Suspension Systems for Acoustical Tile and Lay-  
in Panel Ceilings



- D. Environmental Protection Agency (EPA):
  - 40 CFR 261.....Identification and Listing of Hazardous Waste
- E. Federal Communications Commission (FCC):
  - CFR Title 47, Part 15...Radio Frequency Devices
  - CFR Title 47, Part 18...Industrial, Scientific, and Medical Equipment
- F. Illuminating Engineering Society (IES):
  - LM-79-08.....Electrical and Photometric Measurements of  
Solid-State Lighting Products
  - LM-80-08.....Measuring Lumen Maintenance of LED Light  
Sources
  - LM-82-12.....Characterization of LED Light Engines and LED  
Lamps for Electrical and Photometric Properties  
as a Function of Temperature
- G. Institute of Electrical and Electronic Engineers (IEEE):
  - C62.41-91.....Surge Voltages in Low Voltage AC Power Circuits
- H. International Code Council (ICC):
  - IBC-12.....International Building Code
- I. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
  - 101-12.....Life Safety Code
- J. National Electrical Manufacturer's Association (NEMA):
  - C82.1-04.....Lamp Ballasts - Line Frequency Fluorescent Lamp  
Ballasts
  - C82.2-02.....Method of Measurement of Fluorescent Lamp  
Ballasts
  - C82.4-02.....Lamp Ballasts - Ballasts for High-Intensity  
Discharge and Low-Pressure Sodium (LPS) Lamps  
(Multiple-Supply Type)
  - C82.11-11.....Lamp Ballasts - High Frequency Fluorescent Lamp  
Ballasts
  - LL-9-09.....Dimming of T8 Fluorescent Lighting Systems
  - SSL-1-10.....Electronic Drivers for LED Devices, Arrays, or  
Systems
- K. Underwriters Laboratories, Inc. (UL):
  - 496-08.....Lampholders
  - 542-0599.....Fluorescent Lamp Starters
  - 844-12.....Luminaires for Use in Hazardous (Classified)  
Locations

924-12.....Emergency Lighting and Power Equipment  
 935-01.....Fluorescent-Lamp Ballasts  
 1029-94.....High-Intensity-Discharge Lamp Ballasts  
 1029A-06.....Ignitors and Related Auxiliaries for HID Lamp  
                     Ballasts  
 1598-08.....Luminaires  
 1574-04.....Track Lighting Systems  
 2108-04.....Low-Voltage Lighting Systems  
 8750-09.....Light Emitting Diode (LED) Light Sources for  
                     Use in Lighting Products

## **PART 2 - PRODUCTS**

### **2.1 LIGHTING FIXTURES**

- A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.
- B. Sheet Metal:
  - 1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
  - 2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
  - 3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
  - 4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
- C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
- E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- G. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
  2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
  3. Exterior finishes shall be as shown on the drawings.
- H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
- I. Light Transmitting Components for Fluorescent Fixtures:
1. Shall be 100 percent virgin acrylic.
  2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
  3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.
- J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.
- K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures.

## **2.2 BALLASTS (NOT USED)**

## **2.3 FLUORESCENT EMERGENCY BALLAST (NOT USED)**

## **2.4 EMERGENCY LIGHTING UNIT**

- A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.
1. Enclosure: Shall be impact-resistant thermoplastic. Enclosure shall be suitable for the environmental conditions in which installed.
  2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.

3. Lamps: Shall be sealed-beam MR-16 halogen, rated not less than 12 watts at the specified DC voltage.
4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

#### **2.5 LAMPS (NOT USED)**

#### **2.6 RADIO-INTERFERENCE-FREE FLUORESCENT FIXTURES (NOT USED)**

#### **2.7 WALL MOUNTED FLUORESCENT BEDLIGHT FIXTURES (NOT USED)**

#### **2.8 X-RAY FILM ILLUMINATORS (NOT USED)**

#### **2.9 LED EXIT LIGHT FIXTURES**

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum, or as specified.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum, or as specified.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
  1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
  2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
  3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
- G. Voltage: Multi-voltage (120 - 277V).

#### **2.10 LED LIGHT FIXTURES**

- A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
  - a. Minimum efficiency: 85% at full load.
  - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
  - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
  - d. Integral short circuit, open circuit, and overload protection.
  - e. Power Factor:  $\geq 0.95$ .
  - f. Total Harmonic Distortion:  $\leq 20\%$ .
  - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
  - a. Comply with IES LM-79 and LM-80 requirements.
  - b. Minimum CRI 80 and color temperature 3000 K unless otherwise specified in LUMINAIRE SCHEDULE.
  - c. Minimum Rated Life: 50,000 hours per IES L70.
  - d. Light output lumens as indicated in the LUMINAIRE SCHEDULE.
- B. LED Downlights:
  1. Housing, LED driver, and LED module shall be products of the same manufacturer.
- C. LED Troffers:
  1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
  2. Housing, LED driver, and LED module shall be products of the same manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.

D. Lighting Fixture Supports:

1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
  2. Shall maintain the fixture positions after cleaning and relamping.
  3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
6. Hardware for recessed lighting fixtures:
- a. All fixture mounting devices connecting fixtures to the ceiling system or building structure shall have a capacity for a horizontal force of 100 percent of the fixture weight and a vertical force of 400 percent of the fixture weight.
  - b. Mounting devices shall clamp the fixture to the ceiling system structure (main grid runners or fixture framing cross runners) at four points in such a manner as to resist spreading of these supporting members. Each support point device shall utilize a screw or approved hardware to "lock" the fixture housing to the ceiling system, restraining the fixture from movement in any direction relative to the ceiling. The screw (size No. 10 minimum) or approved hardware shall pass through the ceiling member (T-bar, channel or spline), or it may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
  - c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
    - 1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
    - 2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.
  - d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.

7. Surface mounted lighting fixtures:

- a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
- b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
- c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
  - 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
  - 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
  - 3) The outlet box is supported vertically from the building structure.
- d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.

8. Single or double pendant-mounted lighting fixtures:

- a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.

9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an

approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.

- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.
- I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT, and Section 02 41 00, DEMOLITION.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform the following:
  - 1. Visual Inspection:
    - a. Verify proper operation by operating the lighting controls.
    - b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
  - 2. Electrical tests:
    - a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Resident Engineer. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---



**SECTION 27 05 11**  
**REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes common requirements to communications installations and applies to all sections of Division 27 and Division 28.
- B. Provide completely functioning communications systems.
- C. Comply with VAAR 852.236.91 and FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

**1.2 REFERENCES**

- A. Abbreviations and Acronyms
  - 1. Refer to <http://www.cfm.va.gov/til/sdetail.asp> for Division 00, ARCHITECTURAL ABBREVIATIONS.
  - 2. Additional Abbreviations and Acronyms:

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
AWS	Advanced Wireless Services
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BIM	Building Information Modeling
BOM	Bill of Materials
BTU	British Thermal Units
BUCR	Back-up Computer Room
BTS	Base Transceiver Station
CAD	AutoCAD
CBOPC	Community Based Out Patient Clinic

CBC	Coupled Bonding Conductor
CBOC	Community Based Out Patient Clinic (refer to CBOPC, OPC, VAMC)
CCS	TIP's Cross Connection System (refer to VCCS and HCCS)
CFE	Contractor Furnished Equipment
CFM	US Department of Veterans Affairs Office of Construction and Facilities Management
CFR	Consolidated Federal Regulations
CIO	Communication Information Officer (Facility, VISN or Region)
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CSU	Customer Service Unit
CUP	Conditional Use Permit(s) - Federal/GSA for VA
dB	Decibel
dBm	Decibel Measured
dBmV	Decibel per milli-Volt
DC	Direct Current
DEA	United States Drug Enforcement Administration
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
ECC	Engineering Control Center (refer to DCR, EMCR)
EDGE	Enhanced Data (Rates) for GSM Evolution
EDM	Electrical Design Manual
EMCR	Emergency Management Control Room (refer to DCR, ECC)
EMI	Electromagnetic Interference (refer to RFI)
EMS	Emergency Medical Service
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)

EPBX	Electronic Digital Private Branch Exchange
ESR	Vendor's Engineering Service Report
FA	Fire Alarm
FAR	Federal Acquisition Regulations in Chapter 1 of Title 48 of Code of Federal Regulations
FMS	VA's Headquarters or Medical Center Facility's Management Service
FR	Frequency (refer to RF)
FTS	Federal Telephone Service
GFE	Government Furnished Equipment
GPS	Global Positioning System
GRC	Galvanized Rigid Metal Conduit
GSM	Global System (Station) for Mobile
HCCS	TIP's Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HDTV	Advanced Television Standards Committee High-Definition Digital Television
HEC	Head End Cabinets(refer to HEIC, PA)
HEIC	Head End Interface Cabinets(refer to HEC, PA)
HF	High Frequency (Radio Band; Re FR, RF, VHF & UHF)
HSPA	High Speed Packet Access
HZ	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
ICRA	Infectious Control Risk Assessment
IDEN	Integrated Digital Enhanced Network
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
ILSM	Interim Life Safety Measures
IMC	Rigid Intermediate Steel Conduit
IRM	Department of Veterans Affairs Office of Information Resources Management

ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific, Medical
IWS	Intra-Building Wireless System
LAN	Local Area Network
LBS	Location Based Services, Leased Based Systems
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
LMR	Land Mobile Radio
LTE	Long Term Evolution, or 4G Standard for Wireless Data Communications Technology
M	Meter
MAS	Medical Administration Service
MATV	Master Antenna Television
MCR	Main Computer Room
MCOR	Main Computer Operators Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megahertz ( $10^6$ Hz)
mm	Millimeter
MOU	Memorandum of Understanding
MW	Microwave (RF Band, Equipment or Services)
NID	Network Interface Device (refer to DEMARC)
NEC	National Electric Code
NOR	Network Operations Room
NRTL	OSHA Nationally Recognized Testing Laboratory
NS	Nurse Stations
NTIA	U.S. Department of Commerce National Telecommunications and Information Administration
OEM	Original Equipment Manufacturer
OI&T	Office of Information and Technology
OPC	VA's Outpatient Clinic (refer to CBOC, VAMC)
OSH	Department of Veterans Affairs Office of Occupational Safety and Health

OSHA	United States Department of Labor Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflectometer
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PCR	Police Control Room (refer to SPCC, could be designated SCC)
PCS	Personal Communications Service (refer to UPCS)
PE	Professional Engineer
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PSRAS	Public Safety Radio Amplification Systems
PTS	Pay Telephone Station
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RAN	Radio Access Network
RBB	Rack Bonding Busbar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
RPEC	Radio Paging Equipment Cabinets(refer to HEC, HEIC, PA)
RTLS	Real Time Location Service or System
RUS	Rural Utilities Service
SCC	Security Control Console (refer to PCR, SPCC)
SMCS	Spectrum Management and Communications Security (COMSEC)

SFO	Solicitation for Offers
SME	Subject Matter Experts (refer to AHJ)
SMR	Specialized Mobile Radio
SMS	Security Management System
SNMP	Simple Network Management Protocol
SPCC	Security Police Control Center (refer to PCR, SMS)
STP	Shielded Balanced Twisted Pair (refer to UTP)
STR	Stacked Telecommunications Room
TAC	VA's Technology Acquisition Center, Austin, Texas
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TIP	Telecommunications Infrastructure Plant
TMGB	Telecommunications Main Grounding Busbar (also Primary Bonding Busbar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPCS	Unlicensed Personal Communications Service (refer to PCS)
UPS	Uninterruptible Power Supply
USC	United States Code
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
UV	Ultraviolet
V	Volts
VAAR	Veterans Affairs Acquisition Regulation
VACO	Veterans Affairs Central Office

VAMC	VA Medical Center (refer to CBOC, OPC, VACO)
VCCS	TIP's Vertical Cross Connection System (refer to CCS and HCCS)
VHF	Very High Frequency (Radio)
VISN	Veterans Integrated Services Network (refers to geographical region)
VSWR	Voltage Standing Wave Ratio
W	Watts
WEB	World Electronic Broadcast
WiMAX	Worldwide Interoperability (for MW Access)
WI-FI	Wireless Fidelity
WMTS	Wireless Medical Telemetry Service
WSP	Wireless Service Providers

B. Definitions:

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. Distributed (in house) Antenna System (DAS): An Emergency Radio Communications System installed for Emergency Responder (or first responders and Government personnel) use while inside facility to maintain contact with each respective control point; refer to Section 27 53 19, DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEMS.

8. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
9. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
10. Electrical Supervision: Analyzing a system's function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
11. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
12. Emergency Call Systems: Wall units (in parking garages and stairwells) and pedestal mounts (in parking lots) typically provided with a strobe, camera and two-way audio communication functions.
13. Project 25 (2014) (P25 (TIA-102 Series)): Set of standards for local, state and Federal public safety organizations and agencies digital LMR services. P25 is applicable to LMR equipment authorized or licensed under the US Department of Commerce National Telecommunications and Information Administration or FCC rules and regulations, and is a required standard capability for all LMR equipment and systems.
14. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
15. Grounding Electrode System: Electrodes through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
16. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
17. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected



- equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
18. Microducts: All forms of air blown fiber pathways.
  19. Ohm: A unit of resistive measurement.
  20. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
  21. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
  22. Sound (SND): Changing air pressure to audible signals over given time span.
  23. System: Specific hardware, firmware, and software, functioning together as a unit, performing task for which it was designed.
  24. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm<sup>2</sup> [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding busbar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
  25. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
  26. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location. VA'S WAN/LAN is not nationally listed or coded for life and public safety, critical, emergency or other safety functions.

### **1.3 APPLICABLE PUBLICATIONS**

- A. Applicability of Standards: Unless documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into the documents to extent referenced. Such standards are made a part of these documents by reference.

1. Each entity engaged in construction must be familiar with industry standards applicable to its construction activity.
  2. Obtain standards directly from publication source, where copies of standards are needed to perform a required construction activity.
- B. Government Codes, Standards and Executive Orders: Refer to <http://www.cfm.va.gov/TIL/cPro.asp>:
1. Federal Communications Commission, (FCC) CFR, Title 47:
 

Part 15	Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations
Part 47	Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment
Part 58	Television Broadcast Service
Part 73	Radio and Television Broadcast Rules
Part 90	Rules and Regulations, Appendix C
Form 854	Antenna Structure Registration
Chapter XXIII	National Telecommunications and Information Administration (NTIA, P/O Commerce, Chapter XXIII) the 'Red Book'- Chapters 7, 8 & 9 compliments CFR, Title 47, FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations
  2. US Department of Agriculture, (Title 7, USC, Chapter 55, Sections 2201, 2202 & 2203:RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction:
 

RUS Bull 1751F-630	Design of Aerial Cable Plants
RUS Bull 1751F-640	Design of Buried Cable Plant, Physical Considerations
RUS Bull 1751F-643	Underground Plant Design
RUS Bull 1751F-815	Electrical Protection of Outside Plants,
RUS Bull 1753F-201	Acceptance Tests of Telecommunications Plants (PC-4)
RUS Bull 1753F-401	Splicing Copper and Fiber Optic Cables (PC-2)
RUS Bull 345-50	Trunk Carrier Systems (PE-60)
RUS Bull 345-65	Shield Bonding Connectors (PE-65)
RUS Bull 345-72	Filled Splice Closures (PE-74)
RUS Bull 345-83	Gas Tube Surge Arrestors (PE-80)

3. US Department of Commerce/National Institute of Standards  
Technology, (NIST):

FIPS PUB 1-1	Telecommunications Information Exchange
FIPS PUB 100/1	Interface between Data Terminal Equipment (DTE) Circuit Terminating Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit
FIPS PUB 140/2	Telecommunications Information Security Algorithms
FIPS PUB 143	General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment
FIPS 160/2	Electronic Data Interchange (EDI),
FIPS 175	Federal Building Standard for Telecommunications Pathway and Spaces
FIPS 191	Guideline for the Analysis of Local Area Network Security
FIPS 197	Advanced Encryption Standard (AES)
FIPS 199	Standards for Security Categorization of Federal Information and Information Systems

4. US Department of Defense, (DoD):

MIL-STD-188-110	Interoperability and Performance Standards for Data Modems
MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-115	Communications Timing and Synchronizations Subsystems
MIL-C-28883	Advanced Narrowband Digital Voice Terminals
MIL-C-39012/21	Connectors, Receptacle, Electrical, Coaxial, Radio Frequency, (Series BNC (Uncabled), Socket Contact, Jam Nut Mounted, Class 2)

5. US Department of Health and Human Services:

The Health Insurance Portability and Accountability Act of 1996  
(HIPAA) Privacy, Security and Breach Notification Rules

6. US Department of Justice:

2010 Americans with Disabilities Act Standards for Accessible Design  
(ADAAD).

7. US Department of Labor, (DoL) - Public Law 426-62 - CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards):
  - Subpart 7                      Approved NRTLs; obtain a copy at  
[http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.htm](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.htm)  
1)
  - Subpart 35                      Compliance with NFPA 101, Life Safety Code
  - Subpart 36                      Design and Construction Requirements for Exit Routes
  - Subpart 268                      Telecommunications
  - Subpart 305                      Wiring Methods, Components, and Equipment for General Use
  - Subpart 508                      Americans with Disabilities Act Accessibility Guidelines; technical requirement for accessibility to buildings and facilities by individuals with disabilities
8. US Department of Transportation, (DoT):
  - a. Public Law 85-625, CFR, Title 49, Part 1, Subpart C - Federal Aviation Administration (FAA):AC 110/460-ID & AC 707 / 460-2E - Advisory Circulars Standards for Construction of Antenna Towers, and 7450 and 7460-2 - Antenna Construction Registration Forms.
9. US Department of Veterans Affairs (VA): Office of Telecommunications (OI&T), MP-6, PART VIII, TELECOMMUNICATIONS, CHAPTER 5, AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS: Spectrum Management and COMSEC Service (SMCS), AHJ for:
  - a. CoG, "Continuance of Government" communications guidelines and compliance.
  - b. COMSEC, "VA wide coordination and control of security classified communication assets."
  - c. COOP, "Continuance of Operations" emergency communications guidelines and compliance.
  - d. FAA, FCC, and US Department of Commerce National Telecommunications and Information Administration, "VA wide RF Co-ordination, Compliance and Licensing."
  - e. Handbook 6100 - Telecommunications: Cyber and Information Security Office of Cyber and Information Security, and Handbook 6500 - Information Security Program.

- f. Low Voltage Special Communications Systems "Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance and Life Safety Certifications for CFM and VA Facility Low Voltage Special Communications Projects (except Fire Alarm, Telephone and Data Systems)."
  - g. SATCOM, "Satellite Communications" guidelines and compliance, and Security and Law Enforcement Systems - "Coordinates the Design, Engineering, Construction Contract Specifications and Drawings Conformity, Proof of Performance Testing, VA Compliance, DEA and Public Safety Certification(s) for CFM and VA Facility Security Low Voltage Special Communications and Physical Security Projects.
  - h. VHA's National Center for Patient Safety - Veterans Health Administration (VHA) Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
  - i. VA's CEOSH, concurrence with warning identified in VA Directive 7700.
  - j. Wireless and Handheld Devices, "Guidelines and Compliance,"
  - k. Office of Security and Law Enforcement: VA Directive 0730 and Health Special Presidential Directive (HSPD)-12.
- C. NRTL Standards: Refer to <https://www.osha.gov/dts/otpc/nrtl/index.html>
- 1. Canadian Standards Association (CSA); same tests as presented by UL
  - 2. Communications Certifications Laboratory (CEL); same tests as presented by UL.
  - 3. Intertek Testing Services NA, Inc., (ITSNA), formerly Edison Testing Laboratory (ETL) same tests as presented by UL).
  - 4. Underwriters Laboratory (UL):
 

1-2005	Flexible Metal Conduit
5-2011	Surface Metal Raceway and Fittings
6-2007	Rigid Metal Conduit
44-010	Thermoset-Insulated Wires and Cables
50-1995	Enclosures for Electrical Equipment
65-2010	Wired Cabinets
83-2008	Thermoplastic-Insulated Wires and Cables
96-2005	Lightning Protection Components

96A-2007	Installation Requirements for Lightning Protection Systems
360-2013	Liquid-Tight Flexible Steel Conduit
444-2008	Communications Cables
467-2013	Grounding and Bonding Equipment
486A-486B-2013	Wire Connectors
486C-2013	Splicing Wire Connectors
486D-2005	Sealed Wire Connector Systems
486E-2009	Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-2007	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
497/497A/497B/497C	Protectors for Paired Conductors/Communications Circuits/Data Communications and Fire Alarm Circuits/coaxial circuits/voltage protections/Antenna Lead In
497D/497E	
510-2005	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1069-2007	Hospital Signaling and Nurse Call Equipment
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666-2007	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests

1685-2007	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861-2012	Communication Circuit Accessories
1863-2013	Standard for Safety, communications Circuits Accessories
1865-2007	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024-2011	Standard for Optical Fiber Raceways
2024-2014	Standard for Cable Routing Assemblies and Communications Raceways
2196-2001	Standard for Test of Fire Resistive Cable
60950-1 ed. 2-2014	Information Technology Equipment Safety

#### D. Industry Standards:

##### 1. Advanced Television Systems Committee (ATSC):

A/53 Part 1: 2013	ATSC Digital Television Standard, Part 1, Digital Television System
A/53 Part 2: 2011	ATSC Digital Television Standard, Part 2, RF/Transmission System Characteristics
A/53 Part 3: 2013	ATSC Digital Television Standard, Part 3, Service Multiplex and Transport System Characteristics
A/53 Part 4: 2009	ATSC Digital Television Standard, Part 4, MPEG-2 Video System Characteristics
A/53 Part 5: 2014	ATSC Digital Television Standard, Part 5, AC-3 Audio System Characteristics
A/53 Part 6: 2014	ATSC digital Television Standard, Part 6, Enhanced AC-3 Audio System Characteristics

##### 2. American Institute of Architects (AIA): 2006 Guidelines for Design & Construction of Health Care Facilities.

##### 3. American Society of Mechanical Engineers (ASME):

A17.1 (2013)	Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices
17.3 (2011)	Safety Code for Existing Elevators and Escalators

- 17.4 (2009) Guide for Emergency Personnel
- 17.5 (2011) Elevator and Escalator Electrical Equipment
- 4. American Society for Testing and Materials (ASTM):
  - B1 (2001) Standard Specification for Hard-Drawn Copper Wire
  - B8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)
  - D2301 (2004) Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
  - B258-02 (2008) Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors
  - D709-01(2007) Standard Specification for Laminated Thermosetting Materials
  - D4566 (2008) Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable
- 5. American Telephone and Telegraph Corporation (AT&T) - Obtain following AT&T Publications at <https://ebiznet.sbc.com/SBCNEBS/>):
  - ATT-TP-76200 (2013) Network Equipment and Power Grounding, Environmental, and Physical Design Requirements
  - ATT-TP-76300(2012) Merged AT&T Affiliate Companies Installation Requirements
  - ATT-TP-76305 (2013) Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways
  - ATT-TP-76306 (2009) Electrostatic Discharge Control
  - ATT-TP-76400 (2012) Detail Engineering Requirements
  - ATT-TP-76402 (2013) AT&T Raised Access Floor Engineering and Installation Requirements
  - ATT-TP-76405 (2011) Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments



- ATT-TP-76416 (2011) Grounding and Bonding Requirements for Network Facilities
- ATT-TP-76440 (2005) Ethernet Specification
- ATT-TP-76450 (2013) Common Systems Equipment Interconnection Standards for AT&T Network Equipment Spaces
- ATT-TP-76461 (2008) Fiber Optic Cleaning
- ATT-TP-76900 (2010) AT&T Installation Testing Requirement
- ATT-TP-76911 (1999) AT&T LEC Technical Publication Notice
6. British Standards Institution (BSI):
- BS EN 50109-2 Hand Crimping Tools - Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications - All Parts & Sections. October 1997
7. Building Industry Consulting Service International(BICSI):
- ANSI/BICSI 002-2011 Data Center Design and Implementation Best Practices
- ANSI/BICSI 004-2012 Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
- ANSI/NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling
- NECA/BICSI 607-2011 Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
- ANSI/BICSI 005-2013 Electronic Safety and Security (ESS) System Design and Implementation Best Practices
8. Electronic Components Assemblies and Materials Association,(ECA).
- ECA EIA/RS-270 (1973)Tools, Crimping, Solderless Wiring Devices - Recommended Procedures for User Certification
- EIA/ECA 310-E (2005) Cabinets, and Associated Equipment
9. Facility Guidelines Institute: 2010 Guidelines for Design and Construction of Health Care Facilities.
10. Insulated Cable Engineers Association (ICEA):
- ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems

- ANSI/ICEA  
S-84-608-2010 Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable
- ANSI/ICEA  
S-90-661-2012 Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
- S-98-688 (2012) Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors
- S-99-689 (2012) Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors
- ICEA S-102-700 (2004) Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements
11. Institute of Electrical and Electronics Engineers (IEEE):
- ISSN 0739-5175 March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks
- IEEE C2-2012 National Electrical Safety Code (NESC)
- C62.41.2-2002/  
Cor 1-2012 IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
- C62.45-2002 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
- 100-1992 IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
- 602-2007 IEEE Recommended Practice for Electric Systems in Health Care Facilities

- 1100-2005 IEEE Recommended Practice for Powering and Grounding Electronic Equipment
12. International Code Council:  
AC193 (2014) Mechanical Anchors in Concrete Elements
13. International Organization for Standardization (ISO):  
ISO/TR 21730 (2007) Use of Mobile Wireless Communication and Computing Technology in Healthcare Facilities - Recommendations for Electromagnetic Compatibility (Management of Unintentional Electromagnetic Interference) with Medical Devices
14. National Electrical Manufacturers Association (NEMA):  
NEMA 250 (2008) Enclosures for Electrical Equipment (1,000V Maximum)  
ANSI C62.61 (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits  
ANSI/NEMA FB 1 (2012) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable  
ANSI/NEMA OS 1 (2009) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports  
NEMA SB 19 (R2007) NEMA Installation Guide for Nurse Call Systems  
TC 3 (2004) Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing  
NEMA VE 2 (2006) Cable Tray Installation Guidelines
15. National Fire Protection Association (NFPA):  
70E-2015 Standard for Electrical Safety in the Workplace  
70-2014 National Electrical Code (NEC)  
72-2013 National Fire Alarm Code  
75-2013 Standard for the Fire Protection of Information Technological Equipment  
76-2012 Recommended Practice for the Fire Protection of Telecommunications Facilities  
77-2014 Recommended Practice on Static Electricity  
90A-2015 Standard for the Installation of Air Conditioning and Ventilating Systems  
99-2015 Health Care Facilities Code  
101-2015 Life Safety Code

- 241 Safeguarding construction, alternation and Demolition Operations
- 255-2006 Standard Method of Test of Surface Burning Characteristics of Building Materials
- 262 - 2011 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
- 780-2014 Standard for the Installation of Lightning Protection Systems
- 1221-2013 Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- 5000-2015 Building Construction and Safety Code
16. Society for Protective Coatings (SSPC):
- SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
17. Society of Cable Telecommunications Engineers (SCTE):
- ANSI/SCTE 15 2006 Specification for Trunk, Feeder and Distribution Coaxial Cable
18. Telecommunications Industry Association (TIA):
- TIA-120 Series Telecommunications Land Mobile communications (APCO/Project 25) (January 2014)
- TIA TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
- TIA-155 Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)
- TIA TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points (2013)
- TIA-222-G Structural Standard for Antenna Supporting Structures and Antennas (2014)
- TIA/EIA-423-B Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)
- TIA-455-C General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014)

TIA-455-53-A	FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)
TIA-455-61-A	FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)
TIA-472D000-B	Fiber Optic Communications Cable for Outside Plant Use (July 2007)
ANSI/TIA-492-B	62.5- $\mu$ Core Diameter/125- $\mu$ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers (November 2009)
ANSI/TIA-492AAAB-A	50- $\mu$ m Core Diameter/125- $\mu$ m Cladding Diameter Class IA Graded-Index Multimode Optically Optimized American Standard Fibers (November 2009)
TIA-492CAAA	Detail Specification for Class IVa Dispersion- Unshifted Single-Mode Optical Fibers (September 2002)
TIA-492E000	Sectional Specification for Class IVd Nonzero- Dispersion Single-Mode Optical Fibers for the 1,550 nm Window (September 2002)
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant - OFSTP-7 (December 2008)
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant - SFSTP-14 (August 1998)
TIA-568	Revision/Edition: C Commercial Building Telecommunications Cabling Standard Set: (TIA- 568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard-Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) AND TIA-568-C.4

	Broadband Coaxial Cabling and Components Standard (2011) with addendums and erratas
TIA-569	Revision/Edition C Telecommunications Pathways and Spaces (March 2013)
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
TIA-598-D	Optical Fiber Cable Color Coding (January 2005)
TIA-604-10-B	Fiber Optic Connector Intermateability Standard (August 2008)
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure (2012)
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard (April 2011)
TIA-942-A	Telecommunications Infrastructure Standard for Data Centers (March 2014)
TIA-1152	Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009)
TIA-1179	Healthcare Facility Telecommunications Infrastructure Standard (July 2010)

#### 1.4 SINGULAR NUMBER

- A. Where any device or part of equipment is referred in singular number (such as " rack"), reference applies to as many such devices as are required to complete installation.

#### 1.5 RELATED WORK

- A. Specification Order of Precedence: FAR Clause 52.236-21, VAAR Clause 852.236-71.
1. Field Cutting and Patching: Section 09 91 00, PAINTING.
  2. Additional submittal requirements: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
  3. Availability and source of references and standards specified in applicable publications: Section 01 42 19, REFERENCE STANDARDS.
  4. Control of environmental pollution and damage for air, water, and land resources: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
  5. Requirements for non-hazardous building construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
  6. General requirements and procedures to comply with various federal mandates and U.S. Department of Veterans Affairs (VA) policies for sustainable design: Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
  7. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction: Section 07 84 00, FIRESTOPPING.
  8. Sealant and caulking materials and their application: Section 07 92 00, JOINT SEALANTS.
  9. General electrical requirements that are common to more than one section of Division 26: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  10. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
  11. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
  12. Conduit and boxes: Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.
  13. Wiring devices: Section 26 27 26, WIRING DEVICES.

14. Lightning protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
15. General requirements common to more than one section in Division 28: Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
16. Conductors and cables for electronic safety and security systems: Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY.
17. Low impedance path to ground for electronic safety and security system ground fault currents: Section 28 05 26, GROUNDING AND BONDING FOR SECURITY SYSTEMS.
18. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
19. Physical Access Control System field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
20. Detection and screening systems: Section 28 13 53, SECURITY ACCESS DETECTION.
21. Intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions: Section 28 16 11, INTRUSION DETECTION EQUIPMENT AND SYSTEMS.
22. Video surveillance system cameras, data transmission wiring, and control stations with associated equipment: Section 28 23 00, VIDEO SURVEILLANCE EQUIPMENT AND SYSTEMS.
23. Duress-panic alarms, emergency phones or call boxes, intercom systems, data transmission wiring and associated equipment: Section 28 26 00, ELECTRONIC PERSONAL PROTECTION EQUIPMENT AND SYSTEMS.
24. Alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring: Section 28 31 00, FIRE DETECTION AND ALARM.
25. Emergency Call telephones, intercom systems, with blue strobe light and equipment: Section 28 52 31, SECURITY EMERGENCY CALL/DURESS ALARM/COMMUNICATIONS SYSTEM AND EQUIPMENT.

#### **1.6 ADMINISTRATIVE REQUIREMENTS**

- A. Assign a single communications project manager to serve as point of contact for Government, contractor, and design professional.
- B. Be proactive in scheduling work.



1. Use of premises is restricted at times directed by COR.
  2. Movement of materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.
  3. Coordinate installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  4. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of Work.
  5. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies; provide required connection for each service.
  6. Initiate and maintain discussion regarding schedule for ceiling construction and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (0050P2H3) (202)461-5310 to have a Government-accepted Telecommunications COR assigned to project for telecommunications review, equipment and system approval and coordination with other VA personnel.
- D. Communications Project Manager Responsibilities:
1. Assume responsibility for overall telecommunications system integration and coordination of work among trades, subcontractors, and authorized system installers.
  2. Coordinate with related work indicated on drawings or specified.
  3. Manage work related to telecommunications system installation in a manner approved by manufacturer.

#### **1.7 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Provide parts list including quantity of spare parts.
- C. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
- D. Provide Source Quality Control Submittal:
  1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty

- maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.
2. Submit written certification from OEM that wiring and connection diagrams meet Government Life Safety Guidelines, NFPA, NEC, NRTL, these specifications, and Joint Commission requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.
  3. Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.
- E. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:
1. Installation location and name.
  2. Owner's name and contact information including, address, telephone and email.
  3. Date of project start and date of final acceptance.
  4. System project number.
  5. Three paragraph description of each system related to this project; include function, operation, and installation.
- F. Provide delegated design submittals (e.g. seismic support design).
- G. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on seismic design categories per section 4.0 of VA seismic design requirements H-18-8 dated August, 2013.
- H. Test Equipment List:
1. Supply test equipment of accuracy better than parameters to be tested.
  2. Submit test equipment list including make and model number:
    - a. ANSI/TIA-1152 Level IIIe twisted pair cabling test instrument.
    - b. Fiber optic insertion loss power meter with light source.
    - c. Optical time domain reflectometer (OTDR).
    - d. Volt-Ohm meter.
    - e. Digital camera.

3. Supply only test equipment with a calibration tag from Government-accepted calibration service dated not more than 12 months prior to test.
4. Provide sample test and evaluation reports.

I. Submittal Drawings:

1. Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:
  - a. Telecommunications rooms.
  - b. Equipment rooms.
2. Logical Drawings: Provide logical riser or schematic drawings for all systems.
  - a. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections.
3. Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

J. Provide sustainable design submittals.

K. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

#### **1.8 CLOSEOUT SUBMITTALS**

A. Provide following closeout submittals prior to project closeout date:

1. Warranty certificate.
2. Evidence of compliance with requirements such as low voltage certificate of inspection.
3. Project record documents.
4. Instruction manuals and software that are a part of system.

B. Maintenance and Operation Manuals: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

1. Prepare a manual for each system and equipment specified.
2. Furnish on portable storage drive in PDF format or equivalent accepted by COR.
3. Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.

4. Furnish remaining manuals prior to final completion.
5. Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.
6. Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.
7. Provide a Table of Contents and assemble files to conform to Table of Contents.
8. Operation and Maintenance Data includes:
  - a. Approved shop drawing for each item of equipment.
  - b. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
  - c. A control sequence describing start-up, operation, and shutdown.
  - d. Description of function of each principal item of equipment.
  - e. Installation and maintenance instructions.
  - f. Safety precautions.
  - g. Diagrams and illustrations.
  - h. Test Results and testing methods.
  - i. Performance data.
  - j. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
  - k. Warranty documentation indicating end date and equipment protected under warranty.
  - l. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

C. Record Wiring Diagrams:

1. Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.
2. General Drawing Specifications: Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm

- (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches). Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 1' 0 inch).
3. Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.
  4. Floor plans to include:
    - a. Final room numbers and actual backbone cabling and pathway locations and labeling.
    - b. Inputs and outputs of equipment identified according to labels installed on cables and equipment
    - c. Device locations with labels.
    - d. Conduit.
    - e. Head-end equipment.
    - f. Wiring diagram.
    - g. Labeling and administration documentation.
  5. Submit Record Wiring Diagrams within five business days after final cable testing.
  6. Deliver Record Wiring Diagrams as CAD files in .dwg formats as determined by COR.
  7. Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.
  - D. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.

#### **1.9 MAINTENANCE MATERIAL SUBMITTALS**

- A. After approval and prior to installation, furnish COR with the following:
  1. A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.
  2. One coupling, bushing and termination fitting for each type of conduit.
  3. Samples of each hanger, clamp and supports for conduit and pathways.
  4. Duct sealing compound.

**1.10 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Manufacturer must produce, as a principal product, the equipment and material specified for this project, and have manufactured item for at least three years.
- B. Product and System Qualification:
  - 1. OEM must have three installations of equipment submitted presently in operation of similar size and type as this project, that have continuously operated for a minimum of three years.
  - 2. Government reserves the right to require a list of installations where products have been in operation before approval.
  - 3. Authorized representative of OEM must be responsible for design, satisfactory operation of installed system, and certification.
- C. Trade Contractor Qualifications: Trade contractor must have completed three or more installations of similar systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identify these installations as a part of submittal.
- D. System Supplier Qualifications: System supplier must be authorized by OEM to warranty installed equipment.
- E. Telecommunications technicians assigned to system must be trained, and certified by OEM on installation and testing of system; provide written evidence of current OEM certifications for installers.
- F. Manufactured Products:
  - 1. Comply with FAR clause 52.236-5 for material and workmanship.
  - 2. When more than one unit of same class of equipment is required, units must be product of a single manufacturer.
  - 3. Equipment Assemblies and Components:
    - a. Components of an assembled unit need not be products of same manufacturer.
    - b. Manufacturers of equipment assemblies, which include components made by others, to assume complete responsibility for final assembled unit.
    - c. Provide compatible components for assembly and intended service.
    - d. Constituent parts which are similar must be product of a single manufacturer.
  - 4. Identify factory wiring on equipment being furnished and on wiring diagrams.

G. Testing Agencies: Government reserves the option of witnessing factory tests. Notify COR minimum 15 working days prior to manufacturer performing the factory tests.

1. When equipment fails to meet factory test and re-inspection is required, contractor is liable for additional expenses, including expenses of Government.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

A. Delivery and Acceptance Requirements:

1. Government's approval of submittals must be obtained for equipment and material before delivery to job site.
2. Deliver and store materials to job site in OEM's original unopened containers, clearly labeled with OEM's name and equipment catalog numbers, model and serial identification numbers for COR to inventory cable, patch panels, and related equipment.

B. Storage and Handling Requirements:

1. Equipment and materials must be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  - a. Store and protect equipment in a manner that precludes damage or loss, including theft.
  - b. Protect painted surfaces with factory installed removable heavy kraft paper, sheet vinyl or equivalent.
  - c. Protect enclosures, equipment, controls, controllers, circuit protective devices, and other like items, against entry of foreign matter during installation; vacuum clean both inside and outside before testing and operating.

C. Coordinate storage.

#### **1.12 FIELD CONDITIONS**

A. Where variations from documents are requested in accordance with GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, connecting work and related components must include additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

B. A contract adjustment or additional time will not be granted because of field conditions pursuant to FAR 52.236-2 and FAR 52.236-3; a contract adjustment or additional time will not be granted for additional work required for complete and usable construction and systems pursuant to FAR 52.246-12.

**1.13 WARRANTY**

- A. Comply with FAR clause 52.246-21, except as follows:
  - 1. Warranty material and equipment to be free from defects, workmanship, and remain so for a period of one year for Emergency Systems from date of final acceptance of system by Government; provide OEM's equipment warranty document to COR.

**PART 2 - PRODUCTS****2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide communications spaces and pathways conforming to TIA 569, at a minimum.
- B. Modification to administrative issues requires written approvals from COR with concurrence from SMCS 0050P2H3, OEM, contractor, and local authorities.

**2.2 EQUIPMENT IDENTIFICATION**

- A. Provide laminated black phenolic resin with a white core nameplates with minimum 6 mm (1/4 inch) high engraved lettering.
- B. Nameplates furnished by manufacturer as standard catalog items, unless other method of identification is indicated.

**2.3 UNDERGROUND WARNING TAPE (NOT USED)****2.4 WIRE LUBRICATING COMPOUND**

- A. Provide non-hardening or forming adhesive coating cable lubricants suitable for cable jacket material and raceway.

**2.5 FIREPROOFING TAPE**

- A. Provide flexible, conformable fabric tape of organic composition and coated one side with flame-retardant elastomer.
- B. Tape must be self-extinguishing and cannot support combustion; arc-proof and fireproof.
- C. Tape cannot deteriorate when subjected to water, gases, salt water, sewage, or fungus; and tape must be resistant to sunlight and ultraviolet light.
- D. Application must withstand a 200-ampere arc for minimum 30 seconds.
- E. Securing Tape: Glass cloth electrical tape minimum 0.18 mm (7 mils) thick and 19 mm (3/4 inch) wide.



**2.6 UNDERGROUND CABLES (NOT USED)****2.7 AERIAL (ABOVEGROUND) ENCLOSURES (NOT USED)****2.8 TEMPORARY //\_\_\_\_// TIP PATHS (OVERHEAD TRACKS, ROAD/PATH BRIDGES, ETC.) (NOT USED)****2.9 ACCESS PANELS**

- A. Panels: 304 mm x 304 mm (12 inches by 12 inches), or size allowed by location to provide optimum access to equipment for maintenance and service.
- B. Provide access panels and doors as required to allow service of materials and equipment that require inspection, replacement, repair or service.
- C. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling; ceilings consisting of lay-in or removable splined tiles do not require access panels.
- D. Provide access panels with same fire rating classification as surface penetrated.

**PART 3 - EXECUTION****3.1 PREPARATION**

- A. Penetrations and Sleeves:
  - 1. Lay out penetration and sleeve openings in advance, to permit provision in work.
  - 2. Set sleeves in forms before concrete is poured.
  - 3. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc.
  - 4. Provide sleeves and packing materials at penetrations of foundations, walls, slabs, partitions, and floors.
  - 5. Make sleeves that penetrate outside walls, basement slabs, footings, and beams waterproof.
  - 6. Fill slots, sleeves and other openings in floors or walls if not used.
    - a. Fill spaces in openings after installation of conduit or cable.
    - b. Provide fill for floor penetrations to prevent passage of water, smoke, fire, and fumes.
    - c. Provide fire resistant fill in rated floors and walls, to prevent passage of air, smoke and fumes.
  - 7. Install sleeves through floors watertight and extend minimum 50.8 mm (2 inches) above floor surface.

8. Match and set sleeves flush with adjoining floor, ceiling, and wall finishes where raceways passing through openings are exposed in finished rooms.
  9. Annular space between conduit and sleeve must be minimum 6 mm (1/4 inch).
  10. Do not provide sleeves for slabs-on-grade, unless specified or indicated otherwise.
  11. Comply with requirements for firestopping, for sleeves through rated fire walls and smoke partitions.
  12. Do not support piping risers or conduit on sleeves.
  13. Identify unused sleeves and slots for future installation.
  14. Provide core drilling if walls are poured or otherwise constructed without sleeves and wall penetration is required; do not penetrate structural members.
- B. Core Drilling:
1. Avoid core drilling whenever possible.
  2. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement.
  3. Investigate existing conditions in vicinity of required opening prior to coring, including an x-ray of floor if determined necessary by competent person or COR.
  4. Protect areas from damage.
- C. Verification of In-Place Conditions:
1. Verify location, use and status of all material, equipment, and utilities that are specified, indicated, or determined necessary for removal.
    - a. Verify materials, equipment, and utilities to be removed are inactive, not required, or in use after completion of project.
    - b. Replace with equivalent any material, equipment and utilities that were removed by contractor that are required to be left in place.
  2. Existing Utilities: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under following conditions and then only after arranging to provide temporary utility services, according to requirements indicated:
    - a. Notify COR in writing at least 14 days in advance of proposed utility interruptions.

- b. Do not proceed with utility interruptions without Government's written permission.
- D. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall and ceiling mounting of equipment as required.
- E. Provide steel supports and hardware for installation of hangers, anchors, guides, and other support hardware.
- F. Obtain and analyze catalog data, weights, and other pertinent data required for coordination of equipment support provisions and installation.
- G. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void warranty.

### **3.2 INSTALLATION - GENERAL**

- A. Coordinate systems, equipment, and materials installation with other building components.
- B. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
- C. Conform to VAAR 852.236.91 arrangements indicated, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items because of variances in manufacturers' methods of achieving specified results.
- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed in both exposed and un-exposed spaces.
- E. Install equipment according to manufacturers' written instructions.
- F. Install wiring and cabling between equipment and related devices.
- G. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum interference of adjacent other installations.
- H. Provide access panel or doors where units are concealed behind finished surfaces.
- I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
- J. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom and access for service and maintenance as possible.

- K. Install systems, materials, and equipment giving priority to systems required to be installed at a specified slope.
- L. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of COR and code requirements.
- M. Install equipment and cabling to distribute equipment loads on building structural members provided for equipment support under other sections; install and support roof-mounted equipment on structural steel or roof curbs as appropriate.
- N. Provide supplementary or miscellaneous items, appurtenances, devices and materials for a complete installation.

### **3.3 EQUIPMENT INSTALLATION**

- A. Locate equipment as close as practical to locations shown on drawings.
- B. Note locations of equipment requiring access on record drawings.
- C. Access and Access Panels: Verify access panel locations and construction with COR.
- D. Inaccessible Equipment:
  - 1. Where Government determines that contractor has installed equipment not conveniently accessible for operation and maintenance, equipment must be removed and reinstalled as directed and without additional cost to Government.
  - 2. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for communication equipment cabinet assembly.
  - 3. Refer to Section 27 11 00, TELECOMMUNICATIONS ROOM FITTINGS for equipment labeling.

### **3.4 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. Secure identification signs with screws.

### **3.5 CUTTING AND PATCHING**

- A. Perform cutting and patching according to contract general requirements and as follows:
  - 1. Remove samples of installed work as specified for testing.
  - 2. Perform cutting, fitting, and patching of equipment and materials required to uncover existing infrastructure in order to provide access for correction of improperly installed existing or new work.
  - 3. Remove and replace defective work.
  - 4. Remove and replace non-conforming work.

- B. Cut, remove, and legally dispose of selected equipment, components, and materials, including removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by new work.
- C. Provide and maintain temporary partitions or dust barriers adequate to prevent spread of dust and dirt to adjacent areas.
- D. Protect adjacent installations during cutting and patching operations.
- E. Protect structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- F. Patch finished surfaces and building components using new materials specified for original installation and experienced installers.

### **3.6 FIELD QUALITY CONTROL**

- A. Provide work according to VAAR 852.236.91 and FAR clause 52.236-5.
- B. Provide minimum clearances and work required for compliance with NFPA 70, National Electrical Code (NEC), and manufacturers' instructions; comply with additional requirements indicated for access and clearances.
- C. Verify all field conditions and dimensions that affect selection and provision of materials and equipment, and provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide work specified or indicated, including relocation and reinstallation of existing wiring and equipment.
  - 1. Protect facility, equipment, and wiring from damage.
- D. Submit written notice that:
  - 1. Project has been inspected for compliance with documents.
  - 2. Work has been completed in accordance with documents.
- E. Non-Conforming Work: Conduct project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing and demonstrations after verification of system operation and completeness by Contractor.
- F. For project acceptance inspections, final completion inspections, substantial completion inspections, and testing/demonstrations that require more than one site visit by COR or design professional to verify project compliance for same material or equipment, Government reserves right to obtain compensation from contractor to defray cost of additional site visits that result from project construction or testing deficiencies and incompleteness, incorrect information, or non-compliance with project provisions.

1. COR will notify contractor, of hourly rates and travel expenses for additional site visits, and will issue an invoice to Contractor for additional site visits.
2. Contractor is not eligible for extensions of project schedule or additional charges resulting from additional site visits that result from project construction or testing deficiencies/incompleteness, incorrect information, or non-compliance with Project provisions.

G. Tests:

1. Interim inspection is required at approximately 50 percent of installation.
2. Request inspection ten working days prior to interim inspection start date by notifying COR in writing; this inspection must verify equipment and system being provided adheres to installation, mechanical and technical requirements of construction documents.
3. Inspection to be conducted by OEM and factory-certified contractor representative, and witnessed by COR, facility and SMCS 0050P2H3 representatives.
4. Check each item of installed equipment to ensure appropriate NRTL listing labels and markings are fixed in place.
5. Verify cabling terminations in DEMARC, MCR, TER, SCC, ECC, TRs and head end rooms, workstation locations and TCO adhere to color code for T568A pin assignments and cabling connections are in compliance with TIA standards.
6. Visually confirm minimum Category 6 cable marking at TCOs, CCSs locations, patch cords and origination locations.
7. Review entire communications circulating ground system, each TGB and grounding connection, grounding electrode and outside lightning protection system.
8. Review cable tray, conduit and path/wire way installation practice.
9. OEM and contractor to perform:
  - a. Fiber optical cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.
  - b. Coaxial cable field inspection tests via attenuation measurements on factory reels; provide results along with OEM certification for factory reel tests.

- c. Baseband cable field inspection tests via attenuation measurements on factory reels and provide results along with OEM certification for factory reel tests.
- 10. Relocate failed cable reels to a secured location for inventory, as directed by COR, and then remove from project site within two working days; provide COR with written confirmation of defective cable reels removal from project site.
- 11. Provide results of interim inspections to COR.
- 12. If major or multiple deficiencies are discovered, additional interim inspections could be required until deficiencies are corrected, before permitting further system installation.
  - a. Additional inspections are scheduled at direction of COR.
  - b. Re-inspection of deficiencies noted during interim inspections, must be part of system's Final Acceptance Proof of Performance Test.
  - c. The interim inspection cannot affect the system's completion date unless directed by COR.
- 13. Facility COR will ensure test documents become a part of system's official documentation package.
- H. Pretesting: Re-align, re-balance, sweep, re-adjust and clean entire system and leave system working for a "break-in" period, upon completing installation of system and prior to Final Acceptance Proof of Performance Test. System RF transmitting equipment must not be connected to keying or control lines during "break-in" period.
  - 1. Pretesting Procedure:
    - a. Verify systems are fully operational and meet performance requirements, utilizing accepted test equipment and spectrum analyzer.
    - b. Pretest and verify system functions and performance requirements conform to construction documents and, that no unwanted physical, aural and electronic effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise are present.
  - 2. Measure and record signal, aural and control carrier levels of each DAS RF, voice and data channel, at each of the following minimum points in system:
    - a. PBX interconnections.
    - b. MCR interconnections.
    - c. MCOR interconnections.

- d. TER interconnections.
  - e. TOR interconnections.
  - f. Control room interconnections.
  - g. TR interconnections.
  - h. System interfaces in locations listed herein.
  - i. HE interconnections.
  - j. System and lightning ground interconnections.
  - k. Communications circulating ground system.
  - l. UPS areas.
  - m. Emergency generator interconnections.
  - n. Each general floor areas.
  - o. Others as required by AHJ (SMCS 0050P2H3).
  - 3. Provide recorded system pretest measurements and certification that the system is ready for formal acceptance test to COR.
- I. Acceptance Test:
- 1. Schedule an acceptance test date after system has been pretested, and pretest results and certification submitted to COR.
  - 2. Give COR fifteen working days written notice prior to date test is expected to begin; include expected duration of time for test in notification.
  - 3. Test in the presence of the following:
    - a. COR.
    - b. OEM representatives.
    - c. VACO:
      - 1) CFM representative.
      - 2) AHJ-SMCS 0050P2H3, (202)461-5310.
    - d. VISN-CIO, Network Officer and VISN representatives.
    - e. Facility:
      - 1) FMS Service Chief, Bio-Medical Engineering and facility representatives.
      - 2) OI&T Service Chief and OI&T representatives.
      - 3) Safety Officer, Police Chief and facility safety representatives.
    - f. Local Community Safety Personnel:
      - 1) Fire Marshal representative.
      - 2) Disaster Coordinator representative.
      - 3) EMS Representatives: Police, Sherriff, City, County or State representatives.



4. Test system utilizing accepted test equipment to certify proof of performance and Life and Public Safety compliance, FCC, NRTL, NFPA and OSHA compliance.
  - a. Rate system as acceptable or unacceptable at conclusion of test; make only minor adjustments and connections required to show proof of performance.
    - 1) Demonstrate and verify that system complies with performance requirements under operating conditions.
    - 2) Failure of any part of system that precludes completion of system testing, and which cannot be repaired within four hours, terminates acceptance test of that portion of system.
    - 3) Repeated failures that result in a cumulative time of eight hours to affect repairs is cause for entire system to be declared unacceptable.
    - 4) If system is declared unacceptable, retesting must be rescheduled at convenience of Government and costs borne by the contractor.

J. Acceptance Test Procedure:

1. Physical and Mechanical Inspection: The test team representatives must tour major areas to determine system and sub-systems are completely and properly installed and are ready for acceptance testing.
2. A system inventory including available spare parts must be taken at this time.
3. Each item of installed equipment must be re-checked to ensure appropriate NRTL (i.e. UL) certification listing labels are affixed.
4. Confirm that deficiencies reported during Interim Inspections and Pretesting are corrected prior to start of Acceptance Test.
5. Inventory system diagrams, record drawings, equipment manuals, pretest results.
6. Failure of system to meet installation requirements of specifications is grounds for terminating testing and to schedule re-testing.

K. Operational Test:

1. Individual Item Test: VACO AHJ representative (SMCS 0050P2H3) may select individual items of DAS equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet requirements of the construction documents.

2. Government's Condition of Acceptance of System Language:
  - a. Without Acceptance: Until system fully meets conditions of construction documents, system's ownership, use, operation and warranty commences at Government's final acceptance date.
  - b. With Conditional Acceptance: Stating conditions that need to be addressed by contractor or OEM and stating system's use and operation to commence immediately while its warranty commences only at Government's agreed final extended acceptance date.
  - c. With Full Acceptance: Stating system's ownership, use, operation and warranty to immediately commence at Government's agreed to date of final acceptance.
- L. Acceptance Test Conclusion: Reschedule testing on deficiencies and shortages with COR, after COR and SMCS AHJ jointly agree to results of the test, using the generated punch list or discrepancy list. Perform retesting to comply with these specifications at contractor's expense.
- M. Proof of Performance Certification:
  1. If system is declared acceptable, AHJ (SMCS 0050P2H3) provides COR notice stating system processes to required operating standards and functions and is Government accepted for use by facility.
  2. Validate items with COR needing to be provided to complete project contract (i.e. charts & diagrams, manuals, spare parts, system warranty documents executed, etc.). Once items have been provided, COR contacts FMS service chief to turn over system from CFM oversight for beneficial use by facility.
  3. If system is declared unacceptable without conditions, rescheduled testing expenses are to be borne by contractor.

### 3.7 CLEANING

- A. Remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and clean work area, prior to final inspection and acceptance of work.
- B. Put building and premises in neat and clean condition.
- C. Remove debris on a daily basis.
- D. Remove unused material, during progress of work.
- E. Perform cleaning and washing required to provide acceptable appearance and operation of equipment to satisfaction of COR.
- F. Clean exterior surface of all equipment, including concrete residue, dirt, and paint residue, after completion of project.
- G. Perform final cleaning prior to project acceptance by COR.

- H. Remove paint splatters and other spots, dirt, and debris; touch up scratches and mars of finish to match original finish.
- I. Clean devices internally using methods and materials recommended by manufacturer.
- J. Tighten wiring connectors, terminals, bus joints, and mountings, to include lugs, screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. In absence of published connection or terminal torque values, comply with torque values specified in UL 486A-486B.

### **3.8 TRAINING**

- A. Provide training in accordance with subsection, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide training for equipment or system as required in each associated specification.
- C. Develop and submit training schedule for approval by COR, at least 30 days prior to planned training.

### **3.9 PROTECTION**

- A. Protection of Fireproofing:
  - 1. Install clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed, if possible, prior to start of spray fireproofing work.
  - 2. Install conduits and other items that would interfere with proper application of fireproofing after completion of spray fire proofing work.
  - 3. Patch and repair fireproofing damaged due to cutting or course of work must be performed by installer of fireproofing and paid for by trade responsible for damage.
- B. Maintain equipment and systems until final acceptance.
- C. Ensure adequate protection of equipment and material during installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

- - - E N D - - -



**SECTION 27 05 26**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27 and 28.

**1.2 RELATED WORK**

- A. Requirements for a lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- B. Low voltage wiring: Section 27 10 00, STRUCTURED CABLING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- C. Closeout Submittals: In addition to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide the following:
  - 1. Certified test reports of ground resistance.
  - 2. Certifications: Two weeks prior to final inspection, submit following to COR:
    - a. Certification materials and installation is in accordance with construction documents.
    - b. Certification complete installation has been installed and tested.

**PART 2 - PRODUCTS**

**2.1 COMPONENTS**

- A. Grounding and Bonding Conductors:
  - 1. Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm<sup>2</sup> (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm<sup>2</sup> (4 AWG) and larger per NEC.
  - 2. Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm<sup>2</sup> (10 AWG) and smaller.
- B. Ground Rods:

1. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
  2. Provide quantity of rods required to obtain specified ground resistance.
- C. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.
- D. Telecommunication System Ground Busbars:
1. Telecommunications Main Grounding Busbar (TMGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.
    - b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
    - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
      - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
      - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
    - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
    - e. Listed as grounding and bonding equipment.
  2. Telecommunications Grounding Busbar (TGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.
    - b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
    - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
      - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
      - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
    - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
    - e. Listed as grounding and bonding equipment.
- E. Equipment Rack and Cabinet Ground Bars:
1. Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
    - a. 4.7 mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.

- b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.
  - c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
  - d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole grounding lugs.
  - e. Copper splice bar of same material to transition between adjoining racks.
  - f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
  - g. Listed as grounding and bonding equipment.
2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
- a. 1.3 mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.
  - b. 1997 mm (78 inches) high for mounting vertically on full height racks.
  - c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
  - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
  - e. NRTL listed as grounding and bonding equipment.
- F. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.
- 1. Electroplated tin aluminum extrusion.
  - 2. Accept conductors ranging from #14 AWG through 2/0.
  - 3. Hold conductors in place by two stainless steel set screws.
  - 4. Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
  - 5. Listed as a wire connector.
- G. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.
- H. Irreversible Compression Lugs:

1. Electroplated tinned copper.
  2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
  3. Sized to fit the specific size conductor.
  4. Listed as wire connectors.
- I. Antioxidant Joint Compound: Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

### **PART 3 - EXECUTION**

#### **3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding busbars in telecommunications rooms, digital telephone (PBX) equipment room, VoIP active equipment room, and network operations room to telecommunications main grounding busbar in Demarc room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.
- C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.
- D. Conduit Systems:
1. Bond ferrous metallic conduit to ground.
  2. Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.
- E. Boxes, Cabinets, and Enclosures:
1. Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.
- F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.
- G. Telecommunications Grounding System:



1. Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
2. Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
4. Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding busbar.
5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify COR prior to backfilling at ground connections.
6. Above-Grade Bolted or Screwed Grounding Connections:
  - a. Remove paint to expose entire contact surface by grinding.
  - b. Clean all connector, plate and contact surfaces.
  - c. Apply corrosion inhibitor to surfaces before joining.
7. Bonding Jumpers:
  - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.
  - b. Use connector manufacturer's compression tool.
8. Bonding Jumper Fasteners:
  - a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lockwashers or Belleville Washers.
  - b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
  - c. Grounding Busbars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.

- d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.
- H. Telecommunications Room Bonding:
  - 1. Telecommunications Grounding Busbars:
    - a. Install busbar hardware no less than 950 mm (18 inches) A.F.F.
    - b. Where other grounding busbars are located in same room, e.g. electrical panelboard for telecommunications equipment, bond busbars together as indicated on grounding riser diagrams.
    - c. Make conductor connections with two-hole compression lugs sized to fit busbar and conductors.
    - d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on busbar with anti-oxidant to help prevent corrosion.
  - 2. Telephone-Type Cable Rack Systems:
    - a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
    - b. Make ground connections by installing bonding jumpers:
      - 1) Install minimum 16 mm<sup>2</sup> (6 AWG) bonding between telecommunications ground busbars and the aluminum pan installed on cable rack.
      - 2) Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.
- I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
  - 1. Install rack-mount horizontal busbar or vertical busbar to provide multiple bonding points,
  - 2. At each rack or cabinet containing active equipment or shielded cable terminations:
    - a. Bond busbar to ground as part of overall telecommunications bonding and grounding system.
    - b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.
    - c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.

- d. Provide 16 mm<sup>2</sup> (6 AWG) bonding jumpers between rack and cabinet ground busbars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm<sup>2</sup> (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:
  - 1. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
  - 2. Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
  - 3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.
- M. Communications Cable Tray Systems:
  - 1. Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.
  - 2. Where metallic cable tray systems are mechanically discontinuous:
    - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
    - b. Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
  - 3. Bond cable tray installed in same room as telecommunications grounding busbar to busbar.

N. Communications Raceway Grounding:

1. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.
2. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.

O. Ground Resistance:

1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.
2. Measure grounding electrode system resistance using an earth test meter, clamp-on ground tester, or computer-based ground meter as defined in IEEE 81. Record ground resistance measurements before electrical distribution system is energized.
3. Backfill only after below-grade connection have been visually inspected by COR. Notify COR twenty-four hours before below-grade connections are ready for inspection.

### 3.2 FIELD QUALITY CONTROL

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.
- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

- - - E N D - - -

**SECTION 27 05 33  
RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies conduit, fittings, and boxes to form complete, coordinated, raceway systems. Raceways are required for communications cabling unless shown or specified otherwise.

**1.2 RELATED WORK**

- A. Mounting board for Telecommunication Rooms: Section 06 10 00, ROUGH CARPENTRY.
- B. Sealing around penetrations to maintain integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- C. Fabrications for deflection of water away from building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- D. Sealing around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- E. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- F. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. In accordance with Section 27 50 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
  - 1. Size and location of cabinets, splice boxes and pull boxes.
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. Catalog cuts marked with specific item proposed and area of application identified.
- B. Certification: Provide letter prior to final inspection, certifying material is in accordance with construction documents and properly installed.

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

- A. Minimum Conduit Size: 19 mm (3/4 inch).
- B. Conduit:
  - 1. Rigid Galvanized Steel: Conform to UL 6, ANSI C80.1.
  - 2. Rigid Aluminum: Conform to UL 6A, ANSI C80.5.

3. Rigid Intermediate Steel Conduit (IMC): Conform to UL 1242, ANSI C80.6.
  4. Electrical Metallic Tubing (EMT):
    - a. Maximum Size: 105 mm (4 inches).
    - b. Install only for cable rated 600 volts or less.
    - c. Conform to UL 797, ANSI C80.3.
  5. Flexible Galvanized Steel Conduit: Conform to UL 1.
  6. Liquid-tight Flexible Metal Conduit: Conform to UL 360.
  7. Direct Burial Plastic Conduit: Conform to UL 651 and UL 651A, heavy wall PVC, or high density polyethylene (HDPE).
  8. Surface Metal Raceway: Conform to UL 5.
  9. Wireway, Approved "Basket": Provide "Telecommunications Service" rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- C. Conduit Fittings:
1. Rigid Galvanized Steel and Rigid Intermediate Steel Conduit Fittings:
    - a. Provide fittings meeting requirements of UL 514B and ANSI/ NEMA FB 1.
    - b. Sealing: Provide threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water and vapor. In concealed work, install sealing fittings in flush steel boxes with blank cover plates having same finishes as other electrical plates in room.
    - c. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
    - d. Locknuts: Bonding type with sharp edges for digging into metal wall of an enclosure.
    - e. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into metallic body of fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
    - f. Erickson (union-type) and Set Screw Type Couplings:
      - 1) Couplings listed for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete.

- 2) Use set screws of case hardened steel with hex head and cup point to seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
- g. Provide OEM approved fittings.
- 2. Rigid Aluminum Conduit Fittings:
  - a. Standard Threaded Couplings, Locknuts, Bushings, and Elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are not permitted.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
- 3. Electrical Metallic Tubing Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
  - b. Couplings and Connectors: Concrete tight and rain tight, with connectors having insulated throats.
    - 1) Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller.
    - 2) Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches).
    - 3) Use set screws of case-hardened steel with hex head and cup point to seat in wall of conduit for positive grounding.
  - c. Indent type connectors or couplings are not permitted.
  - d. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
  - e. Provide OEM approved fittings.
- 4. Flexible Steel Conduit Fittings:
  - a. Conform to UL 514B; only steel or malleable iron materials are acceptable.
  - b. Provide clamp type, with insulated throat.
  - c. Provide OEM approved fittings.
- 5. Liquid-tight Flexible Metal Conduit Fittings:
  - a. Conform to UL 514B and ANSI/ NEMA FB1; only steel or malleable iron materials are acceptable.
  - b. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.

- c. Provide connectors with insulated throats to prevent damage to cable jacket.
  - d. Provide OEM approved fittings.
- 6. Surface Metal Raceway: Conform to UL 5 and "telecommunications service" rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
- 7. Surface Metal Raceway Fittings: As recommended by raceway manufacturer.
- 8. Expansion and Deflection Couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate 19 mm (3/4 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
  - c. Include internal flexible metal braid sized to ensure conduit ground continuity and fault currents in accordance with UL 467, and NEC code tables for ground conductors.
  - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
- 9. Rigid Aluminum Fittings:
  - a. Provide malleable iron, steel or aluminum alloy materials; zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
  - d. Indent type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are not permitted.
  - f. Provide OEM approved fittings.
- 10. Wireway Fittings: As recommended by wireway OEM.
- D. Conduit Supports:
  - 1. Parts and Hardware: Provide zinc-coat or equivalent corrosion protection.
  - 2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.



3. Multiple Conduit (Trapeze) Hangers: Minimum 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 2.78 mm (12 gage) steel, cold formed, lipped channels; with minimum 9 mm (3/8 inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Splice, and Pull Boxes:
1. Conform to UL-50 and UL-514A.
  2. Cast metal where required by NEC or shown, and equipped with rustproof boxes.
  3. Sheet Metal Boxes: Galvanized steel, except where otherwise shown.
  4. Install flush mounted wall or ceiling boxes with raised covers so that front face of raised cover is flush with wall.
  5. Install surface mounted wall or ceiling boxes with surface style flat or raised covers.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.
- G. Flexible Nonmetallic Communications Raceway (Innerduct) and Fittings:
1. General: Provide UL 910 listed plenum, riser, and general purpose corrugated pliable communications raceway for optical fiber cables and communications cable applications; select in accordance with provisions of NEC Articles 770 and 800.
  2. Provide Communications Raceway with a factory installed 567 kg (1250 lb.) tensile pre-lubricated pull tape.
  3. Use only metallic straps, hangers and fittings to support raceway from building structure. Cable ties are not permitted for securing raceway to building structure.
  4. Provide fittings to be installed in spaces used for environmental air made of materials that do not exceed flammability, smoke generation, ignitibility, and toxicity requirements of environmental air space.
  5. Size: Metric Designator 53 (trade size 2) or smaller.
  6. Outside Plant: Plenum-rated where each interduct is 75 mm (3 inches) and larger.
  7. Inside Plant: Listed and marked for installation in plenum airspaces and minimum 25 mm (1 inch) inside diameter.
  8. Plenum: Non-metallic communications raceway.
    - a. Constructed of low smoke emission, flame retardant PVC with corrugated construction.

- b. UL 94 V-0 rating for flame spreading limitation.
- 9. Provide innerduct reel lengths as necessary to ensure ducts are continuous; one piece runs from ENTR to MH; MH to MH; DEMARC to MCR/TER; TR to TR. Innerduct connectors are not permitted between rooms.
- 10. Provide pulling accessories used for innerduct including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (blown air) compatible with materials being pulled.
- H. Outlet Boxes:
  - 1. Flush wall mounted minimum 11.9 cm (4-11/16 inches) square, 9.2 cm (3-5/8 inches) deep pressed galvanized steel.
  - 2. 2-Gang Tile Box:
    - a. Flush backbox type for installation in block walls.
    - b. Minimum 92 mm (3-5/8 inches) deep.
- I. Weatherproof Outlet Boxes: Surface mount two gang, 67 mm (2-5/8 inches) deep weatherproof cast aluminum with powder coated finish internal threads on hubs 19 mm (3/4 inch) minimum.
- J. Cable Tray:
  - 1. Provide wire basket type of sizes indicated; with all required splicing and mounting hardware.
  - 2. Materials and Finishes:
    - a. Electro-plated zinc galvanized (post plated) made from carbon steel and plated to ASTM B 633, Type III, SC-1.
    - b. Remove soot, manufacturing residue/oils, or metallic particles after fabrication.
    - c. Rounded edges and smooth surfaces.
  - 3. Provide continuous welded top side wire to protect cable insulation and installers.
  - 4. High strength steel wires formed into a 50 x 100 mm (2 inches by 4 inches) wire mesh pattern with intersecting wires welded together.
  - 5. Wire Basket Sizes:
    - a. Wire Diameter: 5 mm (0.195 inch) minimum on all mesh sections.
    - b. Usable Loading Depth: 105 mm (4 inch).
    - c. Width: 450 mm (18 inches).
  - 6. Fittings: Field-formed, from straight sections, in accordance with manufacturer's instructions.

7. Provide accessories to protect, support and install wire basket tray system.

K. Cable Duct: Equip with hinged covers, except where removable covers are accepted by COR.

L. Cable Duct Fittings: As recommended by cable duct OEM.

### **PART 3 - EXECUTION**

#### **3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS**

A. Raceways typically required for cabling systems unless otherwise indicated:

System	Specification Section	Installed Method
Grounding	27 05 26	Conduit Not Required
Control, Communication and Signal Wiring	27 10 00	Complete Conduit Allowed in Non-Partitioned Cable Tray or Cable Ladders
Communications Structured Cabling	27 15 00	Conduit to Cable Tray Partitioned Cable Tray
Master Antenna Television Equipment and Systems	27 41 31	J-Hooks, Bridle Rings, conduit to Cable Tray, Partitioned Cable Tray
Public Address and Mass Notification Systems	27 51 16	Complete conduit
Intercommunications and Program systems	27 51 23	Conduit to Cable Tray, Partitioned Cable Tray
Nurse Call	27 52 23	Complete Conduit
Security Emergency Call, Duress Alarm, and Telecommunications	27 52 31	Conduit to Cable Tray, Partitioned Cable Tray
Miscellaneous Medical Systems	27 52 41	Complete Conduit
Distributed Radio Antenna Equipment and System	27 53 19	Conduit to Cable Tray, Partitioned Cable Tray
Grounding and Bonding for Electronic Safety and Security	28 05 26	Conduit Not Required Unless Required by Code
Physical Access Control System	28 13 00	Conduit to Cable Tray Partitioned Cable Tray
Physical Access Control System and Database Management	28 13 16	Conduit to Cable Tray Partitioned Cable Tray
Security Access Detection	28 13 53	Complete Conduit

System	Specification Section	Installed Method
Intrusion Detection System	28 16 00	Conduit to Cable Tray, Partitioned Cable Tray
Video Surveillance	28 23 00	Complete Conduit
Electronic Personal Protection System	28 26 00	Conduit to Cable Tray, Partitioned Cable Tray
Fire Detection and Alarm	28 31 00	Complete Conduit

## B. Penetrations:

### 1. Cutting or Holes:

- a. Locate holes in advance of installation. Where they are proposed in structural sections, obtain approval of structural engineer and COR prior to drilling through structural sections.
- b. Make holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not permitted; COR may grant limited permission by request, in condition of limited working space.
- c. Fire Stop: Where conduits, wireways, and other communications raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.
  - 1) Fill and seal clearances between raceways and openings with fire stop material.
  - 2) Install only retrofittable, non-hardening, and reusable firestop material that can be removed and reinstalled to seal around cables inside conduits.
- d. Waterproofing at Floor, Exterior Wall, and Roof Conduit Penetrations:
  - 1) Seal clearances around conduit and make watertight as specified in Section 07 92 00, JOINT SEALANTS or directed by waterproofing manufacturer.

## C. Conduit Installation:

1. Minimum conduit size of 19 mm (3/4 inch), but not less than size required for 40 percent fill.
2. Install insulated bushings on all conduit ends.

3. Install pull boxes after every 180 degrees of bends (two 90 degree bends). Size boxes per TIA 569.
4. Extend vertical conduits/sleeves through floors minimum 75 mm (3 inches) above floor and minimum 75 mm (3 inches) below ceiling of floor below.
5. Terminate conduit runs to and from a backboard in a closet or interstitial space at top or bottom of backboard. Install conduits to enter telecommunication rooms next to wall and flush with backboard.
6. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections.
7. Seal empty conduits located in telecommunications rooms or on backboards with a standard non-hardening putty compound to prevent entrance of moisture and gases and to meet fire resistance requirements.
8. Minimum radius of communication conduit bends:

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

9. Provide 19 mm (3/4 inch) thick fire retardant plywood specified in Section 06 10 00, ROUGH CARPENTRY on wall of communication closets where shown on drawings. Mount plywood with bottom edge 300 mm (12 inches) above finished floor and top edge 2.74 m (9 feet) A.F.F.
10. Provide pull wire in all empty conduits; sleeves through floor are exceptions.
11. Complete each entire conduit run installation before pulling in cables.
12. Flattened, dented, or deformed conduit is not permitted.

13. Ensure conduit installation does not encroach into ceiling height head room, walkways, or doorways.
  14. Cut conduit square with a hacksaw, ream, remove burrs, and draw tight.
  15. Install conduit mechanically continuous.
  16. Independently support conduit at 2.44 m (8 feet) on center; do not use other supports (i.e., suspended ceilings, suspended ceiling supporting members, luminaires, conduits, mechanical piping, or mechanical ducts).
  17. Support conduit within 300 mm (1 foot) of changes of direction, and within 300 mm (1 foot) of each enclosure to which connected.
  18. Close ends of empty conduit with plugs or caps to prevent entry of debris, until cables are pulled in.
  19. Attach conduits to cabinets, splice cases, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on inside of enclosure, made up wrench tight. Do not make conduit connections to box covers.
  20. Do not use aluminum conduits in wet locations.
  21. Unless otherwise indicated on drawings or specified herein, conceal conduits within finished walls, floors and ceilings.
  22. Conduit Bends:
    - a. Make bends with standard conduit bending machines; observe minimum bend radius for cable type and outside diameter.
    - b. Conduit hickey is permitted only for slight offsets, and for straightening stubbed conduits.
    - c. Bending of conduits with a pipe tee or vise is not permitted.
  23. Layout and Homeruns - Deviations: Make only where necessary to avoid interferences and only after drawings showing proposed deviations have been submitted and approved by COR.
- D. Concealed Work Installation:
1. In Concrete:
    - a. Conduit: Rigid steel or IMC.
    - b. Align and run conduit in direct lines.
    - c. Install conduit through concrete beams only when the following occurs:
      - 1) Where shown on structural drawings.

- 2) As accepted by COR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- d. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - 1) Conduit outside diameter larger than 1/3 of slab thickness is prohibited.
  - 2) Space between Conduits in Slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
  - 3) Install conduits approximately in center of slab to ensure a minimum of 19 mm (3/4 inch) of concrete around conduits.
- e. Make couplings and connections watertight. Use thread compounds that are NRTL listed conductive type to ensure low resistance ground continuity through conduits. Tightening set screws with pliers is not permitted.
- E. Furred or Suspended Ceilings and in Walls:
  - 1. Rigid steel, IMC or rigid aluminum. Different type conduits mixed indiscriminately in same system is not permitted.
  - 2. Align and run conduit parallel or perpendicular to building lines.
  - 3. Tightening set screws with pliers is not permitted.
- F. Exposed Work Installation:
  - 1. Unless otherwise indicated on drawings, exposed conduit is only permitted in telecommunications rooms.
    - a. Provide rigid steel, IMC or rigid aluminum.
    - b. Different type of conduits mixed indiscriminately in system is not permitted.
  - 2. Align and run conduit parallel or perpendicular to building lines.
  - 3. Install horizontal runs close to ceiling or beams and secure with conduit straps.
  - 4. Support horizontal or vertical runs at not over 2400 mm (96 inches) intervals.
  - 5. Surface Metal Raceways: Use only where shown on drawings.
  - 6. Painting:
    - a. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
    - b. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color.

- c. Provide labels where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

G. Expansion Joints:

1. Conduits 75 mm (3 inches) and larger, that are secured to building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install couplings in accordance with manufacturer's recommendations.
2. Provide conduits smaller than 75 mm (3 inches) with pull boxes on both sides of expansion joint. Connect conduits to expansion and deflection couplings as specified.
3. Install expansion and deflection couplings where shown.

H. Seismic Areas:

1. In seismic areas, follow H-18-8 Seismic Design Requirements.
2. Rigidly secure conduit to building structure on opposite sides of a building expansion joint with pull boxes on both sides of joint.
3. Connect conduits to pull boxes with 375 mm (15 inches) of slack flexible conduit.
4. Install green copper wire minimum #6 AWG in flexible conduit for bonding jumper.

I. Conduit Supports, Installation:

1. Select AC193 code listed mechanical anchors or fastening devices with safe working load not to exceed 1/4 of proof test load.
2. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
3. Support multiple conduit runs with trapeze hangers. Use trapeze hangers designed to support a load equal or greater than sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other accepted fasteners.
4. Support conduit independent of pull boxes, luminaires, suspended ceiling components, angle supports, duct work, and similar items.
5. Fastenings and Supports in Solid Masonry and Concrete:
  - a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing concrete.
  - b. Existing Construction:



- 1) Code AC193 listed wedge type steel expansion anchors minimum 6 mm (1/4 inch) bolt size and minimum 28 mm (1-1/8 inch) embedment.
  - 2) Power set fasteners minimum 6 mm (1/4 inch) diameter with depth of penetration minimum 75 mm (3 inches).
  - 3) Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
  6. Fastening to Hollow Masonry: Toggle bolts are permitted.
  7. Fastening to Metal Structures: Use machine screw fasteners or other devices designed and accepted for application.
  8. Bolts supported only by plaster or gypsum wallboard are not acceptable.
  9. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
  10. Do not support conduit from chain, wire, or perforated strap.
  11. Spring steel type supports or fasteners are not permitted except horizontal and vertical supports/fasteners within walls.
  12. Vertical Supports:
    - a. Install riser clamps and supports for vertical conduit runs in accordance with NEC.
    - b. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.
- J. Box Installation:
1. Boxes for Concealed Conduits:
    - a. Flush mounted.
    - b. Provide raised covers for boxes to suit wall or ceiling, construction and finish.
  2. In addition to boxes shown, install additional boxes where needed to prevent damage to cables during pulling.
  3. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
  4. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
  5. Outlet boxes mounted back-to-back in same wall are not permitted. A minimum 600 mm (24 inches) center-to-center lateral spacing must be maintained between boxes.

K. Flexible Nonmetallic Communications Raceway (Innerduct), Installation:

1. Install supports from building structure for horizontal runs at intervals not to exceed 900 mm (3 feet) and at each end.
2. Install supports from building structure for vertical runs at intervals not to exceed 1.2 m (4 feet) and at each side of joints.
3. Install only in accessible spaces not subject to physical damage or corrosive influences.
4. Make bends manually to assure internal diameter of tubing is not effectively reduced.
5. Extend each segment of innerduct minimum 300 mm (12 inches) beyond end of service conduit tie or cable tray. Restrain innerduct ends with wall mount clamps and seal when cable is installed.

**3.2 TESTING**

- A. Examine fittings and locknuts for secureness.
- B. Test RMC, IMC and EMT systems for electrical continuity.
- C. Perform simple continuity test after cable installation.

- - - E N D - - -

**SECTION 27 08 00**  
**COMMISSIONING OF COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes requirements for commissioning facility communications systems, related subsystems and related equipment. This Section supplements general requirements specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Complete list of equipment and systems to be commissioned is specified in Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Specification 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Commissioned Systems:
  - 1. Commissioning of systems specified in Division 27 and 28 is part of project's construction process including documentation and proof of performance testing of these systems, as well as training of VA's Operation and Maintenance personnel in accordance with requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS and Division 27, in cooperation with Government and Commissioning Agent.
  - 2. The facility exterior closure systems commissioning includes communications systems listed in Section 01 19 00 GENERAL COMMISSIONING REQUIREMENTS and 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

**1.2 RELATED WORK**

- A. System tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Commissioning process requires review of selected submittals that pertain to systems to be commissioned: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- C. Construction phase commissioning process and procedures including roles and responsibilities of commissioning team members and user training: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

**1.3 COORDINATION**

- A. Commissioning Agent will provide a list of submittals that must be reviewed by Commissioning Agent simultaneously with engineering review; do not proceed with work of sections identified without engineering and Commissioning Agent's review completed.
- B. Commissioning of communications systems require inspection of individual elements of communications system construction throughout construction period. Coordinate with Commissioning Agent in accordance

with Section 01 19 00, GENERAL COMMISSIONING REQUIREMENTS and commissioning plan to schedule communications systems inspections as required to support the commissioning process.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Refer to Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.
- B. Pre-Functional Checklists:
  - 1. Complete pre-functional checklists provided by commissioning agent to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing.
  - 2. Submit completed checklists to COR and to Commissioning Agent. Commissioning Agent can spot check a sample of completed checklists. If Commissioning Agent determines that information provided on the checklist is not accurate, Commissioning Agent then returns the marked-up checklist to Contractor for correction and resubmission.
  - 3. If Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, Commissioning Agent can select a broader sample of checklists for review.
  - 4. If Commissioning Agent determines that a significant number of broader sample of checklists is also inaccurate, all checklists for the type of equipment will be returned to Contractor for correction and resubmission.
- C. Submit training agendas and trainer resumes in accordance with requirements of Section 01 19 00, GENERAL COMMISSIONING REQUIREMENTS.

#### **PART 2 - PRODUCTS - NOT USED**

#### **PART 3 - EXECUTION**

##### **3.1 FIELD QUALITY CONTROL**

- A. Contractor's Tests:
  - 1. Scheduled tests required by other sections of Division 27 must be documented in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 2. Incorporate all testing into project schedule. Provide minimum seven calendar days' notice of testing for Commissioning Agent to witness selected Contractor tests at sole discretion of Commissioning Agent.

3. Complete tests prior to scheduling Systems Functional Performance Testing.

B. Systems Functional Performance Testing:

1. Commissioning process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
2. Commissioning Agent prepares detailed Systems Functional Performance Test procedures for review and acceptance by COR.
3. Provide required labor, materials, and test equipment identified in test procedure to perform tests.
4. Commissioning Agent must witness and document the testing.
  - a. Provide test reports to Commissioning Agent. Commissioning Agent will sign test reports to verify tests were performed.

**3.2 TRAINING**

- A. Training of Government's operation and maintenance personnel is required in cooperation with COR and Commissioning Agent.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning location, operation, and troubleshooting of installed systems.
- C. Schedule instruction in coordination with COR after submission and approval of formal training plans.

- - - E N D - - -



**SECTION 27 10 00**  
**CONTROL, COMMUNICATION AND SIGNAL WIRING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes control, communication and signal wiring for a comprehensive systems infrastructure.
- B. This section applies to all sections of Divisions 27 and 28.

**1.2 RELATED WORK**

- A. Sealing around penetrations to maintain integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Submit written certification from OEM:
  - 1. Indicate wiring and connection diagrams meet National and Government Life Safety Guidelines, NFPA, NEC, NRTL, Joint Commission, OEM, this section and Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
  - 2. Include instructions, requirements, recommendations, and guidance for proper performance of system as described herein.
  - 3. Government will not approve any submittal without this certification.
- C. Identify environmental specifications on technical submittals; identify requirements for installation.
  - 1. Minimum floor space and ceiling heights.
  - 2. Minimum size of doors for cable reel passage.
- D. Power: Provide specific voltage, amperage, phases, and quantities of circuits.
- E. Provide conduit size requirements.
- F. Closeout Submittals:

1. Provide contact information for maintenance personnel to contact contractor for emergency maintenance and logistic assistance, and assistance in resolving technical problems at any time during warranty period.
2. Provide certified OEM sweep test tags from each cable reel to COR.
3. Furnish spare or unused wire and cable with appropriate connectors (female types) for installation in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
4. Turn over unused and opened installation kit boxes, coaxial, fiber optic, and twisted pair cable reels, conduit, cable tray, cable duct bundles, wire rolls, physical installation hardware to COR.
5. Documentation: Include any item or quantity of items, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide system documentation required herein.

## **PART 2 - PRODUCTS**

### **2.1 CONTROL WIRING**

- A. Provide control wiring large enough so voltage drop under in-rush conditions does not adversely affect operation of controls.
- B. Provide cable meeting specifications for type of cable.
- C. Remote Control Cable:
  1. Multi-conductor with stranded conductors able to handle power and voltage required to control specified system equipment, from a remote location.
  2. NRTL listed and pass VW-1 vertical wire flame test (UL 83) (formerly FR-1).
  3. Color-coded Conductors: Combined multi-conductor and coaxial cables are acceptable for this installation, on condition system performance standards are met.
  4. Technical Characteristics:
    - a. Length: As required, in 1K (3,000 ft.) reels minimum.
    - b. Connectors: As required by system design.
    - c. Size:
      - 1) 18 AWG, minimum, Outside.
      - 2) 20 AWG, minimum, Inside.
    - d. Color Coding: Required, EIA industry standard.
    - e. Bend Radius: 10 times cable outside diameter.
    - f. Impedance: As required.



g. Shield Coverage: As required by OEM specification.

h. Attenuation:

Frequency in MHz	dB per 305 Meter (1,000 feet), maximum
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

D. Distribution System Signal Wires and Cables:

1. Provide in same manner, and use construction practices, as Fire Protective and other Emergency Systems identified and defined in NFPA 101, Life Safety Code, Chapters 7, 12, and 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions.
2. Provide system able to withstand adverse environmental conditions without deterioration, in their respective location.
3. Provide entering of each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of cables.
4. Terminate on an item of equipment by direct connection.

## 2.2 COMMUNICATION AND SIGNAL WIRING

- A. Provide communications and signal wiring conforming to recommendations of manufacturers of systems; provide not less than TIA Performance Category 5e.
- B. Wiring shown is for typical systems; provide wiring as required for systems being provided.
- C. Provide color-coded conductor insulation for multi-conductor cables.
- D. Connectors:
  1. Provide connectors for transmission lines, and signal extensions to maintain uninterrupted continuity, ensure effective connection, and preserve uniform polarity between all points in system.
    - a. Provide AC barrier strips with a protective cover to prevent accidental contact with wires carrying live AC current.

- b. Provide punch blocks for signal connection, not AC power. AC power twist-on wire connectors are not permitted for signal wire terminations.
- 2. Cables: Provide connectors designed for specific size cable and conductors being installed with OEM's approved installation tool. Typical system cable connectors include:
  - a. Audio spade lug.
  - b. Punch block.
  - c. Wirewrap.

### **2.3 INSTALLATION KIT**

- A. Include connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, cable tray, etc., required to accomplish a neat and secure installation.
- B. Terminate conductors in a spade lug and barrier strip, wire wrap terminal or punch block, so there are no unfinished or unlabeled wire connections.
- C. Minimum required installation sub-kits:
  - 1. System Grounding:
    - a. Provide required cable and installation hardware for effective ground path, including the following:
      - 1) Control Cable Shields.
      - 2) Data Cable Shields.
      - 3) Equipment Racks.
      - 4) Equipment Cabinets.
      - 5) Conduits.
      - 6) Ducts.
      - 7) Cable Trays.
      - 8) Power Panels.
      - 9) Connector Panels.
      - 10) Grounding Blocks.
    - b. Bond radio equipment to earth ground via internal building wiring, according to NEC.
  - 2. Wire and Cable: Provide connectors and terminals, punch blocks, tie wraps, hangers, clamps, labels, etc. required to accomplish termination in an orderly installation.

3. Conduit, Cable Duct, and Cable Tray: Provide conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, cable tray installation in accordance with NEC and documents.
  4. Equipment Interface: Provide any items or quantity of equipment, cable, mounting hardware and materials to interface systems with identified sub-systems, according to OEM requirements and construction documents.
  5. Labels: Provide any item or quantity of labels, tools, stencils, and materials to label each subsystem according to OEM requirements, as-installed drawings, and construction documents.
- D. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:
1. Connector Panels: Flat smooth 3.175 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in cabinet. Install bulkhead equipment connectors on panel to enable cabinet equipment's signal, control, and coaxial cables to be connected through panel. Match panel color to cabinet installed.
    - a. Voice (or Telephone):
      - 1) Provide industry standard Type 110 (minimum) punch blocks for voice or telephone, and control wiring instead of patch panels, each being certified for category 6.
      - 2) IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS when designed for Category 6 and the size and type of cable used.
      - 3) Secure punch block strips to OEM designed physical anchoring unit on a wall location in TRS; console, cabinet, rail, panel, etc. mounting is permitted at OEM recommendation and as accepted by COR. Punch blocks are not permitted for Class II or 120 VAC power wiring.
      - 4) Technical Characteristics:
        - a) Number of Horizontal Rows: Minimum 100.
        - b) Number of Terminals per Row: Minimum 4.
        - c) Terminal Protector: Required for each used or unused terminal.
        - d) Insulation Splicing: Required between each row of terminals.

b. Digital or High Speed Data:

- 1) Provide 480 mm (19 inches) horizontal EIA/ECA 310 rack mountable patch panel with EIA/ECA 310 standard spaced vertical mounting holes for digital or high-speed data service CSS, with modular female Category 5E (or on a case by case basis Category 6 for specialized powered systems accepted by SMCS 0050P2H3, (202) 461-5310, OI&T and FMS Services, and COR) RJ45 jacks designed for size and type of UTP or F/UTP cable installed in rows.
- 2) Technical Characteristics:
  - a) Number of Horizontal Rows: Minimum 2.
  - b) Number of Jacks Per Row: Minimum 24.
  - c) Type of Jacks: RJ45.
  - d) Terminal Protector: Required for each used or unused jack.
  - e) Insulation: Required between each row of jacks.

## **2.4 EXISTING WIRING**

- A. Reuse existing wiring only where indicated on plans and accepted by SMCS 0050P2H3.
- B. Only existing wiring that conforms to specifications and applicable codes can be reused; existing wiring that does not meet these requirements cannot be reused and must be removed by contractor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:
  1. Install wiring in cable tray or raceway.
  2. Seal cable entering a building from underground, between wire and conduit where cable exits conduit, with non-hardening approved compound.
  3. Wire Pulling:
    - a. Provide installation equipment that prevents cutting or abrasion of insulation during pulling of cables.
    - b. Use ropes made of nonmetallic material for pulling feeders.
    - c. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached to conductors, as accepted by COR.
    - d. Pull multiple cables into a single conduit together.
- B. Control, Communication and Signal Wiring Installation:

1. Unless otherwise specified in other sections, provide wiring and connect to equipment/devices to perform required functions as indicated.
2. Install separate cables for each system so that malfunctions in any system does not affect other systems, except where otherwise required.
3. Group wires and cables according to service (i.e. AC, grounds, signal, DC, control, etc.); DC, control and signal cables can be included with any group.
4. Form wires and cables to not change position in group throughout the conduit run. Bundle wires and cables in accepted signal duct, conduit, cable ducts, or cable trays neatly formed, tied off in 600 mm to 900 mm (24 inch to 36 inch) lengths to not change position in group throughout run.
5. Concealed splices are not allowed.
6. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure.
7. Looking at any enclosure from the rear (wall mounted enclosures, junction, pull or interface boxes from the front), locate AC power, DC and speaker wires or cables on the left; coaxial, control, microphone and line level audio and data wires or cables, on the right.
8. Provide ties and fasteners that do not damage or distort wires or cables. Limit spacing between tied points to maximum 150 mm (6 inches).
9. Install wires or cables outside of buildings in conduit, secured to solid building structures.
10. Wires or cables must be specifically accepted, on a case by case basis, to be installed outside of conduit. Bundled wires or cables must be tied at minimum 460 mm (18 inches) intervals to a solid building structure; bundled wires or cables must have ultra violet protection and be waterproof (including all connections).
11. Laying wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not permitted.
12. Wires or cables installed outside of conduit, cable trays, wireways, cable duct, etc.:

- a. Only when authorized, can wires or cables be identified and approved to be installed outside of conduit.
- b. Provide wire or cable rated plenum and OEM certified for use in air plenums.
- c. Provide wires and cables hidden, protected, fastened and tied at maximum 600 mm (24 inches) intervals, to building structure.
- d. Provide closer wire or cable fastening intervals to prevent sagging, maintain clearance above suspended ceilings.
- e. Remove unsightly wiring and cabling from view, and discourage tampering and vandalism.
- f. Sleeve and seal wire or cable runs, not installed in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers, with an approved fire retardant sealant.

C. AC Power:

- 1. Bond to ground contractor-installed equipment and identified Government-furnished equipment, to eliminate shock hazards and to minimize ground loops, common mode returns, noise pickup, crosstalk, etc. for total ground resistance of 0.1 Ohm or less.
- 2. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted; use these items only for dissipation of internally generated static charges (not to be confused with externally generated lightning) that can be applied or generated outside mechanical and physical confines of system to earth ground. Discovery of improper system grounding is grounds to declare system unacceptable and termination of all system acceptance testing.
- 3. Cabinet Bus: Extend a common ground bus of at least #10 AWG solid copper wire throughout each equipment cabinet and bond to system ground. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground busses together.
- 4. Equipment: Bond equipment to cabinet bus with copper braid equivalent to at least #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.

### 3.2 EQUIPMENT IDENTIFICATION

A. Control, Communication and Signal System Identification:

- 1. Install a permanent wire marker on each wire at each termination.

2. Identify cables with numbers and letters on the labels corresponding to those on wiring diagrams used for installing systems.
3. Install labels retaining their markings after cleaning.
4. In each maintenance hole (manhole) and handhole, install embossed brass tags to identify system served and function.

B. Labeling:

1. Industry Standard: ANSI/TIA-606-B.
2. Print lettering for voice and data circuits using laser printers ; handwritten labels are not acceptable.
3. Cable and Wires (hereinafter referred to as "cable"): Label cables at both ends in accordance with industry standard. Provide permanent labels in contrasting colors. Identify cables matching system Record Wiring Diagrams.
4. Equipment: Permanently labeled system equipment with contrasting plastic laminate or bakelite material. Label system equipment on face of unit corresponding to its source.
5. Conduit, Cable Duct, and Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying system. Label each enclosure according to this standard.
6. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and Record Wiring Diagrams.

### 3.3 TESTING

- A. Minimum test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on cables in frequency ranges specified.
- B. Tests required for data cable must be made to confirm operation of this cable at minimum 10 Mega (M) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of  $10^{-6}$  at maximum rate of speed.
- C. Provide cable installation and test records at acceptance testing to COR and thereafter maintain in facility's telephone switch room.
- D. Record changes (used pair, failed pair, etc.) in these records as change occurs.
- E. Test cables after installation and replace any defective cables.

- - - E N D - - -





**SECTION 27 11 00**  
**TELECOMMUNICATIONS ROOM FITTINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies equipment cabinets, interface enclosures, relay racks, and associated hardware in service provider DEMARC, computer and telecommunications rooms.
- B. Telephone system is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Adhere to Seismic reference standards for systems connecting to or extending telephone system and cabling.

**1.2 RELATED WORK**

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- E. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- F. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- G. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATION.
- B. Separate submittal into sections for each subsystem containing the following:
  - 1. Pictorial layouts of each Telecommunications Room and Cross Connection Space (VCCS, and HCCS termination cabinets), each distribution cabinet layout, and TCO as each is expected to be installed and configured.

2. Equipment technical literature detailing electrical and technical characteristics of each item of equipment to be furnished.
- C. Environmental Requirements: Identify environmental specifications for housing system as initial and expanded system configurations.
  1. Floor loading for batteries and cabinets.
  2. Minimum floor space and ceiling height.
  3. Minimum door size for equipment passage.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS**

- A. Provide components of cabinet system (cabinet, thermal, cable and power management accessories) from a single manufacturer.
- B. Equipment Standards and Testing:
  1. Equipment must be listed by a NRTL where a UL standard is in existence; active and passive equipment must conform with each UL standard in effect for equipment, on the submittal date.
  2. Each item of electronic equipment must be labeled by a NRTL that warrants equipment has been tested in accordance with, and conforms to specified standards.
- C. Equipment Cabinets (Enclosures):
  1. Fully enclose and physically secure internally mounted and connected, active and passive equipment.
  2. Types of Equipment Enclosures accepted for specific VA Spectrum Management, FMS and OI&T applications in CFM and Facility Projects:

CABINET	FUNCTION
Communications	FMS Special Communications Equipment
Server / Router	OI&T Data/LAN/WAN Equipment
Seismic	Either FMS or OI&T use, specify need
Environmental	Either FMS or OI&T use, specify need

3. Each cabinet to be:
  - a. Provided in TER, PCR, EMGR, and each TR at a minimum.
  - b. Fabricated with minimum 1.59 mm (16 gauge) steel.
  - c. Provided with manufacturer's standard painted finish in a color accepted by COR with concurrence from FMS Service Chief.
  - d. Mounted on floor or wall.
  - e. Lockable; tubular locks keyed alike. Provide six keys to COR for each cabinet.
  - f. Compliant with facility's SMS card access system.

4. Provide equipment mounting shelves; attach to front and rear mounting rails and allowing equipment to be secured to respective mounting rails.
5. Each enclosure to include:
  - a. Floor or wall mounting.
  - b. Knock out holes for conduit connections or cable entrance.
  - c. Front and rear locking doors; wall mounted cabinets require only front locking door.
  - d. Power outlet strips.
6. Provide quiet ventilation fan with non-disposable locally cleanable air filter.
7. Size each cabinet in order to contain and maintain internal mounted equipment items.
8. Provide OEM's fully assembled unit.
9. Provide OEM assembled side-by-side enclosures in a single unit, at locations requiring more than two enclosures.
10. Provide minimum one cabinet with blank rack space, for additional system expansion equipment.
11. Bond to communications circulating grounding system.
12. Technical Characteristics:
  - a. External:
    - 1) Overall Height:
      - a) Communications/Server: Maximum 2,184 mm (86 inches).
      - b) Seismic: Maximum 1,905 mm (75 inches).
    - 2) Overall Depth:
      - a) Communications/Server: Maximum 914 mm (36 inches).
      - b) Seismic: Maximum 762 mm (30 inches).
    - 3) Overall Width - All: Maximum 864 mm (34 inches).
  - b. Front Panel Openings:
    - 1) Width:
      - a) Communications: 482.6 mm (19 inches), per EIA.
      - b) Server: 483 mm (19 inches), per EIA/ECA 310.
      - c) Seismic: 483 mm (19 inches), per EIA/ECA 310.
    - 2) Height:
      - a) Communications/Server: Maximum 2,000 mm (78-3/4 inches or 45 Rack Units [RU]), per EIA/ECA 310.
      - b) Seismic: Maximum 1,689 mm (66-1/2 inches or 38 RUs, per EIA/ECA 310).

c. Heavy Duty Cycle: Maximum 544 kilograms (1,200 pounds) capacity.

d. Certification:

- 1) NRTL (i.e. UL): For communications and server cabinets.
- 2) Telcordia Technologies: #63-GR-CORE, (2012) for seismic cabinets.
- 3) Seismic: Provide cabinet OEM constructed to seismic design category.

13. Cabinet Internal Components:

a. AC Power:

- 1) Standard "Quad AC Box":
  - a) Power capacity: 20 Ampere, single phase, 120 VAC continuous duty.
  - b) Wire gauge: #12 AWG, solid copper, connected to room's internal AC Power Panel, or as directed by COR.
  - c) Number of AC power outlets: Minimum 4 receptacles.
  - d) Enclosure: Fully self-contained, metal 102 mm (4 inch) x 102 mm (4 inches) x 64 mm (2-1/2 inches) with cover
  - e) Connection: Minimum 25.4 mm (1 inch) conduit connected to room's AC Power Panel, or as directed by COR
  - f) Number of boxes: One.
  - g) Compliance: NRTL (i.e. UL); NPFA - 70 (NEC).

b. AC Outlet Strips:

- 1) Power Capacity: 15 Ampere, single phase, 120 VAC continuous duty.
- 2) Wire Gauge: Minimum #12 AWG, solid copper.
- 3) Number of AC Power Outlets: Minimum 10 "U" grounded.
- 4) Enclosure: Fully self-contained; typically metal.
- 5) Connecting Wire: Minimum 2 m (6 feet) long, with three prong self-grounding AC plug connected to cabinet's internal AC "Quad" box.
- 6) Number of Strips: 2.
- 7) Certification: NRTL (i.e. UL).

c. AC Power Line Surge Protector and Filter Construction:

- 1) Input Voltage Range: 120 VAC + 15 percent at 50/60 Hz, single phase.
- 2) Power Service Capacity: 20 AMP, 120 VAC.
- 3) Voltage Output Regulation: +5.0 percent, instantaneous of input.

- 4) Circuit Breaker: 15 AMP; may be self-contained.
  - 5) AC Outlets: Minimum four duplex grounded NEMA 5-20R.
  - 6) Response Time: 5.0 nanosecond.
  - 7) Suppression: Isolate and filter any noise, surge spikes
    - a) Surge: Minimum 20,000 AMP.
    - b) Noise:
      - 1) Common: -40 dB.
      - 2) Differential: -45 dB.
  - 8) Clamping Voltage: Minimum 300 V.
  - 9) Enclosure: One; self-contained.
  - 10) Mounting: Internal to cabinet floor or on internal mounting rail shelf, allowing two plugs from two plug strips.
  - 11) AC Power Cord: Required; minimum 1,628 mm (6 feet), three wire (green ground); minimum #14 AWG stranded.
  - 12) Compliance: NRTL (i.e. UL60950-1).
- d. Uninterruptible Power Supply (UPS): Provide each cabinet with an internal UPS which may be combined with surge protector and filter if system's 50 percent expansion requirement is met. Provide at least one hour continuous full load uninterruptible system primary AC Power, with a 50 percent reserve capacity, in the event of facility primary or emergency AC power failure.
- 1) UPS to include:
    - a) On-Off Switch: This function is required to be a part of system's electronic supervision requirements.
    - b) First/Fast Charge Unit: Must provide clean predicable charge voltage/current. Function is required to be a part of system's electronic supervision requirements.
    - c) Over Voltage/Current Protect: Cannot short circuit AC power line at any time. This function is required to be a part of system's electronic supervision requirements.
    - d) Trickle Charge Unit: Must be capable of maintaining a suitable internal battery charge without damaging batteries.
    - e) Mounting: Provide per OEM's direction.
    - f) Proper Ventilation: Do not override cabinets' ventilation system.
    - g) Power Change from AC Input: Accomplish change without interruption to communications link or subsystem being

protected. Generate visual and aural alarms in electrical supervision system, local and remote, to annunciating panels via direct connection for trouble indication.

- 2) Specific requirements for current and surge protection to include:
  - a) Voltage Protection: Threshold, line to neutral, starts at maximum 200 Volts peak. Transient voltage cannot exceed 330 Volts peak. Furnish documentation on peak clamping Voltage as a function of transient waveform.
  - b) Peak Power Dissipation: Minimum 35 Joules per phase, as measured for 1.0 millisecond at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. Typically, power dissipation is 12,000 Watts (W) for 1.0 mS (or 12 Joules). Provide explanation of how ratings were measured or empirically derived.
  - c) Surge Protector (may be combined with On-Off switch of UPS): Must not short circuit AC power line at any time.
    - 1) Components must be minimum silicon semi-conductors.
    - 2) Secondary stages, if used, may include other types of rugged devices.
    - 3) Indicators: Provide visual device indicating surge suppression component is functioning.
    - 4) Electrical Supervision: Required; must be audible and visual, local and remote to annunciating panels via direct connection for trouble indication.
  - d) Provide current and surge protection on ancillary equipment.
  - e) Equip each cabinet with the following:
    - 1) Equipment Mounting Rails (Front & Rear): Fully adjustable internal equipment mounting rails allowing front or rear equipment mounting with pre-drilled EIA/ECA 310-E Standard tapped holes. Support entire equipment by supplementary support in addition to face mounting screws on rails.
    - 2) Cabinet Ground: Stainless steel adjustable, lug connected to cabinet's main structure providing an

internal cabinet ground for all installed equipment properly bolted to rail and with ground wire connected.

- 3) Grounding Terminals: A separate mounting hole on equipment mounting rail, with stainless steel connecting bolt bonded by minimum #10 AWG copper wire to cabinet's internal grounding lug.
14. Ground Interconnection: Bond cabinet's common grounding lug to room's communications circulating ground busbar with a minimum #4 AWG stranded copper wire.
15. Blank Panels: Provide at every unused rack space.
  - a. Match cabinet color.
  - b. Provide panels of 3 mm (1/8 inch) thick aluminum with vertical dimensions in increments of one rack unit (RMU) or 45 mm (1-3/4 inch) with mounting holes spaced to correspond to EIA/ECA 310-E Standard 483 mm (19 inch) rack dimensions.
  - c. Fill large unused openings with single standard large panel instead of numerous types.
  - d. Leave one blank rack space (RMU), covered with a blank panel, between each item of equipment, for minimum internal air flow.
  - e. Leave 356 mm (14 inches)(8.0 RMU) open space, covered with blank cover panel, for additional expansion equipment.
  - f. Wire Management: System that connects each item of installed equipment to room wire management system.
  - g. Knock-out Holes: Provide for cable entrance/exits via conduits, cable duct/trays.
16. Audio Monitor Panel: Provide EIA standard for 483 mm (19 inch) cabinet mounting.
  - a. Provide audio monitor panel in upper portion of HE equipment cabinet.
17. Trouble Annunciator Panel: Provide trouble annunciator panel in HE cabinet locations and as shown on drawings compatible with electrical and electronic supervising signals to continuously monitor operating condition for system HE equipment, remote equipment, and interconnecting trunks.
  - a. When system's supervising system detects malfunctioning equipment or trunk line, system must generate an audible and visual signal; provide spare panel.
  - b. Technical Characteristics:

- 1) Silence Button or Switch: Provide to silence audible signal. Visual signal will continue until supervisory circuit indicating a fault is corrected.
- 2) Visual Enunciators: Visually show system equipment and trunk-line operating conditions via its supervisory circuit indicating fault condition.
- 3) Connect each alarm function to report to PCS Console SMS.

D. Stand Alone Open Equipment Rack:

1. Construct of minimum 1.59 mm (16 gauge) cold rolled steel with manufacturer's standard paint finish, in a color to be selected by COR with concurrence from facility's FMS Service Chief.
2. Floor-mount as directed by COR with concurrence from facility's FMS Service Chief.
3. Equip rack same as equipment cabinet, except mount UPS with additional support for weight and AC power connection in conduit to AC service panel.
4. Provide an OEM fully assembled unit.
5. Technical Characteristics:
  - a. Overall Height: Maximum 2,180 mm (85-7/8 inches).
  - b. Overall Width: Maximum 535 mm (21-1/16 inches).
  - c. Front Panel Opening: 483 mm (19 inches), EIA/ECA 310 horizontal width.
  - d. Hole Spacing: Per EIA/ECA 310.
  - e. Load Capacity: Maximum 680.4 kg (1,500 lbs).
  - f. Certifications:
    - 1) EIA/ECA: 310-E.
    - 2) NRTL (i.e. UL): OEM specific.

E. Wire Management Equipment:

1. Provide an orderly horizontal and vertical interface between outside and inside wires and cables, distribution and interface wires and cables, interconnection wires and cables and associated equipment, jumper cables, and provide an uniform connection media for system fire-retardant wires and cables and other subsystems.
2. Interface to each cable tray, duct, wireway, or conduit used in the system.
3. Interconnection or distribution wires and cables must enter system at top (or from a wireway in the floor) via overhead protection system and be uniformly routed down // either or // both sides at



same time, of the frames side protection system, then laterally for termination on rear of each respective terminating assembly.

F. Vertical Cable Managers:

1. Use same make, style and size of vertical cable manager on rack/frame or in between racks/frames when more than one cable manager is used on a rack/frame or group of racks/frames.
2. Match color and cover style of racks/frames and cable managers.

G. Horizontal Cable Managers:

1. Use same make and style of cable manager on rack/frame or racks/frames, when more than one horizontal cable manager is used on a rack/frame or group of racks/frames.
2. Match color of racks/frames and cable managers.

H. Provide installation hardware when enclosures or racks are attached to structural floor.

I. Provide noise filters and surge protectors for each equipment interface cabinet, switch equipment cabinet, control console, and local and remote active equipment locations to ensure protection from input primary AC power surges so as a consequence noise glitches are not induced into low voltage data circuits.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate cabinet installation such that doors fully close and lock, with active and passive equipment installed and connected.
- B. Verify equipment dimensions and brackets allow mounting with cabinet doors closed. Front door or rear door of any cabinet that does not close and lock may result in immediate cancellation of inspections or tests.

#### **3.2 INSTALLATION**

A. Equipment Cabinets:

1. Install cabinets in a manner that complies with OEM instructions, requirements of this specification, and in a manner which does not constitute a safety hazard.
2. Provide weatherproof equipment installed outdoors or install in NEMA 3S rated enclosures with hinged doors and locks with two keys.
3. Install equipment indoors in NEMA 4 rated metal cabinets with hinged doors and locks with two keys.

B. Grounding:

1. Bond equipment, including identified Government furnished equipment, to ground so total ground resistance measures maximum 0.1 Ohm.
  - a. Install lightning arrestors and grounding in accordance with NFPA.
  - b. Install gas protection devices at nearest point of entrance in buildings where protection is required and on same circuits as MDF in telephone switch room.
  - c. Do not use AC neutral, including in power panel or receptacle outlet, for system control, subcarrier or audio reference ground.
  - d. Use of conduit, signal duct or cable trays as system or electrical ground is not permitted.
2. Connect each equipment grounding terminal to a separate mounting hole on equipment mounting rail, to right as one looks at it from rear, with a minimum #12 AWG stranded copper wire with protective green jacket.
3. Extend common ground bus of minimum #10 AWG solid copper wire throughout each equipment cabinet and bond to TGB. Provide a separate isolated ground connection from each equipment cabinet ground bus to system ground. Do not tie equipment ground buses together.
4. Bond equipment to cabinet bus with copper braid equivalent to #12 AWG. Self-grounding equipment enclosures, racks or cabinets, that provide OEM certified functional ground connections through physical contact with installed equipment, are acceptable alternatives.
5. Bond cable shields to cabinet ground bus with minimum #12 AWG stranded copper wire at only one end of cable run. Insulate cable shields from each other, faceplates, equipment racks, consoles, enclosures or cabinets, except at system common ground point. Bond coaxial and audio cables only at source; in all cases, keep cable shield ground connections to a minimum.

C. Equipment Assembly:

1. Cabinets:
  - a. Install and adjust cabinet/frame accessories to position, including thermal management accessories, vertical cable managers, vertical power managers and equipment-mounting rails, using manufacturer's installation instructions prior to buying or placing cabinet for attachment to building and before installing any rack-mount equipment into cabinet. Shelves, horizontal cable

managers and filler panels (rack-mount accessories), if used, may be installed after cabinet is placed.

- b. When used in a multi-cabinet bay, attach cabinets side-by-side using baying kits according to manufacturer's instructions.
- c. Attach overhead ladder rack or cable tray to ceiling or top of cabinet. Maintain minimum 75 mm (3 inches) clearance between top of cabinet and bottom of ladder rack/cable tray. Position ladder rack/cable tray so that it does not interfere with hot air exhaust through cabinet's top panel. Use radius drops where cable enters or exits ladder rack/cable tray.
- d. In seismic areas, install additional bracing as required by building codes and recommendations of a licensed structural engineer.
- e. Install ladder rack with side stringers facing rack or cabinet so that ladder forms an inverted U-shape and so that welds between stringers (sides) and cross members (middle) face away from cables.
- f. Secure ladder rack to tops of equipment racks or cabinets using manufacturer's recommended supports and appropriate hardware.
- g. Attach bonding conductor sized per TIA-607-B between telecommunications grounding busbar and cabinet. Attach bonding conductor to cabinet using a ground terminal block according to manufacturer's installation instructions.
- h. Provide bonding conductor and other hardware required to make connections between cabinet and telecommunications grounding busbar.
- i. Install rack mounted equipment normally requiring adjustment or observation so operational adjustments can be conveniently made.
- j. Mount heavy equipment with rack slides or rails to allow servicing from front of enclosure. Provide support in addition to front panel mounting screws for heavy equipment.
- k. Provide with cable slack to permit servicing by removal of installed equipment from front of enclosure.
- l. Install color-matched blank panel spacer 44 mm (1.75 inches) high between each piece of active and passive equipment to ensure adequate air circulation for efficient equipment cooling and air ventilation.

- m. Provide quiet fans and non-disposable air filters at each console or cabinet.
  - n. Install enclosures and racks plumb and square, permanently attached to building structure and held in place.
  - o. Provide 381 mm (15 inches) of front vertical space opening for additional equipment.
  - p. Install equipment located indoors in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
  - q. Cables must enter equipment racks or enclosures in such a manner to allow doors or access panels to open and close without disturbing or damaging cables.
  - r. Mount distribution hardware in a manner that allows access to connections for testing and provides room for doors or access panels to open and close without disturbing the cables.
2. Racks:
- a. Assemble racks according to manufacturer's instructions.
  - b. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching rack to floor.
  - c. Attach assembled racks to floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through raised floor tile and be secured in structural floor below.
  - d. Bond racks to telecommunications grounding busbar using appropriate hardware provided by contractor.
  - e. In seismic areas, install additional bracing as required by building codes and recommendations of a licensed structural engineer.
  - f. Ladder rack may be attached to top of rack to deliver cables to rack. Do not drill rack to attach; use appropriate hardware from rack manufacturer.
  - g. Provide radius drops to guide cable where cable exits or enters side of overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field.
  - h. Evenly distribute equipment load on rack. Place large and heavy equipment towards bottom of rack. Secure equipment to rack with equipment mounting screws. In seismic areas, secure equipment to shelves with additional bracing.

### 3. Vertical Cable Managers:

- a. Provide vertical managers so number of cables in each manager does not exceed OEM fill capacity.
- b. Attach vertical cable managers to side of rack/frame using manufacturer's installation instructions and hardware.
- c. Attach vertical cable manager to both racks/frames when a single vertical cable manager is used between two racks/frames.
- d. Dress cables through openings in between T-shaped guides on manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
- e. Attach doors to cable manager in closed position after cabling is complete.

### 4. Horizontal Cable Managers:

- a. Attach horizontal cable managers to rack/frame with minimum four screws according to manufacturer's installation instructions. Center each cable manager within allocated rack-mount space (RMU).
- b. Provide horizontal managers located so number of cables each manager supports is less than cable manager's cable fill capacity.
- c. Dress cables through openings in between T-shaped guides on cable manager so that cables make gradual bends as they exit or enter cable manager into rack-mount space (RMU). Do not twist, coil or make sharp bends in cables.
- d. Attach covers to cable manager in closed position after cabling is complete.

### D. Labeling: Permanently label each enclosure in accordance with TIA-606-B using laser printers; handwritten labels are not acceptable.

- 1. Equipment: Label system equipment with contrasting plastic laminate or bakelite material on face of unit corresponding to its source.
- 2. Conduit, Cable Duct, and/or Cable Tray: Label conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 m (10 feet), identifying system.

- - - E N D - - -



**SECTION 27 15 00  
COMMUNICATIONS STRUCTURED CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a complete and operating voice and digital structured cabling distribution system and associated equipment and hardware to be installed in VA Medical Center, Out Patient Clinic here-in-after referred to as the "facility".

**1.2 RELATED WORK**

- A. Wiring devices: Section 26 27 26, WIRING DEVICES.
- B. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- E. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- F. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- G. Extension of a voice communication switching and routing system: Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- H. High Definition (HDTV) Master Antenna Television (MATV) system and associated equipment: Section 27 41 31, MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS.
- I. Emergency Service Public Address System (PAS) and associated equipment: Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.

**1.3 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
1. Pictorial layout drawing of each voice (telephone) equipment room, and telecommunications room, showing termination cabinets, each distribution cabinet and rack, as each is expected to be installed and configured.

2. List of test equipment as per 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. Certifications:

1. Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of contract maintenance are authorized representatives of OEM. Include individual's legal name and address and OEM warranty credentials in the certification.
2. Pre-acceptance Certification: Submit in accordance with test procedures.
3. Test system cables and certify to COR before proof of performance testing can be conducted. Identify each cable as labeled on as-installed drawings.
4. Provide current and qualified test equipment OEM training certificates and product OEM installation certification for contractor installation, maintenance, and supervisory personnel.

- C. Closeout Submittal: Provide document from OEM certifying that each item of equipment installed conforms to OEM published specifications.

#### **1.4 WARRANTY**

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide complete system including "punch down" and cross-connector blocks voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, "break out" devices and equipment cabinets, interface cabinets, and radio relay equipment rack.
- B. Industry Standards:
1. Cable distribution systems provided under this section are connected to systems identified as critical care performing life support functions.
  2. Conform to National and Local Life Safety Codes (whichever are more stringent), NFPA, NEC, this section, Joint Commission Life Safety Accreditation requirements, and OEM recommendations, instructions, and guidelines.



3. Provide supplies and materials listed by a nationally recognized testing laboratory where such standards are established for supplies, materials or equipment.
  4. Refer to industry standards and minimum requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and guidelines listed.
  5. Active and passive equipment required by system design and approved technical submittal; must conform to each UL standard in effect for equipment, when technical submittal was reviewed and approved by Government or date when COR accepted system equipment to be replaced. Where a UL standard is in existence for equipment to be used in completion of this contract, equipment must bear approved NRTL label.
- C. System Performance: Provide complete system to meet or exceed TIA Category 6 requirements.
- D. Provide continuous inter- and/or intra-facility voice, data, and analog service.
1. Provide voice and data cable distribution system based on a physical "Star" topology.
  2. Provide separate cable distribution system for emergency, safety and protection systems (i.e. emergency bypass phones; police emergency voice communications from parking lots and stairwells personal protection, duress alarms and annunciation systems; etc.)
  3. Contact SMCS 0050P2H3 (202-462-5310) for specific technical assistance and approvals.
- E. Specific Subsystem Requirements: Provide products necessary for a complete and functional voice, data, analog and videotele communications cabling system, including backbone cabling system, patch panels and cross-connections, horizontal cabling systems, jacks, faceplates, and patch cords.
- F. Coordinate size and type of conduit, pathways and firestopping for maximum 40 percent cable fill with subcontractors.
- G. Terminate all interconnecting twisted pair, fiber-optic or coaxial cables on patch panels or punch blocks. Terminate unused or spare conductors and fiber strands. Do not leave unused or spare twisted pair wire, fiber-optic or coaxial cable unterminated, unconnected, loose or unsecured.

- H. Color code distribution wiring to conform to ANSI/TIA 606-B and construction documents, whichever is more stringent. Label all equipment, conduit, enclosures, jacks, and cables on record drawings, to facilitate installation and maintenance.
- I. In addition to requirements in Section 27 05 11, REQUIREMENTS FOR COMMUNICATION INSTALLATIONS, provide stainless steel faceplates with plastic covers over labels.

## **2.2 EQUIPMENT AND MATERIALS**

- A. Where system connects to an existing or future voice (telephone) system, refer to Section 27 31 00, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT or Section 27 31 31, VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT - EXTENSION for specific voice (telephone) equipment and system operational performance standards.
- B. Cable Systems - Twisted Pair, Fiber optic, Coaxial and Analog:
  - 1. General:
    - a. Provide cable (i.e. backbone, outside plant, and horizontal cabling) conforming to accepted industry standards with regards to size, color code, and insulation.
    - b. Some areas can be considered "plenum". Comply with all codes pertaining to plenum environments. It is contractor's responsibility to review the VA's cable requirements with COR and OI&T Service prior to installation to confirm type of environment present at each location.
    - c. Provide proper test equipment to confirm that cable pairs meet each OEM's standard transmission requirements, and ensure cable carries data transmissions at required speeds, frequencies, and fully loaded bandwidth.
  - 2. Telecommunications Rooms (TR):
    - a. In TR's served with UTP fiber optic, coaxial and analog backbone cables, terminate UTP cable on RJ-45, 8-pin connectors of separate 48-port modular patch panels, 110A or equivalent type punch down blocks that are dedicated to voice and data applications.
    - b. Provide connecting cables required to extend backbone cables (i.e. patch cords, twenty-five pair, etc.), to ensure complete and operational distribution systems.

- c. In TR's, which are only served by a UTP backbone cable, terminate cable on separate modular connecting devices, Type 110A punch down blocks (or equivalent), dedicated to data applications.
- 3. Backbone Copper Cables:
  - a. Riser Cable:
    - 1) Provide communication riser cables listed in NEC Table 800, 154(a) for the purpose and suited for electrical connection to a communication network.
    - 2) Provide STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors for communication (analog RF coaxial cable is not to be provided in riser systems) riser cables with a thermoplastic outer jacket.
    - 3) Label and test complete riser cabling system.
- 4. Horizontal Cable: Installed from TCO jack to the TR patch panel.
  - a. Tested to ANSI/TIA-568-C.2 Category 6 requirements including NEXT, ELFEXT (Pair-to-Pair and Power Sum), Insertion Loss (attenuation), Return Loss, and Delay Skew.
  - b. Minimum Transmission Parameters: 250 MHZ.
  - c. Provide four pair 0.205 mm<sup>2</sup> (24 AWG) cable
  - d. Terminate all four pairs on same port at patch panel in TR.
  - e. Terminate all four pairs on same jack, at work area
- Telecommunication Outlets (TCO):
  - 1) Jacks: Minimum three eight-pin RJ-45 ANSI/TIA-568-C.2 Category 6 Type jacks at TCO.
    - a) Top Port: RJ-45 jack compatible with RJ-11 plug for voice.
    - b) Bottom Two Ports: Unkeyed RJ-45 jacks for data.
- C. Cross-Connect Systems (CCS):
  - 1. Copper Cables: Provide copper CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
  - 2. Maximum DC Resistance per Cable Pair: 28.6 Ohms per 305 M (1,000 feet).
  - 3. Fiber Optic Cables:
    - a. Provide fiber CCS sized to connect cables at TR and allow for a minimum of 50 percent anticipated growth.
    - b. Install fiber optic cable slack in protective enclosures.
- D. Telecommunication Room (TR):

1. Terminate backbone and horizontal, copper, fiber optic, coaxial and analog cables on appropriate cross-connection systems (CCS) containing patch panels, punch blocks, and breakout devices provided in enclosures and tested, regardless of installation method, mounting, termination, or cross-connecting used. Provide cable management system as a part of each CCS.
  2. Coordinate location in TR with FMS equipment (i.e. fire alarm, nurse call, code blue, video, public address, radio entertainment, intercom, and radio paging equipment).
- E. Coaxial and Analog Cables: Bond equipment to ground per TIA standards, such that all grounding systems comply with all applicable National, Regional, and Local Building and Electrical codes.
1. Provide current arrester for each copper or coaxial cable that enters from outside of a building regardless if cable is installed underground or aerial.
  2. Provide a gas surge protector/module and bond to earth ground.
- F. Main Cross-connection Subsystem (MCCS): MCCS is common point of distribution for inter- and intra-building copper and fiber optic backbone system cables, and connections to the voice (telephone) and data cable systems.
- G. Voice (or Telephone) Cable Cross-Connection Subsystem:
1. Provide Insulation Displacement Connection (IDC) hardware.
  2. Provide the following for each Category 5E (or on a case by case basis Category 6 for specialized powered systems technically accepted by SMCS 0050P2H3, (202) 461-5310, OI&T and FMS Services and COR) Cabling System termination; RJ-45 patch cord connector to RJ-45 patch cord connector.
    - a. Provide terminations to be accessible without need for disassembly of IDC wafer. Provide IDC wafers removable from their mounts to facilitate testing on either side of connector.
    - b. Provide removable designation strips or labels to allow for inspection of terminations.
    - c. Provide cable management system as a part of IDC.
  3. Provide IDC connectors capable of re-terminations, without damage, a minimum of 200 IDC insertions or withdrawals on either side of connector panel.
  4. Install using only non-impact terminating tool having both a tactile and an audible feedback to indicate proper termination.

5. Provide inputs from FTS, Local Voice (Telephone) System, or diverse routed voice distribution systems on left side of IDC (110A blocks with RJ45 connections are acceptable alternates to IDC) of MCCS.
6. Provide system outputs from MCCS to voice backbone cable distribution system on the right side of same IDC (or 110A blocks) of MCCS.
7. Do not split pairs within cables between different jacks or connections.
8. Provide UTP cross connect wire to connect each pair of terminals plus an additional 50 percent spare.

H. Data Cross-Connection Subsystems:

1. Provide patch panels with modular RJ45 female to 110 connectors for cross-connection of copper data cable terminations and system ground with cable management system.
2. Provide patch panels conforming to EIA/ECA 310-E dimensions and suitable for mounting in standard equipment racks, with 48 RJ45 jacks aligned in two horizontal rows per panel. Provide RJ45 jacks of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging jack.
  - a. Provide system inputs from servers, data LAN, bridge, or interface distribution systems on top row of jacks of appropriate patch panel.
  - b. Provide backbone cable connections on bottom row of jacks of same patch panel.
  - c. Provide patch cords for each system pair of connection jacks with modular RJ45 connectors provided on each end to match panel's modular RJ45 female jack's being provided.

I. Horizontal Cabling (HC):

1. Horizontal cable length to farthest system outlet to be maximum of 90 m (295 ft).
2. Splitting of pairs within a cable between different jacks is not permitted.

## 2.3 DISTRIBUTION EQUIPMENT AND SYSTEMS

A. Telecommunication Outlet:

1. TCO consists of minimum one voice (telephone) RJ45 jack and two data RJ45 jacks mounted in a separate steel outlet box 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches) minimum with a labeled

stainless steel faceplate. Where shown on drawings, provide a second steel outlet box minimum 100 mm (4 inches) x 100 mm (4 inches) x 63 mm (2-1/2 inches), with a labeled faceplate, adjacent to first box to ensure system connections and expandability requirements are met.

2. Provide RJ-45/11 compatible female type voice (telephone) multi-pin connections. Provide RJ-45 female type data multi-pin connections.
3. Provide wall outlet with a stainless steel face plate and sufficient ports to fit voice (telephone) multi-pin jack, data multi-pin jacks and plastic covers for labels when mounted on outlet box provided (minimum 100mm (4 inches) x 100mm (4 inches) for single and 100mm (4 inches) x 200mm (8 inches) for dual outlet box applications. Install stainless steel face plate, for prefabricated bedside patient unit installations.

**B. Backbone Distribution Cables:**

1. Meet TIA transmission performance requirements of Voice Grade Category 6.
2. Provide cable listed for environments where it is installed.
3. Technical Characteristics:
  - a. Length: As required, in minimum 1 kilometer (3,000 ft.) reels.
  - b. Size:
    - 1) Minimum 0.326 mm<sup>2</sup> (22 AWG) outside plant installation.
    - 2) Minimum 0.205 mm<sup>2</sup> (24 AWG) interior installations.
  - c. Color Coding: American Telephone and Telegraph Company Standard; Bell System Practices Outside Plant Construction and Maintenance Section G50.607.3, Issue 2 February, 1959.
  - d. Minimum Bend Radius: 10X cable outside diameter.
  - e. Impedance: 120 Ohms + 15 percent.
  - f. DC Resistance: Maximum 8.00 ohms/100 m
  - g. Shield Coverage: As required by drawing notes dual shield tape design.
  - h. Maximum attenuation for 100m at 20° C:

Frequency (MHz)	Category 3 (dB)	Category 6 (dB)
.772	2.2	-
1	2.6	2.0
4	5.6	3.8
8	8.5	5.3

Frequency (MHz)	Category 3 (dB)	Category 6 (dB)
10	9.7	6.0
16	13.1	7.6
20		8.5
25		9.5
31.25		10.7
62.5		15.4
100		19.8
200		29.0
250		32.8
300		
400		
500		

4. Data Multi-Conductor:

- a. Unshielded cable with solid conductors.
- b. Able to handle the power and voltage used over the distance required.
- c. Meets TIA transmission performance requirements of Category /6.
- d. Technical Characteristics:
  - 1) 0.205 mm<sup>2</sup> (24 AWG) - 0.326 mm<sup>2</sup> (22 AWG) cable
  - 2) Bend Radius: 10 times cable outside diameter.
  - 3) Impedance: 100 Ohms + 15%, BAL.
  - 4) Bandwidth: 250MHZ.
  - 5) DC Resistance: Maximum 9.38 Ohms/100M (328 ft.) at 20 degrees C.
  - 6) Maximum Mutual Capacitance: 5.6 nF per 100 m (328 ft.).
  - 7) Shield Coverage:
    - a) Overall Outside (if OEM specified): 100 percent.
    - b) Individual Pairs (if OEM specified): 100 percent.
  - 8) Maximum attenuation for 100m (328 ft.) at 20° C:

Frequency (MHz)	Category 5e (dB)	Category 6 (dB)	
-----------------	------------------	-----------------	--

Frequency (MHz)	Category 5e (dB)	Category 6 (dB)	
1	2.0	2.0	
4	4.1	3.8	
8	5.8	5.3	
10	6.5	6.0	
16	8.2	7.6	
20	9.3	8.5	
25	10.4	9.5	
31.25	11.7	10.7	
62.5	17.0	15.4	
100	22.0	19.8	
200		29.0	
250		32.8	
300			
400			
500			

C. Outlet Connection Cables:

1. Voice (Telephone):

- a. Provide a connection cable for each TCO voice (telephone) jack in system with 10 percent spares able to connect voice (telephone) connection cable from voice (telephone) instrument to TCO voice (telephone) jack. Do not provide voice (telephone) instruments or equipment.

b. Technical Characteristics:

- 1) Length: Minimum 1.8 m (6 feet).
- 2) Cable: Voice Grade.
- 3) Connector: RJ-11/45 compatible male on each end.
- 4) Size: Minimum 24 AWG.
- 5) Color Coding: Required, telephone industry standard.

2. Data:



- a. Provide a connection cable for each TCO data jack in system with 10 percent spares to connect a data instrument to TCO data jack. Do not provide data terminals/equipment.
  - b. Technical Characteristics:
    - 1) Length: Minimum 1.8 m (6 feet).
    - 2) Cable: Data grade Category 5E or on a case-by-case basis Category 6 for specialized powered systems accepted by SMCS 0050P2H3 (202) 461-5310, IT and FMS Services and COR.
    - 3) Connector: RJ-45 male on each end.
    - 4) Color Coding: Required, data industry standard.
    - 5) Size: Minimum 24 AWG.
- D. System Connectors:
1. Modular (RJ-45/11 and RJ-45): Provide voice and high speed data transmission applications type modular plugs compatible with voice (telephone) instruments, computer terminals, and other type devices requiring linking through modular telecommunications outlet to the system compatible with UTP cables.
    - a. Technical Characteristics:
      - 1) Number of Pins:
        - a) RJ-45: Eight.
        - b) RJ-11/45: Compatible with RJ-45.
      - 2) Dielectric: Surge.
      - 3) Voltage: Minimum 1,000V RMS, 60 Hz at one minute.
      - 4) Current: 2.2A RMS at 30 Minutes or 7.0A RMS at 5.0 seconds.
      - 5) Leakage: Maximum 100  $\mu$ A.
      - 6) Connections:
        - a) Initial contact resistance: Maximum 20 milli-Ohms.
        - b) Insulation displacement: Maximum 10 milli-Ohms.
        - c) Interface: Must interface with modular jacks from a variety of OEMs. RJ-11/45 plugs provide connection when used in RJ-45 jacks.
        - d) Durability: Minimum 200 insertions/withdrawals.
- E. Conduit and Signal Ducts:
1. Conduit:
    - a. Provide conduit or sleeves for cables penetrating walls, ceilings, floors, interstitial space, fire barriers, etc.
    - b. Minimum Conduit Size: 19 mm (3/4 inch).

- c. Provide separate conduit and signal ducts for each cable type installation.
  - d. When metal (plastic covered, flexible cable protective armor, etc.) systems are authorized to be provided for use in system, follow installation guidelines and standard specified in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and NEC.
  - e. Maximum 40 percent conduit fill for cable installation.
2. Signal Duct, Cable Duct, or Cable Tray: Use existing signal duct, cable duct, and cable tray, when identified and accepted by COR.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install for ease of operation, maintenance, and testing.
- B. Install system to comply with NFPA 70 National Electrical Code, NFPA 99 Health Care Facilities, NFPA 101 Life Safety Code, Joint Commission Manual for Health Care Facilities, and original equipment manufacturers' (OEM) installation instructions.
- C. Cable Systems Installation:
  - 1. Install system cables in cable duct, cable tray, cable runway, conduit or when specifically approved, flexible NEC Article 800 communications raceway. Confirm drawings show sufficient quantity and size of cable pathways. If flexible communications raceway is used, install in same manner as conduit.
  - 2. Coordinate outside plant and backbone cables to furnish number of cable pairs for system requirements and obtain approval of COR and IT Service prior to installation.
  - 3. Bond to ground metallic cable sheaths, etc. (i.e. risers, underground, horizontal, etc.).
  - 4. Install temporary cable to not present a pedestrian safety hazard and be responsible for all work associated with removal. Temporary cable installations are not required to meet Industry Standards; but, must be reviewed and accepted by COR, IT Service, FMS and SMCS 0050P2H3 (202-461-5310) prior to installation.
- D. Labeling:
  - 1. Industry Standard: Provide labeling in accordance with ANSI/TIA-606-B.
  - 2. Print lettering of labels with laser printers; handwritten labels are not acceptable.

3. Label both ends of all cables in accordance with industry standard. Provide permanent Labels in contrasting colors and identify according to system "Record Wiring Diagrams".
4. Termination Hardware: Label workstation outlets and patch panel connections using color coded labels with identifiers in accordance with industry standard and record on "Record Wiring Diagrams".

### **3.2 FIELD QUALITY CONTROL**

#### **A. Interim Inspection:**

1. Verify that equipment provided adheres to installation requirements of this section. Interim inspection must be conducted by a factory-certified representative and witnessed by COR.
2. Check each item of installed equipment to ensure appropriate NRTL label.
3. Verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568A pin assignments and cabling connections comply with TIA standards.
4. Visually confirm marking of cables, faceplates, patch panel connectors and patch cords.
5. Perform fiber optical field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.
6. Notify COR of the estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date, so interim inspection does not affect systems' completion date.
7. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation.
8. Do not proceed with installation until COR determines if an additional inspection is required. In either case, re-inspection of deficiencies noted during interim inspections must be part of the proof of performance test.

#### **B. Pretesting:**

1. Pretest entire system upon completion of system installation.

2. Verify during system pretest, utilizing the accepted equipment, that system is fully operational and meets system performance requirements of this section.
3. Provide COR four copies of recorded system pretest measurements and the written certification that system is ready for formal acceptance test.

C. Microduct Tests:

1. Furnish COR, obstruction and pressure test data for each microduct installed. Complete pressure and obstruction tests per manufacturer's recommended procedures prior to installing fiber, and ensure 100 percent of all microducts are compliant with manufacturer.
2. Complete microduct pressure testing before proceeding with end-to-end microduct obstruction testing.
3. Notify COR at least one week in advance of test date so that Government and design professional may be present to witness testing.
4. Maintain close contact with chosen and technically-approved OEM and SMCS 0050P2H3 throughout installation, testing and certification process.

D. Acceptance Test:

1. After system has been pretested and the contractor has submitted pretest results and certification to COR, then schedule an acceptance test date and give COR 30 days' written notice prior to date acceptance test is expected to begin.
2. Test only in presence of a COR.
3. Test utilizing approved test equipment to certify proof of performance.
4. Verify that total system meets the requirements of this section.
5. Include expected duration of test time, with notification of the acceptance test.

E. Verification Tests:

1. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has an overall shield. Test cables after termination and prior to cross-connection.
2. Multi-mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-14A using Method A,

Optical Power Meter and Light Source. Perform verification acceptance test.

3. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with TIA-568-B.3 and TIA-526-7 using //Method A, Optical Power Meter and Light Source // and // Method B, OTDR //. Perform verification acceptance test.

F. Performance Testing:

1. Perform Category 5E (or on a case by case basis Category 6 for specialized powered systems accepted by SMCS 0050P2H3, (202) 461-5310, IT and FMS Services and COR) tests in accordance with TIA-568-B.1 and TIA-568-B.2. Include the following tests - wire map, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, propagation delay and delay skew.
2. Fiber Optic Links: Perform end-to-end fiber optic cable link tests in accordance with TIA-568-B.3.

- G. Total System Acceptance Test: Perform verification tests for UTP copper cabling systems after complete telecommunication distribution system and workstation outlet are installed.

### 3.3 MAINTENANCE

- A. Accomplish the following minimum requirements during one year warranty period:

1. Respond and correct on-site trouble calls, during standard work week:
  - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord to be inoperable.
  - b. Standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
2. Respond to an emergency trouble call within six hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point to be inoperable at any time.
3. Respond on-site to a catastrophic trouble call within four hours of its report. A catastrophic trouble call is considered total system failure.
  - a. If a system failure cannot be corrected within four hours (exclusive of standard work time limits), provide alternate equipment, or cables within four hours after four hour trouble shooting time.

- b. Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) are also be deemed as a catastrophic trouble.
- 4. Provide COR written report itemizing each deficiency found and the corrective action performed during each official reported trouble call. Provide COR with sample copies of reports for review and approval at beginning of total system acceptance test.

- - - E N D - - -

**SECTION 27 31 31**  
**VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a complete extension of an emergency voice communication switching and routing system (here-in-after referred to as "system"), including equipment cabinets, interface enclosures, radio relay racks, stand-by batteries, combiners, traps, and filters; distribution nodes, amplifiers; voice stations or instruments; auxiliary systems; and passive devices including protectors, isolators, splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, cable management items, and associated hardware.
- B. Government defines system as a Critical Service Communication System and is so listed by NFPA.

**1.2 RELATED WORK**

- A. Section 26 27 26, WIRING DEVICES.
- B. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. General requirements common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- E. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- F. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- G. Voice and data cable distribution system and associated equipment: Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.
- H. Physical access control system field-installed controllers connected by data transmission network: Section 28 13 00, PHYSICAL ACCESS DETECTION.
- I. Security emergency call communication system: Section 28 52 31, SECURITY EMERGENCY CALL, DURESS ALARM, AND TELECOMMUNICATIONS

**1.3 COORDINATION**

- A. Coordinate and conduct system data base survey with SMCS 0050P2H3 (202) 461-5310, COR and a member of OI&T Service identifying programming of features, classes of service, and equipment installed by type and

physical location as specified in this document and attachments thereto.

#### 1.4 SUBMITTALS

- A. On-Site Survey: Provide on-site system equipment location, cable pathway, TR, TCO, and interconnection survey no later than 18 months prior to completion of facility.
  - 1. Walk through facility and existing locations with construction documents (including accepted changes) and existing survey provided by IRM department.
  - 2. Identify differences in locations between the two surveys and provided to COR in writing within 30 days of the completion of survey.
- B. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit the following:
  - 1. Drawing showing location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
  - 2. Interface cabinet layout drawing.
  - 3. Distribution cabinet layout drawing.
  - 4. Equipment technical literature detailing electrical and technical characteristics of each item of equipment.
  - 5. Engineering drawings of system, indicating calculated signal levels at:
    - a. CSU/DSU output.
    - b. Each input and output distribution point.
    - c. Proposed system outlet values.
    - d. Signal level at each system outlet multi-pin jack.
  - 6. Proposed floor plan, based on expanded system configuration of contractor's proposed system for this facility.
  - 7. Proposed main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit size requirements (between main TR, remote TR, TER, MCR and devices).
  - 8. Two copies of an OEM developed training video presentation for evaluation and approval by COR.
  - 9. Table with details of complete record program in spreadsheet for associated station assignments.



- C. Environmental Requirements: Confirm environmental specifications for physical TR areas occupied by system. Identify requirements for initial and expanded system configurations for:
1. Floor loading for batteries and cabinets.
  2. Minimum floor space and ceiling heights.
  3. Minimum size of doors for equipment passage.
  4. Power requirements: Provide specific voltage, amperage, phases, and quantities of circuits required.
  5. Air Conditioning, Heating, and Humidity Requirements:
    - a. Identify ambient temperature and relative humidity operating ranges required to prevent equipment damage.
    - b. Air conditioning requirements expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards.
- D. System Data Base Survey Report: After completing survey required under Quality Assurance, submit complete list of equipment to COR for approval by SMCS 0050P2H3, (202) 461-5310, prior to start of installation.
- E. Voice Traffic Management System (TMS) Submittals:
1. Submit samples of reports generated by TMS with technical submittal for evaluation of formats and compliance with information field content.
  2. Submit detailed description of method to be used to measure traffic data in the technical submittal.
  3. Submit normal system traffic data to appropriate facility staff within seven days of a facility request. Prepare and submit a complete and comprehensive traffic study, including the required traffic data with the contractor's comments and recommendations, quarterly to appropriate facility staff.
- F. Proof of Performance Test Plan: Provide COR and SMCS 0050P2H3 (202) 461-5310 with a Proof of Performance Test Plan 90 days prior to cut-over of system.
1. Include tests to demonstrate system's capabilities of providing indicated services.
  2. Use only test equipment accepted by SMCS 0050P2H3 (202) 461-5310 and COR included with acceptance test plan.
  3. Submit test equipment certification verifying calibration within six months of system cut-over.

- G. Provide current and qualified OEM training certificates and OEM certification for all contractor installation, maintenance, and supervisory personnel.
- H. Closeout Submittals:
  - 1. Provide a written commitment from system equipment OEM to supply parts and on-site engineering support services for one year warranty service (materials and labor).
  - 2. Provide OEM certification allowing, OEM or authorized distributor to fully support contract (initial installation, warranty service for warranty period of the contract).
    - a. System equipment OEM's signatory of certified written commitment must be of an individual who has full authority to obligate OEM to this commitment.
    - b. Include names, corporate addresses, and telephone numbers of individuals who have this authority as a part of the commitment.
- I. Maintenance Material Submittals:
  - 1. Provide a complete set of system electronic modules and cards to be used as on-hand operational emergency spare equipment. One each of T-1, DS-\*\*, interface cards etc. minimum or a compliment as directed by OEM.

### **1.5 QUALITY ASSURANCE**

- A. Supervision:
  - 1. Provide a full time on-site project manager, effective with issuance of notice to proceed to coordinate and supervise contractor and installer personnel in every phase of installation, training, inspection, cutover, and final acceptance of system. This individual to prepare and deliver COR a complete copy of specifications to include amendments prior to start of installation.
  - 2. Coordinate final location of station equipment with COR prior to installation.
  - 3. Ensure that the project manager and skilled personnel remain on premise until all items on the punch list for system are completed, inspected, and accepted by COR.
  - 4. Be responsible for coordination with LEC relative to interface with commercial telephone system. Also be responsible for removal of voice and data equipment and cabling abandoned by the LEC, Government, or other organizations and not retained for exclusive use by Government as a result of this installation.

## 1.6 WARRANTY

- A. Work subject to terms of Article "Warranty of Construction," FAR clause 52.246-21.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESIGN CRITERIA

- A. Extend following services generated by existing telephone system. If these services are not generated by an operating existing telephone system, system must be compatible and capable of providing minimum services. Perform following minimum services designed in accordance with and supported by an OEM:
1. Provide continuous inter and intra-facility voice service.
  2. Size and install so loss of connectivity to external telephone system, VoIP and facility's LAN/WAN systems does not affect facility's operation in specific designated emergency operating locations and instruments - i.e. Joint Commission and NFPA 101 listed Analog Emergency By-Pass Phones; Police Emergency Call (elevator cabs, parking lots, stairwells, Duress Alarms & Locator) Equipment; emergency call system, Code Blue, Facsimile machines (fax), Patient Phones.
  3. Inter-operate, connect, and function with existing Local (Telephone) Exchange Company (LEC) Networks, Federal Telephone System (FTS) Inter-city Networks, Inter-exchange Carriers, Integrated Services Digital Network (ISDN) and Voice over Internet Protocol (VoIP). VoIP Service is not allowed to perform Facility Safety of Life Functions as well as facility's LAN/WAN. Contact SMCS 0050P2H3, (202) 461-5310 for specific technical assistance and approvals.
  4. Provide control and switching equipment (voice and digital system) with attendant consoles.
  5. Interoperate with current voice mail and automatic attendant functions and continuous intra and inter facility voice service.
  6. Provide universal night answering function from facility designated remote locations.
  7. Provide direct digital connection to trunk level equipment compatible with audio paging, radio paging, Federal Information Processing Standards [FIPPS] publications, Industry Standard digitally multiplexed terrestrial signal carrier (t-carrier) and digital signal level protocols, and external protocol converters.

8. Connect to "T" and "DS" access/equipment or Customer Service Units (CSU or DTE) used in FTS and other trunk applications.
9. Provide T-1 equipment required to terminate and make operational quantity of circuits designated. Connect CSUs to system's emergency battery power supply. Provide system capable of operating in Industry Standard "DS" protocol and provide that level of service when required.
10. Contain attendant and operator consoles, video monitors with keyboards, and printers to provide employees directory access from Traffic Management System (TMS) if not provided by existing telephone system or deactivated by system installation. Provide identical capabilities at console positions, video monitors and keyboards. Provide attendant consoles accepting a mixture of trunk types and extend calls received via these trunks to station users.
11. Provide interfacing for operating with Direct-Incoming-Dial (DID) service to stations without affecting intra-facility operation. Provide DID trunk group, operating as a separate trunk group from other Central Office (CO) trunks.
12. Provide designated number of telephone instruments, where each instrument (also referred to as "station") has ability to direct dial other facility telephone stations, public telephone network, tie-lines, and FTS telephone numbers without attendant assistance. Provide dual tone multi-frequency (DTMF) for intra-facility and external-facility calling at each station. The term DTMF, as used herein, is defined as "a dialing or analog operation".
13. Provide standard digital VoIP telephone instruments at designated TCOs.
14. Receive specified telephone signals acquired from the LEC and FTS contracted carrier, process and distribute them to designated telephone stations, as determined by Class of Service (CoS).
15. At a minimum, provide one TCOs on each room wall and on either side of each door opening. Only exception is specifically identified "special" locations (e.g., surgical suites, radiology, MRI rooms, labs, patient rooms, warehouse, loading docks, storage rooms, etc.) where usually active TCOs are designated and as shown on drawings.
16. Interface and connect telephone multi-pin jack to system via 110 type punch blocks in TR.

17. Perform adjacent channel operation of existing telephone system's local, long distance, and FTS telephone signals. Install and interface system equipment according to OEM's schematic diagram for adjacent telephone channel operation. Provide testing capability in each equipment cabinet, rack, interface point and test ports that provide access for each telephone channel without need to disconnect distribution cables or equipment. Process each telephone channel as a single channel. Include a means of monitoring complete system along with appropriate printout and archiving of each processed and distributed channel.
  18. Design system to minimize cross talk, background processor noise, inter-modulation, and other signal interference. Install and interface equipment according to OEM head-end schematic diagram for adjacent audio channel operation. Process each audio input channel as a single separate channel and combine into one output channel. If not provided in existing telephone system, or deactivated by system installation, provide capability in telephone switch room audio and visual monitoring panels to test each converted audio input and distribution channel and analog channels, transmitted and received signal functions. Electrically supervise system's Alternating Current (AC) power input, stand by batteries and charger, and internal Direct Current (DC) power supply primary voltages and currents; each remote control unit, audio interface unit, from TER. Provide capability in TER, telephone operator room, MCR, Police Security Service Control Console to check supervisory signals, signal level, audio sound and visual level, and alert personnel to problems.
- B. System must be capable of interfacing with existing or future planned system.
- C. System designs "looping" distribution cables from room to room are not acceptable.
- D. System Location Selection: Locate system cabinets and associated equipment in building.
- E. System Performance Criteria:
1. Support and operate in the following functional modes:
    - a. Integrated Services for Digital Networks (ISDN):
      - 1) Basic Rate Interface (BRI).
      - 2) Primary Rate Interface (PRI).

- b. Fiber-optic Distributed Data Interface (FDDI).
- 2. System Sensitivity: Provide satisfactory service for at least 3,000 feet for voice locations.
- 3. System Controller/Manager:
  - a. System speed: Minimum 1.0 giga-Bits (gb) per second.
  - b. Impedance: 600 Ohms, BALANCED
  - c. Cross Modulation: -60 deci-Bel (dB)
  - d. Hum Modulation: -55 dB.
  - e. System Data Error: Minimum 10 to -10 Bits per second (Bps).
  - f. Loss: Measured at frame output with reference 0 deci-Bel measured (dBm) at 1,000 Hertz (Hz) applied to frame input:
    - 1) Trunk to station: Maximum 1.5 dB.
    - 2) Station to station: Maximum 3.0 dB.
    - 3) Internal switch crosstalk: -60 dB when a signal of + 10 dBm, 500-2,500 Hz range is applied to primary path.
  - g. Idle channel noise: 25 dB relative noise per channel (rnC) or 3.0 dBm at 0 above (terminated) ground noise, whichever is greater.
  - h. Traffic Grade of Service for Voice: Minimum grade P-01 with an average traffic load of 7.0 One Hundred Call Seconds (CCS) per station per hour.
  - i. Average CCS per voice station: CCS capacity maintained at 7.0 CCS and a Time Between Failures (TBF) of 99.99 percent when system is expanded up to projected maximum growth.
- F. Voice and Audio Standards:
  - 1. Input and Output Signal Level: 0.0 dBm at 1 kilo Hertz (kHz) test tone modulation level; each level variable over a 6.0 dB range.
  - 2. Input and Output Impedance: 600 Ohms Balanced (BAL).
  - 3. Input and Output Signals: Terminated on each system unit.
  - 4. Frequency Range: Minimum 50 Hertz (Hz) to 3.0 kHz + 1.0 percent.
  - 5. S/N Ratio: 60 deci-Bell per mili-Volt (dBmV) + 1.0 dBmV.
  - 6. Cross Modulation: -46 dB.
  - 7. Hum Modulation: -55 dB.
  - 8. Isolation (control unit to unit): Minimum 24 dB.
- G. Control Signal Standards:
  - 1. Input and Output Signal: 0.0 dBmV + 1.0 dBmV Level.
  - 2. Input and Output Signals: Terminated on each system unit.
  - 3. Input and Output Impedance: 600 Ohms, BAL.
  - 4. Channel Bandwidth: Voice, minimum 50 Hz to 3.0 kHz, + 5.0 percent.

5. S/N Ratio: 60 dBmV + 1.0 dBmV.

H. Telecommunication Outlet (TCO) Standards:

1. Isolation (outlet-outlet): 24 dB.
2. Impedance: 600 Ohms.
3. Signal Level: 0 dBmV + 0.1 dBmV
4. System Speed: Minimum 100 mega-Bits (mb) per second.
5. System Data Error: Minimum 10 to -6 Bits per second.

I. Auxiliary Systems:

1. Provide Public Address System (PA) interface as described in Section 27 51 16, PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS.
2. Provide direct access to selected zones or all zone paging from each system console.
3. Provide console attendant "priority access" (or ALL CALL or CODE ONE or CODE BLUE) to all zones. Selected station users to have access to appropriate zones via sub zones, by dialing proper access.
4. Provide required NFPA and NRTL certified devices for Security Management System (SMS) to be interfaced to a designated critical care emergency communications system.
5. Provide feature to prevent system from being "locked up" by a user placing system on hold or leaving the receiver off-hook.

## 2.2 EQUIPMENT

A. General Product Requirements:

1. Provide current model of standard products of OEM of record. OEM of record to be defined as a commercial business enterprise manufacturing items of equipment and which:
  - a. Maintains a factory production line for item submitted.
  - b. Maintains a stock of replacement parts for item submitted.
  - c. Maintains engineering drawings, specifications, and operating manuals for items submitted.
  - d. Has published and distributed descriptive literature and equipment specifications on items of equipment submitted at least one year prior to Invitation for Bid.
2. Where standards are established for supplies, materials or equipment, provide supplies, materials and equipment listed by NRTL.
3. Provide equipment labeled with approved seal of NRTL.
4. Provide COR with verification, at time of installation, that type of cable being provided is recommended and approved by OEM. Provide cabling conforming to requirements of NRTL, TIA Wiring Standards and

- requirements of NFPA 70. Coordinate correct protection, cable duct and conduit with installers.
5. Interface with SMS telephone, PA, and, Radio Paging, systems utilizing interfacing methods approved by OEM and Government. Acceptable interfacing method requires not only a physical and mechanical connection, but includes matching of signal, voltage, and processing levels, with regard to signal quality and impedance. Provide separation of Critical Care, Life Safety, and Emergency systems.
  6. Provide electronic components rated for continuous duty service, and complying with FCC standards for system equipment, systems, and service.
  7. Provide passive distribution equipment with -80 dB radiation shielding specifications or greater.
  8. Terminate interconnecting twisted pair cables on equipment terminal boards, 110 style punch blocks, or breakout boxes. Terminate unused equipment ports/taps according to OEM's instructions for system cable systems without adapters. Terminate unused or spare twisted pair cable, and fiber-optic cable that is unconnected, loose or unsecured.
  9. Utilize microprocessor components for signaling, programming circuits and functions. Ensure program memory is non-volatile or protected from erasure during power outages for a minimum of two hours.
  10. Provide continuous electrical supervision of system equipment, interconnecting cabling, distribution cable plant, and UPS back up battery and charger to determine change in status and to assist in trouble shooting system faults.
  11. Voltage: Not to exceed 30V AC RMS or 42V DC, except for primary power to power supply circuits.
  12. Color Code Distribution Wiring: Conform to TIA administration standard.
  13. Permanently label equipment, cable duct and conduit, enclosures, wiring, terminals, and cables according TIA 606-B standard and record on wiring diagrams, to facilitate installation and maintenance.
  14. Coordinate connection of primary input power to critical branch of electrical distribution system.



15. Verify existing UPS system supports extensions' additional power requirement. If adequate capacity is not present, provide additional equipment required to support normal operation and functions of system including extension (as if there was no AC power failure) in event of an AC power failure for a minimum of four hours.
  16. Provide plug-in connectors to connect equipment.
  17. Utilize barrier terminal screw type connectors, at a minimum for base band cable systems.
    - a. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternative as long as cable dress, pairs, shielding, grounding, connections and labeling are provided same as barrier terminal strip connectors.
    - b. Tape of any type, wire nuts, or solder type connections will not be permitted.
  18. Provide stainless steel, anodized aluminum faceplates, or UL approved cycolac plastic matching equipment.
  19. Provide noise filters and surge protectors for each equipment (including interface) cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches.
- B. Equipment Functional Characteristics:
1. Input Voltage: 105 to 130 VAC.
  2. Power Line Frequency: 60 Hz  $\pm$ 2.0 Hz.
  3. Operating Temperature: 0 to 50 degrees Centigrade (C).
  4. Humidity: 80 percent minimum rating.
- C. Customer Service Unit (CSU)/Data Service Unit (DSU) Equipment:
1. Self-contained, electronic, digital and VoIP in operation, and provide, fully compatible with existing telephone equipment, a system as a minimum with following functions:
    - a. Intra-Facility station-to-station four digit direct dialing to include those telephone instruments equipped with direct incoming dial features.
    - b. Direct-output-dial (DOD) from any unrestricted telephone instrument to any CO trunk, ISDN, or FTS access lines by dialing a pre-designated access code.
    - c. DOD from any station to tie lines by dialing a pre-designated access code.

- d. Ability of Incoming calls from FTS access lines and tie lines to direct dial system stations without attendant assistance.
  - e. Access to outside lines through operator's console at restricted telephone instruments.
  - f. Access to features, functions, CO trunks, FTS access lines, tie-lines, toll free numbers, and long distance directory assistance from unrestricted telephone instruments.
  - g. Provide Class-of-Service (COS) restrictions to match existing telephone system to be applied individually or in combination as dictated by individual telephone number service requirements. Describe number and type of COS restrictions available in submittals.
2. Provide station users with feature package to match existing telephone system and at a minimum, those listed by this paragraph. Provide ability to restrict any of these features on a station by station basis.
- a. Line Hunt Capability: Assign sequential and circular line hunting lines to a hunt group; submit number of hunt groups available and capacity of each group.
  - b. Consultation Hold: Capability to place an incoming call on hold, making a consulting call, and then return to original call.
  - c. Call Transfer: Permit a user to transfer an incoming or outgoing CO trunk, FTS, or tie-line call to another system station without attendant assistance.
  - d. Call Pick-Up: Answer a ringing, but unanswered call, within a pre-designated group of station lines by dialing a feature code or activating a feature button.
  - e. Call Forwarding "Follow Me" Functions: Automatically reroute incoming calls to another selected telephone number. Activate and deactivating this feature from selected telephone instruments at their discretion.
  - f. "Busy and Don't Answer" Functions: Automatically reroute calls to a pre-programmed secondary telephone instrument when a given telephone instrument is busy or does not answer within a prescribed time interval.
  - g. Call Queuing: Telephone instrument encountering a busy trunk, e.g. CO, FTS, Foreign Exchange (F/X), and tie-lines, can be automatically connected to trunk when it becomes available.

- h. Call Back/Ring Back: Call back/ring back is activated at calling instrument initiating call to another internal busy instrument by an access code or feature button. Automatically ring calling instrument when both instruments become idle, and when answered, rings called instrument without preventing calling instrument from originating or receiving other calls.
- i. Conferencing: Telephone instrument initiated conference (minimum of three parties) which allows stations to conference any combination of telephone instrument, CO, or FTS calls.
- j. Automatic Number Identification: A facility where directory number or equipment number of a calling instrument is obtained automatically for use in message accounting.
- k. Station-to-Station Call Waiting: Busy telephone instruments are allowed to receive a second incoming call from another telephone instrument. Play call waiting tone on busy instrument, upon receiving a second incoming call. Busy instrument has ability to place initial call on hold and answer second call and alternate between both calls.
- l. Station and System Speed Dialing:
  - 1) System Speed Dialing: Minimum 50 numbers; allow designated telephone instruments to originate speed calls to CO, FTS, FX, or tie lines.
  - 2) Station Speed Dialing: Ten numbers per instrument; instrument must include capability of entering, removing, or changing numbers programmed on their station speed dialing list.
- m. Call Park: Allows non-preselected internal instruments to access an attendant initiated feature in response to an internal/external paging situation.
- n. Universal Night Answer Service: Provide a means of night service transfer for answering incoming calls, which would normally be answered at console, from locations other than console. Provide chimes, with cut-off switches, to announce incoming calls strategically placed at two locations.
- o. Line Load Control: A pre-programmed attendant controlled feature which, when activated from console positions, restricts all but selected stations from accessing FTS and CO trunks during emergency conditions. Activation of line load control must not

affect intra-facility communications (i.e. station-to-station, access to public address system, audio-page, etc.).

p. Dual Common Controls: Provide following minimum features:

- 1) A redundant common processing unit with automatic transfer capability offering a stored program technology control feature.
- 2) Either common control capable of handling total system traffic load without degradation of service.
- 3) Automatic switch, in event of primary common control failure, to redundant unit with no interruption to calls in progress and no loss of program features.

q. Line Lock Out:

- 1) Lock out station line in the event a telephone instrument handset is not replaced in telephone instrument cradle, after a pre-determined time interval with no dial action (i.e. not tie up system switch equipment).
- 2) Apply audible tone to locked out station lines.
- 3) Automatically restore associated station line to full service when a locked out telephone instrument handset is replaced.

r. Supervisory Telephone (not Electrical or Electronic) Signaling and Ringing:

- 1) Provide dual solid state signal generating devices, or equivalent, which produce standard supervisory signaling, i.e., ringing, dial tone, busy tone, etc. A maximum one-third of installed main station line capacity can be affected by failure of any one signal generating device.
- 2) Provide automatic transfer to alternate signal generating device in the event of failure, of primary device, for dual solid state signal generating devices.

s. Supervisory Signaling and Ringing:

- 1) Provide tones to indicate progress of a call through the exchange, i.e. dial tone - to indicate that switching equipment is ready to receive dial digits and, when required, provide a secondary dial tone for FTS 2000 access; busy tone (60 to 120 interruptions per minute) - to indicate that a busy line or trunk has been encountered; audible ring back tone - to indicate to calling subscriber that the number dialed is being called.

- 2) Provide supervisory signaling and ringing devices capable of operating from emergency DC power source.
- t. Fusing:
- 1) Equip CSU/DSU with fuses to protect telephone system and individual segments of CSU so a problem in one segment can be isolated without damaging total CSU/DSU.
  - 2) Provide alarm indicating type fuses with their rating designated by numerical or color code on fuse panels that are visible.
- u. Alarms and Trouble Indicators:
- 1) Provide visual and audible alarms, equipped with cut-off switches, indicating AC power failure, rectifier failure, major and minor trouble, and temperature/humidity alarms. Provide sensors for remote environmental alarms at existing telephone system and one other location. Separate these alarms in addition to major and minor alarm functions.
  - 2) Provide small red indicator lamps on alarm panel for each alarm with cut-off switches or one switch for alarms and distinctive audible alarms that can be heard over ambient noise in its respective location. If one cutoff switch is provided for all audible alarms, restore alarms to ready status condition for audible registration of additional alarms.
  - 3) On submittal describe other CSU/DSU alarms that are remote and describe CSU/DSU alarms/indicators of malfunctions that are located on the equipment.
- v. Provide capability of CSU/DSU to provide four-digit intra-station dialing and desired functions described herein.
- w. Due to varied trunk group requirements and possible future trunk group requirements (i.e. public address system access) alternate access codes can be proposed. Grouping of similar type trunk group/features (i.e. 5-1 public address system all call, 5-2 public address system zone 1, etc.) is acceptable.
- x. Provide emergency numbers accessible by CSU/DSU station users. Label numbers on console or a multi-line instrument and at least one other designated location. Provide a distinctive audible and visual signal associated with the emergency number to ensure an immediate response to calls. Provide capability of priority

answering emergency number and extending call as the situation dictates at console or multi-line instrument; a modified trunk circuit can be used for this purpose.

- y. Provide sensitivity for voice service up to 914.4 m (3,000 feet).
  - z. Provide CSU compatible with existing EBPX or equipped with following features:
    - 1) AC to DC power supplies.
    - 2) Emergency battery power supply.
    - 3) DC to AC inverter power supply (connected to CSU emergency battery power supply).
    - 4) Dual common controls.
    - 5) Redundant signaling supply units or equivalent.
    - 6) Cable distribution frame.
    - 7) Cable distribution system.
    - 8) Programmable emergency telephone numbers.
    - 9) On-site automatic program loading device (tape drives are not acceptable) to reload system memory in case of power or system failure (connected to CSU emergency battery power supply).
    - 10) On-site maintenance administration terminal (MAT) with monitor, keyboard and printer (connected to CSU emergency battery power supply).
    - 11) Automatic central office trunk connection to pre-determined stations for emergency trunk by-pass/cut-through service. Provide capability to immediately, upon failure of GFE system, have stations process calls. Equip each of these stations with automatic ground start for outgoing calls if required. Provide single line instruments, if required.
3. Voice Mail Requirements:
- a. General: Provide complete voice mail system allowing predetermined number of users to send complete and confidential messages in user's own voice and receive complete and confidential messages in sender's own voice 24 hours per day, 7 days per week. Integrate into operation of existing telephone system and be compatible with local telephone company central office.
  - b. Provide capacity for the following number of ports (minimum):

	Equipped Capacity	Wired Capacity
--	----------------------	-------------------

	Equipped Capacity	Wired Capacity
Automated Attendant	12	20
Voice Mail	12	20

- c. Provided voice mail system for 500 mailboxes and 40 hours of storage with growth to 60 hours of storage.

4. Voice Mail Features:

- a. Access to system and its features from any instrument anywhere that provides dual tone multi-frequency (DTMF) signaling.
- b. Ability of those leaving a message to review the message and edit the message that is being placed in the mailbox.
- c. Privacy/Security through use of a password.
- d. Ability to send messages to users on voice mail system in the following manner:
  - 1) To any user on same voice mail system.
  - 2) To more than one user on same voice mail system; an ad hoc distribution list determined by sender at time of message transmission.
  - 3) To a predetermined distribution list.
  - 4) Broadcast to all users on same voice mail system.
- e. Verification with Receipt: Ability of a user to request and receive verification of when a message is played through the use of a touch-tone command. Indicate time and date of when a message is played and place that information in sender's mailbox.
- f. Envelope Information: Ability of a user to request and receive time and date information of when specific messages were left in user's mailbox.
- g. Connection to voice mail system through extension number of existing telephone system or a seven/ten digit telephone number from LEC.
- h. Message "PROMPTS" for every transaction; provide messages for "GREETINGS" and "INSTRUCTIONS FOR RECORDING OR EDITING A MESSAGE".
- i. Notification that messages are in user's mailbox with a message waiting tone, lamp, and display.
- j. Notification upon accessing system, of how many messages are in the user mailbox.
- k. Message response alternatives:

- 1) Respond or send a reply to another user on same voice mail system.
- 2) Route message to another user on same voice mail system.
- 3) Delete message.
- 4) Save message.
- l. Ability to fast forward or rewind recorded messages while being reviewed by user.
- m. Messages presented to user on a First-In, First-Out (FIFO) basis.
- n. User Administration: Provide management information and statistics in the following categories:
  - 1) Port Usage: Traffic statistics on each of the different access paths into system.
  - 2) Usage of Storage Capacity: Remaining storage capacity at any one time and during peak periods.
  - 3) Mailbox Usage: Connect time and number of new or saved messages.
- o. User administration terminal that allows for "Class of Service Controls" in the following areas and for the following parameters:
  - 1) Initial Authorization.
    - a) Ability to enable a mailbox.
    - b) Record "Owner's" name.
    - c) Set initial Pass Number.
  - 2) Usage Control:
    - a) Length of personal greeting.
    - b) Length of messages received.
    - c) Number of messages.
    - d) Message retention time.
  - 3) Feature Authorizations: Allowed or not.
    - a) Group List Creation.
    - b) Group List Usage.
    - c) Broadcast Messages.
- D. Call Detail Reporting (CDR):
  - 1. Provide complete and self-contained on-site CDR compatible with existing telephone system.
  - 2. Functions:
    - a. Provide laser printer for reports generated by system and maintenance administration terminal.



- b. Connect CDR to system emergency battery power supply.
  - c. Include screen menus to provide access to each category of reports.
- E. Traffic Accounting and Management System (TMS) for voice circuits:
- 1. Include hardware, software, and interconnections to CSU/DSU.
  - 2. Include a database stored on non-volatile media.
  - 3. Provide line numbers, physical locations of equipment by building and room number, the department to which a line is assigned, name of persons assigned to a particular number, type of equipment, and any comments regarding CSU/DSU features.
  - 4. Support additional input and output (I/O) ports for video monitors or other terminals that allows a passive display of data bases by authorized medical center personnel other than those individuals responsible for data input and conducting studies.
  - 5. Protect data bases with user ID and password.
  - 6. Provide separate voice line reports, on demand and predetermined schedule, for automatic printing. The following reports are required:
    - a. Originating trunk traffic by trunk group, expressed in CCS.
    - b. Terminating trunk traffic by trunk group, expressed in CCS.
    - c. All trunks busy, by trunk group, expressed as blocked call count.
    - d. All equipment busy, i.e., no dial tone and failure to complete cross-office call because of all equipment busy, expressed in blocked call count.
    - e. List of equipment alarms, error tables, trouble logs, history files, V&H coordinates etc.
  - 7. Measurements for each Console:
    - a. Incoming calls.
    - b. Calls answered.
  - 8. Provide remote video monitors compatible with TMS hardware and software in immediate vicinity of telephone operators for use as an on-line directory lookup system of facility personnel.
  - 9. Print reports in English notation that does not require interpretation of abbreviations or codes by user.
  - 10. Provide storage on disk to prevent a purge of stored data. Maintain call record and facility usage data in database for a minimum 30 days with storage capability of accommodating a minimum 5,000 calls per day.

11. Load and maintain directory that includes, name, title, organization, location, extension, and class-of-service.
  12. Provide cable plant management function with the following minimum requirements:
    - a. A list of off-premise cable by circuit number, numbers of pairs for each circuit, and circuit definition.
    - b. Complete cable plant distribution record to identify location (cable pair) on main distribution frame (MDF), the riser, the size cable, cable pair in-use (main cable feeder and station cable), building and room number of the termination, and equipment type terminated.
    - c. Cable number and pair assignments provided automatically when service order is entered.
  13. Provide equipment inventory list containing the following minimum requirements:
    - a. CSU cabinets, cards (active and spares), batteries, current and surge protectors, rectifiers, peripheral equipment (i.e. public address, radio page, etc.).
    - b. Quantity of single and multi-line telephones, speakerphones, dial intercom units, speakers, gongs, loud horns, bells, chimes, recorders, etc.
    - c. A list of equipment as being used or spare; ordered or received; installed date, warranty date, cost, location, serial number, etc.
  14. Electrical or electronic supervisory alarms and faults reports.
- F. Cross-Connection System (CCS) Equipment: Breakout, termination connector (or bulkhead), patch panels, and connection assemblies, in addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, must include the following:
1. Connector panels made of flat smooth 3.175 mm (1/8 inch) thick solid aluminum, custom designed, fitted and installed in the cabinet.
  2. Bulkhead equipment connectors mounted on the panel to enable cabinet equipment's signal, control, and coaxial cables to be connected through the panel.
  3. Each panel color matching cabinet installed.
- G. Voice:
1. 110-type punch blocks certified for category six represent the minimum requirement for voice, and control wiring instead of patch

panels. Category six IDC punch blocks (with internal RJ45 jacks) are acceptable for use in CCS. Secure punch block strips to OEM designed physical anchoring unit located on a wall in Demarc Room, Telephone Equipment Room, and TR. However, console, cabinet, rail, panel, etc. mounting is allowed with OEM recommendation and as accepted by COR. Punch blocks will not be permitted for Class II or 120 VAC power wiring.

2. Technical Characteristics:

- a. Number of Horizontal Rows: Minimum 100.
- b. Number of Terminals per Row: Minimum 4.
- c. Terminal Protector: Required for each used or unused terminal.
- d. Insulation Splicing: Required between each row of terminals.

H. Fiber Optic and Analog Audio:

- 1. Product reference type is Tele wire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows. This panel can be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with proper connectors. This panel will not be permitted for 120 VAC power connections.

2. Technical Characteristics:

- a. Height: Minimum two RUs, 89 mm (3-1/2 inches).
- b. Width: Minimum 484 mm (19-1/16 inches), EIA.
- c. Number of Connections: Minimum 12 pairs.
- d. Connectors:
  - 1) Audio Service: Use RCA, 6.35 mm (1/4 inch Phono), XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained).
  - 2) Control Signal Service: Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained).
  - 3) Low Voltage Power (Class II): Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted.
  - 4) Fiber Optic: "LC" Stainless steel, female.

I. Mounting Strips and Blocks:

1. Barrier Strips:

- a. Barrier strips must be approved for AC power, data, voice, and control cable or wires that accommodate size and type of audio

spade (or fork type) lugs used with insulating and separating strips between terminals for securing separate wires in orderly fashion.

- b. Provide barrier strips with audio spade lug, which is connected to an individual screw terminal on the barrier strip at each cable or wire end.
  - c. Secure barrier strips to console, cabinet, rail, panel, etc. Do not connect 120 VAC power wires to signal barrier strips.
2. Technical Characteristics:
- a. Terminal Size: Minimum 6-32.
  - b. Terminal Count: Any combination.
  - c. Wire Size: Minimum 20 AWG.
  - d. Voltage Handling: Minimum 100 V.
  - e. Protective Connector Cover: Required for Class II and 120 VAC power connections.
  - f. Solderless Connectors: Crimp-on insulated lug to fit 6-32 minimum screw terminal. Install fork connector using standard crimp tool.
  - g. Furnish items for balancing and minimizing interference capable of passing telephone signals in the frequency bands selected, in directions specified, with low loss, and high isolation and with minimum delay of specified frequencies and signals.

J. System Instruments:

- 1. Provide system instruments equipped with inductive capability to radiate a magnetic field required to activate hearing aid telecoil and to provide personnel, who use hearing aids, access to instruments within facility.
- 2. Provide station equipment consisting of standard single line instruments, patient bedside instruments, and multi-line digital electronic system instruments with digital display, of latest state-of-the-art design.
- 3. Provide system instruments except patient bedside phones, with a flash button (or equivalent feature button) with pre-determined timing feature to initiate consultation hold and other features normally initiated by operation of hook-switch. Flash button distinct from hook-switch.
- 4. Attach laminated faceplate listing the most common user features and their appropriate access codes to system instruments, except patient bedside phones. Faceplates can be an integral part of instrument

- housing or be an adhesive backed decal applied over tone pad area of the housing at time of system set installation.
5. Provide station instruments with transmission characteristics compatible with proposed system.
  6. Provide system instrument signaling by means of standard adjustable, buzzers, chimes, or electronic tone, unless otherwise specified.
  7. Single Line Instruments:
    - a. Single line instruments can be electronic or 2500-type analog phones.
    - b. Single line instruments used must be capable of supporting bridged cabling to allow a single phone number on multiple instruments without using multiple switch ports.
    - c. Single line instruments must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment without using multiple switch ports.
  8. Multi-Line, Digital and Electronic Instruments - Features:
    - a. Digital read-out display and with less than 14 programmable (lines or features) buttons.
    - b. Adjustable ringer, bell, buzzer, chime or electronic tone to announce calls.
    - c. Detect an incoming call to multi-button instrument and provide an audible signal only on designated lines.
    - d. Lights to identify called line and remain illuminated for duration of call.
    - e. Associate telephone intercom systems with these instruments.
    - f. Equipment associated with intercom systems can require special features such as built in microphone and speaker. Provide a means of announcing calls to offices with extensions or pickups on system. Identify provision of intercom systems during data base survey required and provide any required intercom systems.
    - g. Equipment must be capable of supporting auxiliary equipment, such as amplified handsets; external chimes, light, or bells; and other similar equipment. The use of analog switch ports to provide ringing voltage, if required, is acceptable and include these switch ports in specified equipped capacity.
    - h. Provide hot line telephones between two identified points provided with two-way automatic ring and cut-off controlled by

telephone hook-switch, i.e. when near-end hand set is removed from hook switch, the far-end telephone rings until the hand set is removed from hook-switch.

- i. Configure speaker on hands free system stations to be used as both transmitter and receiver to answer or initiate a call. These facilities to normally be used as a hot line between two points.

9. Patient Bedside Instruments - Features:

- a. Maintenance free, sanitized packet, and capable of supporting table top, side-rail, top bed-rail, or wall mounting. Provide each phone with minimum 15 feet of self-contained line cord.
- b. At the discretion of the facility, patient bedside instruments can be discarded cleaned for reuse, or given to the patient, as appropriate. Expected anticipated cost per instrument does not exceed ten dollars.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Install system according to this section and the following:

- 1. NFPA 70, National Electrical Code (NEC), Article 517, Chapter 7, and Chapter 9.
- 2. NFPA 99, Health Care Facilities, Chapters 3, and 4.
- 3. NFPA 101, Life Safety Code, Chapters 7, 12, and 13.
- 4. Joint Commission/NFPA Life Safety Book for Health Care Organizations (June 2013).
- 5. OEM recommendations and instructions, when more stringent than requirements of this section.

B. System Installation:

- 1. Ensure that installation personnel understand requirements of this specification.
- 2. Install filters, traps, directional couplers, splitters, system outlets, and pads for minimizing interference and for balancing amplifiers and distribution systems.
- 3. Connect passive equipment according to OEM specifications to insure correct termination, isolation, impedance match and signal level balance at each system outlet.
- 4. Install one outlet for each instrument where TCOs are installed adjacent to each other.

5. Terminate lines in a suitable manner to facilitate future expansion of system. Provide a minimum of one spare 25 pair cable at each distribution point on each floor.
6. Terminate vertical and horizontal copper and fiber optic, and coaxial lines in CSU / DSU, TER, MCR and TR equipment only.
7. Install terminating resistors or devices on unused branches, outlets, and equipment ports of system designed for the purpose of terminating fiber optic or twisted pair, and coaxial cables carrying system signals in system.
8. Install equipment outdoors in weatherproof enclosures with hinged doors and locks if equipment is not weatherproof. Provide minimum two keys for each lock.
9. Install equipment indoors in metal cabinets with hinged doors and locks. Provide minimum two keys for each lock and VA Police Access Control System.

C. Rack and Cabinet Equipment Mounting:

1. Install rack mount equipment on enclosures' equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustments can be conveniently made.
2. Heavy Equipment:
  - a. Install heavy equipment using rack slides or rails allowing servicing from front of enclosure.
  - b. Install additional support to supplement front panel mounting screws for heavy equipment.
3. Install cable slack to permit servicing by removal of equipment from front of enclosure.
4. Install color matched blank panel (spacer) of 44 mm (1-3/4 inches) high, between each piece of equipment (active or passive) to ensure adequate air circulation maintaining enclosure design for efficient equipment cooling and air ventilation.
5. Provide 380 mm (15 inches) of front vertical space opening for additional equipment. Install color matched blank panels to cover any unused enclosure openings.
6. Connect signal connector, patch, and bulkhead panels (i.e. PA, system , control, etc.) so that outputs from each source, device or system component enters panel at top row of jacks, beginning left to right as viewed from front; designate these as "inputs". Install

- connection to load, device or system component to exit panel at bottom row of jacks, beginning left to right as viewed from front; designate these as "outputs".
7. Mount equipment located indoors installed in metal racks or enclosures with hinged doors so it can be accessible for maintenance without interference to other nearby equipment.
  8. Fasten cables to equipment racks or enclosures in a manner that allow doors or access panels to open and close without disturbing or damaging cables.
  9. Install distribution hardware allowing access to connections for testing and provide room for doors or access panels to open and close without disturbing cables.
  10. Install a quad outlet with modular jacks and stainless steel face plate for each system outlet. Provide appropriate modular jack (single or quad) with appropriate face plate for each 'outlet' location identified and verified.
  11. Install wall system and pole instruments on a single modular jack designed for wall and pole system instruments and patient wall or PBPU installations.
  12. Install permanent telephone cables in conduit or an enclosed duct system. Obtain acceptance for installation, as determined by Government requirements, without conduit or enclosed duct system in cable tray or mechanically supported and separated from other signal cable systems.
  13. Where cables penetrate fire/smoke partitions, firewalls, or floors, coordinate installation of fire stopping material of type accepted by COR.
  14. Replace ceiling tiles damaged during installation and maintenance service of cable and wire distribution system. Restore immediate areas damaged during system installation and maintenance service.
  15. Run cross connects to established circuits during installation and maintenance service.
  16. Remove debris and scrap generated in conduct of work, on a daily basis.
- D. Installation of Conduit, Cables And Wiring, Cable Tray, Raceways, Signal Ducts:



1. General: Conduits installed in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS and Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
2. Ensure that system, SMS, and PA Systems (as identified by NEC Section 517) are separated and protected from other systems.
3. Install cable junctions and taps to be accessible. Do not install multi-taps or other distribution equipment items inside cable ducts or raceways. Use minimum 200 mm x 200 mm x 100 mm (8" X 8" X 4") junction box attached to cable duct or raceway for installation of distribution system passive equipment. Ensure equipment and tap junctions are accessible.
4. Install and fasten cables without causing sharp bends or rubbing of cables against sharp edges. Fasten with hardware that does not damage or distort cables.
5. Identify cables with permanent labels at terminals of electronic and passive equipment and at each junction point in system. Lettering on cables must correspond with lettering on the record wiring diagrams.
6. Group cables to not change position throughout cable run.
7. Test cables after installation and replace any defective cables.

### **3.2 FIELD QUALITY CONTROL**

#### **A. Interim Inspection:**

1. Conduct an interim inspection of installed equipment in presence of COR prior to proof of performance testing. Verify that equipment provided, adheres to installation requirements.
2. Install 50 percent of system extension equipment to include CSU, interface, origination and junction enclosures powered with permanent AC wiring, outlets, conduit and cables, before interim inspection can take place.
3. Notify COR of estimated date the contractor expects to be ready for interim inspection, minimum seven working days before requested inspection date.
4. Furnish results of interim inspection to COR and Project Manager. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting contractor to continue with system installation; SMCS 0050P2H3, (202) 461-5310 must be a part of this inspection team.
5. COR in conjunction with RE determine if an additional inspection is required, or if contractor will be allowed to proceed with

installation. In either case, re-inspection of deficiencies noted during interim inspections, must be part of proof of performance test. Interim inspection is not permitted to affect the system's completion date. Include test documents as part of system's record wiring diagrams.

- B. Pretesting: Align and balance system. Upon completing the installation of system, pretest entire system.
- C. Pretesting Procedure: During system pretest, verify (utilizing accepted spectrum analyzer and test equipment) that system is fully operational and meets system performance requirements. Measure and record aural carrier levels of each system instrument, at each of the following points in system:
  - 1. Telephone System inputs.
  - 2. CSU/DSU inputs and outputs.
  - 3. TER, MCR and TR amplifiers, channel processor and converter inputs and outputs.
  - 4. CSU/DSU output signal-to-noise ratio for each instrument.
  - 5. Signal level at each interface point to distribution system, last outlet on each trunk line and outlets installed as part of this project.
  - 6. Submit recorded system pretest measurements along with pretest certification, to COR.
- D. Pretesting Certification: After pretesting system, notify COR that system is ready for proof of performance testing in presence of a SMCS 0050P2H3, (202) 461-5310, and others specifically identified by COR, and that system complies with documented requirements. Submit notification of system readiness no later than twenty working days prior to beginning of scheduled Government proof of performance test. Failure of contractor to comply with these pretest requirements, automatically cancels scheduled acceptance test.
- E. Acceptance Test:
  - 1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test date and give COR 30 days written notice prior to date acceptance test is expected to begin; include expected duration of time for test. Test in presence of a COR and OEM certified representative. Test utilizing test equipment to certify proof of performance and Life Safety Compliance. Verify that total system meets specified

requirements under operating conditions, and complies with listed system performance standards.

2. Make only those operator adjustments required to show proof of performance. Demonstrate and verify that installed system does comply with operational requirements under operating conditions. Rate system as either acceptable or unacceptable at conclusion of test. Failure of any part of system, that precludes completion of system testing and cannot be repaired within four hours, terminates acceptance test of system.
3. Declare entire system unacceptable if repeated failures result in a cumulative time of eight hours to effect repairs and retesting entire system at convenience of Government.

F. Acceptance Test Procedure:

1. Mechanical and Physical Inspection:

- a. COR may tour major areas where system and sub-systems are located to ensure they are completely and properly installed in place and are operationally ready for proof of performance acceptance testing. A system inventory including available spare parts must be taken at this time. Verify equipment to ensure appropriate UL certification labels are affixed.
- b. Review system diagrams, record drawings, equipment manuals, AutoCAD files, intermediate and pretest results.
- c. Failure of system to meet installation requirements of this specification will terminate testing.

2. Sub-system Operational Test:

- a. After mechanical and physical inspection, perform operational test of each sub-system to verify that equipment is connected, interfaced and operational to meet requirements of this section. If any sub-system is not ready, that sub-system will be declared unacceptable and all testing terminated. At this point, Contractor is only permitted one hour to correct deficiencies.
- b. Agree with COR, at this time, to wait one hour or to commence testing of next sub-system.
- c. Repeated failures of sub-system testing or total system testing that results in a cumulative time of four hours to effect repairs, is grounds for declaring entire system unacceptable and testing to be terminated. Reschedule retesting at the convenience of Government.

3. Sub-system Performance Test: After operational test of each sub-system, verify that all performance requirements and standards are met. Verify there are no visible signal distortions, such as intermodulation, beats, etc. appearing on any received or generated system with spectrum analyzer, signal level meter and BERT.
4. Total System Test: Commences after system and sub-systems have been tested and accepted.
  - a. Existing System Point of Demarcation: Check system outputs.
  - b. CSU/DSU: Test within 30 days following successful pretesting of CSU/DSU. In addition to compliance with technical characteristics and quantities of equipment specified herein, the final acceptance test provision that 30 continuous days of uninterrupted system service, must be completed prior to Contractor being deemed to be in compliance with contract.
    - 1) For purpose of final acceptance, system service is considered interrupted when failure of any contractor provided telephone equipment including batteries, results in an interruption of service. This includes a failure of more than 20 percent of any trunk group, 15 percent of any number group (15 or more stations), operator console, or telephone service to any area determined to be critical by Facility Director. Response time to restore service has bearing upon term "interrupted service".
    - 2) To facilitate CSU/DSU acceptance test and to allow familiarization and training of government employees, activate CSU/DSU, including operator consoles, stations, and equipment a minimum 30 days prior to acceptance test date. Test installed equipment and circuits prior to acceptance by Government. During this "burn-in" period, de-bug CSU/DSU. Make CSU/DSU available for in-house communications and demonstrate features to facility staff. Government and contractor will ensure trunks are available to CSU/DSU during this "burn-in" period for testing.
    - 3) At conclusion of Acceptance Test, if Project Manager, SMCS and COR agree to the results of the test, reschedule testing on deficiencies and shortages, if any. The 30 days of uninterrupted service provision begins when test shows the system performs in accordance with the specifications. If any

retests are needed to reach agreement on the results of tests or to establish compliance with these specifications, such retesting is provided at contractor's expense.

5. Individual Item Test: COR can select individual items of equipment for detailed proof-of-performance testing to verify items selected meet or exceed minimum requirements of the specification.
6. Interface Cable Sub-system: To ensure that system meets performance requirements, check a minimum 75 percent of system outlets and interface points. Additionally check each sub-system interface, junction, and connection point or location. Each distribution active and passive item of equipment, signal inputs and outputs must be tested.
7. Distribution Cable Plant Sub-system: For specific distribution testing instructions refer to Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.

G. Test Conclusion:

1. Government will reschedule testing on deficiencies and shortages, using generated punch list (or discrepancy list).
2. If system is declared unacceptable without conditions, retesting is provided at contractor's expense.

### **3.3 SYSTEM STARTUP**

- A. Provide personnel (switch technicians, installers, trainers, and project manager, etc.) on premise for seven consecutive days after cutover, to clear any malfunctions that develop, to assign/reassign any software features/COS, and conduct any additional training as required.
- B. Connect system equipment located in TR and TER to telecommunications grounding busbar.
- C. Provide system ground between CSU/DSU and interfaced systems such as existing SMS, system equipment chassis, etc.
- D. Ensure that other dedicated telecommunications systems applications within facility (i.e., pay stations, electro-writing equipment, facsimile etc.) that require space within TER, MCR and TRs, conduits, and cable pair are accommodated. Coordination between applicable parties is necessary to ensure accommodation of these systems.
- E. Verify system installation conforms to local building and fire codes.

### **3.4 TRAINING**

- A. Provide services of OEM trained and certified engineer or technician for two eight-hour classes to instruct designated facility maintenance

personnel. Include cross connection, corrective, and preventive maintenance of system and equipment.

- B. Provide services of OEM trained and certified engineer or technician, familiar with functions and operation of system and equipment, for two eight-hour periods to train designated facility IRM personnel. Instruct staff personnel in each area where system is installed under this contract. Group classes when multiple areas are involved. Coordinate periods of training with COR to ensure all shifts receive required training. Include instructions utilizing "hands-on" operation and functions of system.
- C. Before system can be accepted by Government, this training must be accomplished. Schedule training at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

### **3.5 MAINTENANCE**

- A. Provide COR the ability to contact OEM's central emergency assistance maintenance center and request remote diagnostic testing and assistance in resolving technical problems at any time, during warranty period. Provide remote diagnostic testing and assistance capability to Government.
- B. Response Time during Warranty Period:
  - 1. Respond on-site, during the standard work week, to a routine trouble call within 24 hours of its report. A routine trouble is considered a trouble that causes a sub-system to be inoperable.
  - 2. Respond on-site to an emergency trouble call within four hours of its report. An emergency trouble is when failure:
    - a. Causes a system to be inoperable at any time.
    - b. Involves more than 20 voice circuits.
    - c. Is of a common control unit, power supply, signal generating device or attendant console.
  - 3. Respond on-site to a catastrophic trouble call within two hours of its report. System failure is considered a catastrophic trouble call.
    - a. If system failure cannot be corrected within six hours, provide an alternate CPU/Key System/mini- system equipped for a minimum of 100 main station lines, 10 CO trunks, 10 FTS access lines and two operator's consoles.

- b. Install alternate system to provide emergency service to critical areas as determined by Facility Director within 12 hours (time to commence at end of the six hour trouble shooting period).
  - c. Provide to Facility Contracting Officer (CO), prior to cut-over of main telephone system, a pre-written program disk from programmable alternate system.
- 4. Catastrophic trouble calls include failures affecting operation of critical emergency health care facilities (i.e., cardiac arrest teams, intensive care units, etc.) if so determined by Facility Director.
- 5. Respond on-site to installation of station or equipment requests for service within:
  - a. Eight hours for emergency installations designated by Facility CO.
  - b. Three working days for routine installations designated by Facility CO.
- C. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
- D. Provide compatible temporary equipment returning system or sub-system to full operational capability, until repairs are completed for any trouble that cannot be corrected within one working day.
- E. COR and Facility CO are contractor's reporting and contact officials for system trouble calls, during warranty period.
- F. Required On-Site Visits during Warranty Period:
  - 1. Visit, once every twelve weeks, to perform system preventive maintenance, equipment cleaning and operational adjustments to maintain system.
    - a. Arrange facility visits with COR or Facility CO prior to performing maintenance visits.
    - b. Perform preventive maintenance in accordance with OEM's recommended practice and service intervals during non-busy times agreed to by COR or Facility CO.
    - c. Provide preventive maintenance schedule to COR and Facility CO for approval.
    - d. Provide on-site replacement spare parts and equipment, plus test equipment, ensuring they meet OEM's minimum recommended spare parts stock sizing requirements for this specific system.

2. Provide Facility CO a report itemizing each deficiency found and corrective action performed during each visit or official reported trouble call. Provide COR or Facility CO with sample copies of reports for review and approval at beginning of acceptance test.

Minimum reports required:

- a. Monthly summary of equipment and sub-systems serviced during warranty period to COR or Facility CO by fifth working day after end of each month. Describe services rendered, parts replaced, repairs performed and prescribe anticipated future needs of equipment and systems for preventive and predictive maintenance.
- b. Separate log entry for each item of equipment and each sub-system of system listing dates and times of scheduled, routine, and emergency calls. Describe details of the nature and causes of each emergency call, emergency steps taken to rectify situation and specific recommendations to avoid such conditions in the future.
- c. Include in Warranty GFE accepted by contractor, interfaced and installed in system; attach GFE List.

- - - E N D - - -



**SECTION 27 41 31**  
**MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a complete and operating National Television Standards Committee (NTSC) High Definition (HDTV) Master Antenna Television (MATV) system, hardware and associated equipment for VA Medical Center, Out Patient Clinic, here-in-after referred to as the "facility".
- B. Provide complete system including antennae, antennae mounts, lighting protection, head-end equipment, RF amplification and distribution systems splitters, taps, cross-connection blocks including panels and associated hardware, telecommunication outlets (TCO), coaxial distribution wires, power supplies, cables, connectors, "patch" cables and internal communications system ground, required for reception and distribution of cable signals.
  - 1. RF Service.
  - 2. Analog Video Service.
  - 3. Analog Audio Service.

**1.2 RELATED WORK**

- A. System Tests: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals (including samples, test reports, certificates, and manufacturers' literature): Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Sealant and caulking materials and their application around conduit penetrations through building envelope to prevent moisture migration into building: Section 07 92 00, JOINT SEALANTS.
- D. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- E. Wiring devices: Section 26 27 26, WIRING DEVICES.
- F. Lightning protection system: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- G. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

- H. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- I. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- J. Low voltage cabling system infrastructure: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- K. Voice and data cable distribution system and associated equipment: Section 27 15 00, COMMUNICATIONS STRUCTURED CABLING.

### 1.3 COORDINATION

- A. Coordinate with Facility Chief of MMPS to establish circuits throughout facility and provide proper test equipment to ensure that video, and audio cables meet each OEM's standard transmission requirements, and ensure cables carry video and audio transmissions at required speeds, frequencies, and fully loaded bandwidth.//

### 1.4 SUBMITTALS

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit PDF electronic copies for each of the following:
  1. Provide site drawing showing system grounding electrode connections and routing of grounding electrode conductors.
  2. Pictorial layout drawing of each antenna, mount, lead-in and lightning ground connections, antenna head end equipment room, Demarc Room, TR Equipment Room show termination cabinets, each distribution cabinet and rack, user TCO locations and wire management practices.
  3. Engineering drawings of system, showing calculated signal levels at each input and output distribution point, used to determine proposed TCO values.
  4. Calculated system layout drawing indicating cable types, amplifiers, taps, splitters, lengths of cable "Bus" Topology .
  5. Anticipated signal level at each coaxial cable TCO jack.
  6. RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identify floor by number (i.e. 1st, 2nd, etc.)
TR ROOM NUMBER	Identify room, by number, from which cabling will be installed

Column	Explanation
TO FLOOR TR	Identify building, by number or location, to which cabling will be installed
NUMBER OF CONDUCTORS	Identify the number of conductors in each run of RF cable
INSTALLATION METHOD	Identify the method of installation
NOTES	Identify note numbers for special features or equipment
BUILDING MTR	Identify building by number or title //

7. Analog Video (and Audio) Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identify building, by number or location, from which cabling will be installed
TR ROOM NUMBER	Identify the room, by number, from which cabling will be installed
TO BUILDING IMR	Identifies building, by number or title, to which cabling will be installed
TR ROOM NUMBER	Identify the room, by number, to which cabling will be installed
NUMBER OF CONDUCTORS	Identify the number of conductors in each run of cable
INSTALLATION METHOD	Identify method of installation
NOTES	Identify a note number for special features or equipment
BUILDING MTR	Identifies the building by number or title

8. Antenna Signal Survey:

- a. Submit RF signal survey from recognized industry source, derived mathematically from fixed information, showing radiated and received RF signals at project and approximation of signal levels expected using given antenna.
  - 1) Record findings on a geographic map with facility residing in its center and outline coverage locations, radiating in a 360-degree pattern. Depict primary, secondary, marginal and out of range areas of operation by different colors for each frequency of operation.
  - 2) Include longitude and latitude of facility along with elevation above mean sea level using a Geostationary System (GPS) portable device.

- 3) An on-site survey, using actual transmitting and receiving equipment of type contractor is submitting, is an acceptable alternative to recognized industry source.

9. List of test equipment required by Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

B. Certifications:

1. Submit certification from OEM that MATV installation supervisor and maintenance provider are authorized representatives of OEM. Include each individual's legal name, address and OEM credentials in the certification that includes the most recent approval date.
2. Submit pre-acceptance certification in accordance with test procedures.

C. Needs Assessment Report: Provide a summary report of the needs assessment meeting conducted with nursing manager of each unit, as required by this section.

D. Provide sample copy of report format to be used for trouble calls; obtain COR approval of sample report before beginning total system acceptance test.

## **1.5 WARRANTY**

- A. In addition to compliance with FAR clause 52.246-21 provide OEM warranty documents certifying each item of equipment conforms to specifications and OEM installation recommendations.
- B. Warrant system picture fidelity equal to that received from cable provider and other modulated channels.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

A. Design Criteria:

1. Coordinate features to provide components forming an integrated system. Match components and interconnections for optimum performance of specified functions.
2. Provide system with capacity to increase quantity of TCOs by 40 percent above indicated without adding any internal or external components or main trunk cable conductors.
3. Distribute HDTV television signal to MATV TCOs to permit simple connection of A/53 ATSC Digital Television Standard Parts 1-6 HDTV receivers.
4. Deliver at MATV TCOs HDTV television channel signals.

5. Provide reception quality at each MATV TCO exceeding that received in area with individual antennas. Deliver minimum +6.0 dBmv (2,000 microvolts across 75 Ohms) and maximum of +20 dBmv (20,000 microvolts) for each HDTV channel at each MATV TCO.
6. Only employ interfacing methods accepted by OEM and VACO's AHJ (SMCS 0050P2H3). Selected interface or interconnecting methods require physical and mechanical connections, matching signal, voltage, processing levels and impedance that provides described signal levels and quality.
7. Interface PA with system only as accepted by AHJ (SMCS 0050P2H3).
8. Provide passive distribution equipment to meet or exceed -80 dB radiation shielding specifications .
9. Terminate trunk, branch, and interconnecting cables and unused equipment ports or taps with terminating resistors designed for RF, audio, and digital cable systems without adapters.
10. Utilize microprocessor components for signaling and programming circuits and functions. Use non-volatile system program memory, or protected from erasure during power outages for a minimum of 24 hours.
11. Provide UPS for system (including each distribution cabinet/point) to allow normal operation and function in event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
12. Use coaxial cable connections recommended by cable OEM and approved by equipment OEM for coaxial cable distribution points and RF transmission lines.
  - a. Utilize barrier terminal screw type connectors, minimum at base band cable systems.
  - b. Crimp type connectors installed with a ratchet type installation tool are acceptable alternative if cable dress, pairs, shielding, grounding, connections and labeling are same as barrier terminal strip connectors.
  - c. Tape of any type, wire nuts or solder type connections are not permitted.
13. Utilizing LAN/WAN cable systems for control, management and distribution of equipment and distribution of MATV signals is not permitted. Connect system ensuring NFPA Critical Care and Life

Safety Circuit separation guidelines are satisfied. Connections to Telephone and LAN/WAN systems are not permitted.

14. Telephone cable to distribute MATV signals, carrying system or sub-system AC or DC voltage is not permitted.
15. Audio Level Processing: Provide control location equipment to ensure system produces audio channel capacity identified on drawings at each TV/speaker.
16. Provide weather-resistant equipment listed by National Recognized Testing Laboratory (NRTL) for installation outdoors or in damp locations.

B. Performance Criteria:

1. RF Service:

- a. "Off air" RF High Definition (HDTV) Television service (considered to be at RF (below 900 MHz in frequency bandwidth). RF television systems require backbone coaxial cable, from antenna farm to antenna head end room, and to each TR and distribution coaxial cable to each HDTV outlet location.
- b. Isolation (outlet-outlet): 14 dB.
- c. Impedance: 75 Ohms, unbalanced.
- d. Signal Level: 10 dBmV, +/- 5.0 dBmV.
- e. Bandwidth: Minimum 6.0 MHz per channel fully loaded.

2. Analog Video Service: Baseband below 100 MHz in frequency bandwidth.

- a. Isolation (outlet-outlet): Minimum 24 dB.
- b. Impedance: 75 Ohm, unbalanced.
- c. Output Level: 1.0 V peak to peak (P-P), for 87.5 percent depth of Modulation (Mod).
- d. Diff Gain:  $\pm 1.0$  dB at 87.5 percent Mod.
- e. Diff Phase:  $\pm 1.5$  at 87.5 percent Mod.
- f. Signal to Noise (S/N) ratio: Minimum 44 dB.
- g. Hum Modulation: -55 dB.
- h. Return Loss: Maximum -14 dB or 1.5 Voltage Standing Wave Ratio (VSWR).
- i. Bandwidth: Minimum 6.0 MHz per channel, fully loaded.

3. Analog Audio Service: is baseband below 10 MHz in frequency bandwidth. Analog audio circuits require separate audio connectors and video connectors even though both are considered baseband signals. Each TCO has multiple 600 (or 120) Ohm BAL line pairs.

- a. Impedance: 600 Ohm, BAL

- b. Input Level: Minimum 59 mV RMS.
  - c. Output Level: 0 dBm.
  - d. S/N ratio: Minimum 55 dB.
  - e. Hum Modulation: Minimum -50 dB.
  - f. Return Loss: Maximum -14 dB (or 1.5 VSWR).
  - g. Isolation (outlet-outlet): Minimum 24 dB.
  - h. Frequency Bandwidth: Minimum 100 Hz - 10 KHz.
- C. Provide accessories and miscellaneous equipment for a complete and operating HDTV system.
- D. Equipment:
  - 1. Modular type rated for continuous duty.
  - 2. Provide NRTL Listed equipment by OEM that is a commercial business enterprise manufacturing items of equipment and which:
    - a. Maintains replacement parts for equipment in stock,
    - b. Maintains engineering drawings, specifications, and operating manuals for equipment.
    - c. Published and distributed descriptive literature and equipment specifications on equipment submitted 30 days prior to Invitation for Bid.
- E. For protection from input power surges and to ensure noise is not induced into circuits, provide noise filters and surge protectors for each equipment interface, distribution and head end cabinet, control console, and local and remote amplifier locations. Provide lightning/surge suppression of the antenna farm and ground per NEC article 810.
- F. Provide stainless steel, or AHJ (SMCS 0050PO2H3) accepted faceplates.

## **2.2 ANTENNA EQUIPMENT (OR ANTENNA FARM) (NOT USED)**

## **2.3 HEAD END EQUIPMENT AND ROOM (NOT USED)**

## **2.4 DISTRIBUTION EQUIPMENT**

- A. Distribution Devices:
  - 1. Distribution Amplifiers:
    - a. Description: Broadband, very low distortion, cable television system quality, HDTV distribution amplifier.
    - b. Characteristics:
      - 1) Frequency Range: 49MHz to 1,000MHz.
      - 2) Channel Loading: 150.
      - 3) Flatness: +/-0.75dB.
      - 4) Gain: 32dB.

- 5) Output Level: +40dBmV.
- 6) Gain Control Range: 10dB.
- 7) Slope Control Range: 8dB.
- 8) Plug in Equalizers: As needed.
- 9) Attenuator Options: As needed.
- 10) Programming: Minimum 35 HDTV channels.
- 11) Gain of the Preamplifier: 32dB, with an output level of 48dBmV for each HDTV channel processed.
- 12) Amplifier Module: Hybrid push-pull.
- 13) Gain and Slope Control Ranges: 8dB and 9dB, respectively.

B. Combiners:

- 1. Provide 8-port passive combiner for combining RF signals into one main trunk run for distribution to building locations.
- 2. Bandwidth of Combiner: 0 to 1,000 MHz.

C. Cable:

- 1. Provide RG-6, RG-11, or appropriate hardline minimum 13 mm (1/2 inch) coaxial cable to achieve specified signal level.
  - a. Provide RG-11 or 13 mm (1/2 inch) hardline coaxial cable for runs over 45.72 m (150 feet) in length.
  - b. Provide plenum rated coaxial cable with a nominal characteristic impedance of 75 Ohms throughout entire frequency spectrum utilized in this system.
- 2. Sweep-test and return-loss test each reel of cable, over frequency range 50 MHz to 750 MHz, at manufacturer prior to shipping.
- 3. Trunk Cable:
  - a. Description: 13 mm (1/2 inch), semi-rigid coax, riser rated.
  - b. Maximum Attenuation:
    - 1) 2.92 dB/100ft at 700 MHz.
    - 2) 3.78 dB/100ft at 1000 MHz.
    - 3) Impedance: 75 Ohm.
- 4. RG6 Cable:
  - a. Description: RG6 double shielded cable //CMR or// CMP Rated
  - b. Attenuation:
    - 1) 1.48 dB/100ft at 50 MHz.
    - 2) 7.45 dB/100ft at 1000 MHz.
    - 3) Impedance: 75 Ohm.
- 5. General Purpose Analog RF:
  - a. Size:



- 1) Minimum coaxial cable size RG-6 type (or equal).
- 2) Increase size (i.e. RG-11, 13 mm (1/2 inch), 19 mm (3/4 inch), etc.) to meet system design signal level.
- 3) Use for baseband signals as approved by OEM.

b. Technical Characteristics:

- 1) Impedance: 75 Ohm, unbalanced.
- 2) Center Conductor: 20 AWG, solid or stranded copper, or copper plated steel or aluminum.
- 3) Dielectric: Cellular polyethylene.
- 4) Shield Coverage: 95 percent, copper braid.
- 5) Connector Type: BNC or UHF.
- 6) Attenuation:
  - a) Frequency 10 kHz: Maximum 0.20 dB/30.5 M (100 ft.)
  - b) Frequency 100 kHz: Maximum 0.22 dB/30.5 M (100 ft.)
  - c) Frequency 1 MHz: Maximum 0.25 dB/30.5 M (100 ft.)
  - d) Frequency 4.5 MHz: Maximum 0.85 dB/30.5 M (100 ft.)
  - e) Frequency 10 MHz: Maximum 1.40 dB/30.5 M (100 ft.)
  - f) Frequency 100 MHz: Maximum 5.00 dB/30.5 M (100 ft.)

6. RG11 Cable:

- a. Description: RG11 cable CMP Rated.
- b. Attenuation:
  - 1) 0.90 dB/100ft at 50 MHz.
  - 2) 5.04 dB/100ft at 1000 MHz.
  - 3) Impedance: 75 Ohm.

D. Line Splitters:

1. Provide low-radiation line splitters with a flat frequency response from 50 MHz to 1,000 MHz. Provide units of a hybrid design with a 75-ohm match on input and outputs and a VSWR no greater than 1.4:1.
2. Provide two-way line splitters with signal loss of not more than 3.5 dB at each output.
3. Provide four-way line splitters with signal loss of not more than 7.2 dB at each output.
4. Terminate unused splitter outputs with 75-Ohm terminations.

E. RF signal splitters:

1. Frequency Range: 5MHz to 900MHz.
2. Outputs: 2, 3, 4 and 8.
3. Splitter Loss: less than 12 dB.
4. RFI Shielding: 120 dB.

## F. HDTV Outlets:

1. Provide HDTV outlets at each location shown. Install outlets in 10.2 cm (4 inch) square, 5.1 cm (2 inch) deep minimum flush electrical boxes.
2. Incorporate provisions in the network to prevent 60 Hz AC or DC feedback into distribution lines.
3. Outlets:
  - a. Frequency Range: 10 MHz to 900 MHz, minimum
  - b. Insertion Loss: less than 1.0 dB at any frequency within designated frequency range for a 17 dB isolation network.
  - c. Back-matched from 10 to 1,000 MHz.
  - d. One F-type connector on front and two F-type connectors on rear.
  - e. Minimum Isolation Value between any Two Outlets: 24 dB.

## G. Taps:

1. Description: Directional coupler type taps.
2. Rated for installation in TR or accessible area of cable tray.
3. Frequency Range: 5 MHz to 900 MHz.
4. Outputs: 2, 4 and 8.

## H. Wall plates and Bulkhead Connectors:

1. Provide wall plates for termination of CATV signals at television sets.
2. Impedance: 75 Ohms.
3. Frequency Band: SUB/VHF/CATV-HDTV/UHF.

## I. Combiners, Traps, and Filters; and Passive Devices such as Splitters, Couplers, "Patch" Cables, or Devices:

1. Use coaxial cable connections recommended by cable OEM and approved by system OEM for coaxial cable distribution points and RF transmission lines.
  - a. Utilize barrier terminal screw type connectors minimum at base-band cable systems.
  - b. Crimp type connectors installed with a ratchet type installation tool are an acceptable alternative if cable dress, pairs, shielding, grounding, connections and labeling are provided same as barrier terminal strip connectors.
  - c. Tape of any type, wire nuts, or solder type connections are not permitted.
2. Analog RF terminating panels:
  - a. "Patch" Type:

- 1) 48.26 cm (19 inches) EIA/ECA 310-E rack dimensions.
- 2) Minimum 12 double female "F" connector rows.
- 3) Expansion capability of a maximum of 24 double row "F" slots that can be field activated.
- 4) In a lockable cabinet or enclosure. //Stacking of "patch" panels is permitted if installation guidelines are met. //

### 3. "Patch" Cords:

#### a. Analog RF:

- 1) Provide a connection cable for each TCO analog RF connector in system with 10 percent spares. Provide analog RF connection cable of length to connect analog RF instrument to TCO analog RF jack.
- 2) Technical Characteristics:
  - a) Length: Minimum 1.8M (6 ft.).
  - b) Cable: Minimum flexible RG-6.
  - c) Connector: "F" male on each end.

### J. System Connectors:

#### 1. Solderless (Forked Connector):

- a. Crimp-on coupling for quick connect/disconnect of wires or cables.
- b. Designed to fit wire or cable.
- c. Insulated and color-coded connector barrel.
- d. Technical Characteristics:
  - 1) Impedance: As required.
  - 2) Working Voltage: 500 V.

#### 2. Multipin:

- a. Crimp-on coupling for quick connect/disconnect of wires or cables.
- b. Designed to fit wire or cable.
- c. Enclosed and shielded housing.
- d. Secure to cable group by screw type compression sleeves.
- e. Technical Characteristics:
  - 1) Impedance: As required.
  - 2) Working Voltage: 500 V.
  - 3) Number of Pins: As required, Minimum 25 pairs.

#### 3. "F" Type Connectors:

- a. Coaxial cable connectors and connector inserts designed to provide maximum performance with cable to be used.

- b. Hex type crimp or a "Snap and Seal" type connectors. Use Housing to housing (KS to KS) type or 90-degree type connectors where specified by OEM.
  - c. Screw type coupling for quick connect/disconnect of coaxial cable/terminations.
  - d. Crimp-on connector designed to fit coaxial cable with integral 12.7 mm (1/2 inch) ferrule.
  - e. Technical Characteristics:
    - 1) Impedance: 75 Ohms, unbalanced.
    - 2) Working Voltage: 500 V.
  - f. Coaxial cables connected with head end quality 360 degree F or BNC connectors as applicable, meeting or exceeding standard industry and cable manufacture's specifications.
- K. Terminators:
- 1. Coaxial:
    - a. Description: 75-Ohm terminator.
    - b. Metal-housed precision types in frequency ranges selected. Screw-on type that has low VSWR when installed and proper impedance to terminate system unit or coaxial cable.
    - c. Technical Characteristics:
      - 1) Frequency: 0-1 GHz.
      - 2) Power Blocking: As required.
      - 3) Return Loss: 25 dB.
      - 4) Connectors: Minimum "F", "BNC".
      - 5) Impedance: 75 Ohms, unbalanced.
      - 6) DC blocking.
      - 7) Bandwidth: 50 MHz-890 MHz.
- L. Mounting Strips and Blocks:
- 1. Barrier Strips for AC Power, and Control Cable or Wires:
    - a. Accommodate size and type of audio spade (or fork type) lugs used with insulating and separating strips between terminals for securing separate wires in an orderly fashion.
    - b. Provide each cable or wire end with an audio spade lug, connected to individual screw terminal on barrier strip.
    - c. Surface secured to a console, cabinet, rail, panel, etc.
    - d. 120 VAC power wires are not permitted to be connected to signal barrier strips.
  - 2. Technical Characteristics:

- a. Terminal Size: Minimum 6-32.
  - b. Terminal Count: Any combination.
  - c. Wire size: Minimum 20 AWG.
  - d. Voltage Handling: Minimum 100 V.
  - e. Protective Connector Cover: Required for Class II and 120 VAC power connections.
- M. Coaxial Cable Kit: Coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish neat and secure installation.
- 1. Solderless Connectors: Install crimp-on connector using a standard F connector crimping tool.
  - 2. Cables: Connectors designed for specific size cable being used and installed with OEM's approved installation tool. Typical system cable connectors include; but, are not limited to F, N, BNC, etc.
- N. Communication Ground System: provide this system to conform to Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

## **2.5 TOPOLOGY "TREE" OR "BUS"**

- A. //Provide Analog RF coaxial cable distribution system in a "home run" configuration from each associated riser TR to identified locations and as shown on drawings. //
- B. Provide an analog RF coaxial cable trunk system. Provide a minimum of two coaxial cables between head end and each riser patch panel to comprise an individual circuit as designated and as shown on drawings. Provide Additional analog RF coaxial cables as system design dictates and as shown on drawings.
- C. Connect one end of each coaxial RF cable to a female "F" connector at each TCO, and at other locations on drawings, and opposite end to a bottom row "F" connector on patch panel in TR serving the area. Contractor is not to "interconnect" backbone with coaxial RF distribution cables or provide active RF distribution equipment.
- D. Interface analog RF "F", video "BNC", and audio "XL" jacks to appropriate patch panels in associated TR. Do not cross-connect analog cables in TRs to analog equipment.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Coordinate with cabling trade contractor locations of faceplates and faceplate openings for MATV back boxes.

- B. Coordinate with cabling trade contractor locations of MATV equipment in the Telecommunications Rooms.
- C. Before beginning work, verify location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits required for equipment.
  - 2. Emergency and auxiliary AC power generator requirements.
  - 3. Pull boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for systems.
  - 4. System components provided by others.
  - 5. Overhead supports and rigging hardware installed by others.
- D. Immediately notify COR and General Contractor of discrepancies.

### **3.2 INSTALLATION**

- A. General:
  - 1. Install for ease of operation, maintenance, and testing.
  - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice.
  - 3. Install system to prevent direct pickup of signals from building structure and follow FCC requirements regarding low radiation or interference of RF signals.
  - 4. Protect work from dust, paint and moisture as dictated by site conditions.
  - 5. Contractor is responsible for protection of work during construction phase up until final acceptance by Government.
  - 6. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  - 7. Secure equipment firmly in place, including equipment racks, system cables, etc:
    - a. Install supports, mounts, fasteners, attachments and attachment points to support their loads with a safety factor of 5:1 or better.
    - b. Do not impose weight of equipment on supports provided for other trades or systems.
    - c. Suspended equipment or associated hardware must be certified by OEM for overhead suspension.
  - 8. Locate overhead ceiling-mounted equipment as shown on drawings, with minor changes not to exceed 12 inches in any direction.

- a. Mount transformers securely to brackets or enclosures using screws.
  - b. Adjust torsion springs as needed to securely support assembly.
- 9. Install Analog RF coaxial cable distribution systems in a "home run" configuration from each associated riser TR to identified locations and as indicated on drawings.
- 10. Coordinate finishes for any exposed work such as plates, racks, panels, speakers, etc. with design professional, Government and 0050P3B.
- 11. Coordinate cover plates with field conditions. Size and install cover plates to cover spaces between back boxes and surrounding wall.
- 12. Do not allow cable to leave or enter boxes without cover plates installed. Where cover plates are not fitted with connectors, provide grommets in size and quantity required.
- B. Equipment Racks:
  - 1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
  - 2. Provide security covers for devices not requiring routine operator control.
  - 3. Follow manufacturer's recommendations regarding ventilation space between amplifiers. Provide adequate ventilation space between equipment for cooling. Provide vent panels and cooling fans for operation of equipment within OEM specified temperature limits.
  - 4. Provide insulated connections of electrical raceway from equipment racks.
  - 5. Provide continuous raceway and conduit for cable with no more than 40 percent fill between wire troughs and equipment racks. Ensure systems are mechanically separated from each other in wireway.
- C. Wiring Practice:
  - 1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
  - 2. Where raceway is conduit, install wiring of differing classifications in separate conduits. Where raceway is to be in an enclosure (e.g. rack, tray, wire trough, utility box, install wiring of differing classifications, sharing same enclosure, with mechanical partition and separate by at least 4 inches. Where Wiring

of differing classifications must cross, cross wires perpendicular to one another.

3. Do not splice cabling anywhere along entire length of run. Ensure cables are insulated and shielded from each other and from the raceway for entire length of run.
  4. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
  5. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
  6. Use wire pulling lubricants suitable for cable jacket and do not exceed pulling tension recommended by OEM.
  7. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
  8. Do not use tape-based or glue-based cable anchors.
  9. Bond shields and drain wires to ground.
  10. Terminate field wiring entering equipment racks as follows:
    - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops must be of length to allow plates, panels and equipment to be removed for service and inspection.
    - b. Where terminal blocks are not designed for rack mounting, utilize 19 mm (3/4 inch) plywood or 3 mm (1/8 inch) thick aluminum plates/blank panels as a mounting surface. Do not mount on bottom of rack.
    - c. Employ permanent strain relief for any cable with an outside diameter of 25 mm (1 inch) or greater.
  11. Make connections using rosin-core solder or mechanical connectors appropriate to application.
    - a. For crimp-type connections, use only tools that are specified by manufacturer for the application.
    - b. Use only insulated spade lugs on screw terminals sized to fit wire gauge; do not exceed two lugs per terminal.
    - c. Twist-on wire connectors or electrical tape connections are not permitted for any application.
- D. Cable Installation:
1. Support cable on maximum 122 cm (4 feet) centers. Acceptable means of cable support are cable tray and conduit (EMT, Flexible Metallic



- Tubing, and Communications Raceway). Attach cable bundles loosely to cable trays with plenum rated hook and loop straps. Tie wraps are not permitted as a means to bundle.
2. Run cables parallel to walls.
  3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork. Maintain minimum 61 cm (2 feet) clearance from shielded electrical apparatus.
  4. Test cables after the total installation is complete. Test results must document cables pass test requirements and levels. Remedy cabling problems or defects to pass testing, including installation of new cable as required.
  5. Terminate ends of cables on both ends, per industry and OEM's recommendations.
  6. Provide proper temporary protection of cable after pulling is complete and until final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie cables up off of the floor until ready to terminate.
  7. Cover shield/drain wires with heat-shrink tubing extending back to overall jacket. Extend tubing 6 mm (1/4 inch) past end of unused wires, fold back over jacket and secure with cable tie.
  8. For each solder-type connection, cover bare wire and solder connection with heat-shrink tubing.
  9. Terminate conductors; no cable can contain unterminated elements. Make terminations only at outlets and terminals.
  10. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables cannot be spliced.
  11. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
  12. Cold-Weather Installation: Bring cable to room temperature without using heat lamps before de-reeling.
  13. Install cable without passing through structural members or in contact with pipes, ducts, or potentially damaging items.
- E. Labeling:
1. Permanently label outlets, connectors, jacks, electronics and other equipment.

2. Engrave and paint fill patch panel labels using minimum 3 mm (1/8 inch) high lettering and contrasting paint.
  3. For rack-mounted equipment, use engraved Lamacoid labels with white minimum 3 mm (1/8 inch) high lettering on black background. Label front and back of rack-mounted equipment.
  4. Where multiple pieces of equipment reside in same rack group, label each indicating to which room, channel, outlet locations, etc. they correspond.
  5. Permanently label cables at each end, including intra-rack connections. Cover labels by same, transparent heat-shrink tubing covering end of overall jacket. Alternatively, machine printed labels including a clear protective wrap can be used.
  6. Label racks with contractor's name no more than once on each continuous set of racks; do not label wall plates or portable equipment with contractor's name.
  7. Ensure each piece of OEM equipment has permanently attached NRTL Label indicating service the equipment is to perform. Equipment not bearing NRTL marks will not be permitted as part of system.
- F. Protect HDTV //Analog// network devices during unpacking and installation by wearing electrostatic discharge (ESD) wrist straps tied to chassis ground for prevention of electrical shock.
- G. Cutting and Patching:
1. Keep work area clear of debris and clean area daily at completion of work.
  2. Patch and paint any wall or surface that has been disturbed by execution of this work.
  3. Provide any additional cutting, drilling, fitting or patching, not indicated as provided by others, to complete work or to make its parts fit together.
  4. Do not damage or endanger a portion of work of the Government or separate contractors by cutting, patching, excavation or otherwise altering such construction. Prior to cutting or otherwise altering such construction obtain written consent of COR and of such separate contractor. Do not unreasonably withhold from COR or a separate contractor, contractor's consent to cutting or otherwise altering MATV work.
  5. Where coring of in-place concrete is required, // including coring indicated under unit prices, // clearly identify location of such

coring in the field and have location accepted by COR prior to commencement of coring.

H. Fireproofing:

1. Where MATV cables penetrate rated walls, floors and ceilings, fireproof openings to restore rating.
2. Provide conduit sleeves for cables that penetrate rated walls.
3. After cabling installation is complete, install fire proofing material in and around conduit sleeves and openings to restore rating. Install fire proofing material thoroughly and neatly.
4. Seal floor and ceiling penetrations. Use only materials and methods that preserve the integrity of fire stopping system and its rating.

I. Grounding:

1. Ensure lightning protection system is in place per Section 26 41 00, FACILITY LIGHTNING PROTECTION. If not present, contact COR immediately for instructions.
2. Communication Ground: provide this system in accordance with Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS, and:
  - a. Bond cable shields and equipment to ground to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
  - b. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
  - c. Do not connect system ground to building's external lightning protection system.
  - d. Do not "mix grounds" of different systems. Do not use electrical system conductors for ground.

J. Cleaning: Refer to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

### **3.3 FIELD QUALITY CONTROL**

A. Tests:

1. Refer to Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
2. HDTV MATV System is NFPA listed; therefore, testing provisions are the minimum to be performed and provided by contractor and warranted by OEM.

B. Interim Inspection:

1. After completion of 25-30 percent of installation of head end cabinets and equipment, one wing of HDTV MATV outlets and prior to

any further work, this portion of system must be pretested, inspected, and certified.

2. Verify equipment provided adheres to installation requirements of this section.
3. Include a full operational test.
4. Inspection and test must be conducted by a factory-certified contractor representative and witnessed by COR.
5. Conduct an identical inspection between 65 and 75 percent of system construction phase, at direction of COR.
6. Check each item of installed equipment to insure appropriate NRTL label.
7. Confirm marking of cables, faceplates, patch panel connectors and patch cords.
8. Perform inspection tests via continuity measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon test failure.
9. Notify COR, in writing, of estimated date the contractor expects to be ready for interim inspection, at least 20 working days before requested inspection date so interim inspection does not affect system completion date.
10. Provide results of interim inspection to COR. If major or multiple deficiencies are discovered, COR can require a second interim inspection before permitting system installation to continue.
11. Do not proceed with installation until COR determination of additional inspection. In either case, re-inspection of deficiencies noted during interim inspections must be part of proof of performance test.

C. Pretesting:

1. Upon completing installation of system, align, balance, and pretest entire system under full operating conditions.
2. Pretesting Procedure:
  - a. During system pretest verify, utilizing accepted test equipment, system is operational and meets performance requirements.
  - b. Pretest and verify specification requirements are met and system functions are operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling

noise, etc. are present. At a minimum, pretest each of the following locations:

- 1) Antennae.
- 2) Lightning Grounds.
- 3) Head-End.
- 4) Local and Remote Control Units/Enunciation Panels.
- 5) Networked locations.
- 6) System interface locations (i.e. PA, Nurse Call, etc.).
- 7) System trouble reporting.
- 8) UPS operation.
- 9) Primary and emergency AC power requirements.
- 10) Extra auxiliary generator requirements.

c. Provide recorded system pretest measurements and certification that system is ready for formal acceptance test to COR.

D. Acceptance Test:

1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test dates and give COR 30 days written notice prior to date acceptance test is expected to begin. Include expected duration of time for test with notification of acceptance test.
2. Test only in the presence of COR and AHJ (SMCS 0050P2H3).
3. Test utilizing test equipment to certify proof of performance.
4. Verify that total system meets requirements of this specification.

E. Verification Tests:

1. Test copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield. Test cables after termination.
2. Perform same tests appropriate to each coaxial cable accepted for use in system.

F. Performance Testing: Test every video distribution outlet for clear picture and sound.

1. At each outlet with television, select each channel and view picture on television. Observe active channels. Verify picture is clear with no visual presence of interference of any kind and no audible variance in volume level between channels.
2. Perform tests utilizing signal level meter to determine values and record.

- G. Total System Acceptance Test: Perform verification tests for copper cabling systems after complete video distribution system and workstation outlet are installed.
1. Acceptance tests are performed on a "go-no-go" basis.
  2. Only perform operator adjustments required to show proof of performance.
  3. Demonstrate and verify that installed system complies with requirements of specification under operating conditions.
  4. Obtain rating of system as either acceptable or unacceptable from COR at conclusion of test.
  5. Failure of any part of system that precludes completion of system testing, and which cannot be repaired in four hours, is cause for terminating acceptance test of system. Repeated failures that result in a cumulative time of eight hours to affect repairs can cause entire system to be declared unacceptable and require retest of entire system at the convenience of Government.
- H. Acceptance Test Procedure:
1. Physical and Mechanical Inspection:
    - a. Coordinate COR tour of major areas where system and sub-systems are installed to ensure they are operationally ready for proof of performance testing. Provide system inventory including available spare parts for COR to verify and check each item of installed equipment has appropriate NRTL certification labels affixed during tour.
    - b. Formally inventory and review system diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) AutoCAD files, intermediate, and pretest results formally inventoried and reviewed.
    - c. Failure of system to meet installation requirements of this specification is grounds for terminating testing.
  2. Operational Test:
    - a. After physical and mechanical inspection, verify head end terminating and control equipment meets performance requirements outlined herein. Utilize spectrum analyzer and signal level meter to accomplish this requirement.
    - b. Following head end equipment test, connect local // and remote // control unit to the head end equipment's output. Test tap to ensure there are no signal distortions such as intermodulation,

data noise, popping sounds, erratic system functions, on any function.

- c. Check distribution system at each interface, junction, and distribution point, first, middle, and last leg to verify that HDTV MATV video, audio and control signals meet system performance standards.
- d. Functionally test HDTV MATV outlets utilizing contractor's accepted hospital grade TV receiver and spectrum analyzer.
- e. Once these tests have been completed, test each installed subsystem function as a unified, functioning and fully operating system.
- f. Individual Item Test: COR can select individual items of equipment for detailed proof of performance testing until 100 percent of system has been tested and found to meet specification.

I. Acceptable Test Equipment:

- 1. Utilize test equipment with calibration tag of an acceptable calibration service dated not more than 12 months prior to test. Furnish test equipment list that includes make and model number of the following type of equipment as a minimum:
  - a. Spectrum Analyzer.
  - b. Signal Level Meter.
  - c. Volt-Ohm Meter.
  - d. Oscilloscope.
  - e. Pillow Speaker Test Set (Pillow Speaker with appropriate load and cross connections instead of the set is acceptable).

J. Non-Conforming Work:

- 1. Government, OEM and contractor must agree to results of Acceptance Test, create consensus punch lists, and reschedule testing for technical deficiencies and equipment shortages.
- 2. Any retests needed to reach agreement and validate results of punch lists, or to establish compliance with these specifications, are at contractor's expense.
- 3. These requirements must be met for contract compliance and Government acceptance of system.

### 3.4 TRAINING

- A. Provide thorough training of facility's engineering and maintenance staff on operation, performance and preventative maintenance of system.

- B. Schedule training at convenience of facility's Chief Engineer.
- C. MATV system will not be accepted without completion of training.
- D. Provide the following training at locations provided by Government:
  - 1. Minimum eight hours for system operation and performance no less than 48 hours prior to opening of facility.
  - 2. Minimum eight hours for system preventative maintenance no less than 24 hours before opening of facility.

### **3.5 MAINTENANCE**

- A. Accomplish the following minimum requirements during one year warranty period:
  - 1. Response Time:
    - a. Standard work week is 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
    - b. Respond and correct on-site trouble calls, during standard work week:
      - 1) Routine trouble call within one working day. Routine trouble is an inoperable system outlet.
      - 2) Emergency trouble call within six hours. Emergency trouble is an inoperable subsystem or distribution point.
- B. Provide report itemizing each deficiency found and corrective actions performed, to COR, for each trouble call.

- - - E N D - - -



**SECTION 27 51 16**  
**PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION SUMMARY**

- A. Work covered by this document includes design, engineering, labor, material and products, equipment warranty and system warranty, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) - Life Safety Code 101.3-2 (a) Labeled and (b) Listed Emergency Service Public Address System (PAS) and associated equipment (here-in-after referred to as the System) in approved locations indicated on the contract drawings. These items shall be tested and certified capable of receiving, distributing, interconnecting and supporting PAS communications signals generated local and remotely as detailed herein.
- B. Work shall be complete, Occupational Safety and Health Administration (OSHA), National Recognized Testing Laboratory (NRTL - i.e. Underwriters Laboratory [UL]) Listed and Labeled; and VA Central Office (VACO), Telecommunications Voice Engineering (TVE 0050P3B) tested, certified and ready for operation.
- C. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- D. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- E. Specification Order of Precedence: In the event of a conflict between the text of this document and the Project's Contract Drawings outlined and/or cited herein; **THE TEXT OF THIS DOCUMENT TAKES PRECEDENCE.** *HOWEVER, NOTHING IN THIS DOCUMENT WILL SUPERSEDE APPLICABLE EMERGENCY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND/OR LOCAL LIFE AND PUBLIC SAFETY CODES.* The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document's EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing and confirmed by VA's PM, RE and TVE-0050P3B. The VA PM is the only approving authority for other amendments to this document that may be granted, on a case by case basis, in writhing with technical concurrences by VA's RE, TVE-0050P3B and identified Facility Project Personnel.

F. The Original Equipment Manufacturer (OEM) and Contractor shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this specification before the system is designed, engineered, delivered and provided. The Contractor shall furnish a written statement attesting this requirement as a part of the technical submittal that includes each name and certification, including the OEMs.

## 1.2 RELATED SECTIONS

- A. 01 33 23 - Shop Drawings, Product Data and Samples.
- B. 07 84 00 - Firestopping.
- C. 26 05 21 - Low - Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- D. 26 41 00 - Facility Lightning Protection.
- E. 27 05 11 - Requirements for Communications Installations.
- F. 27 05 26 - Grounding and Bonding for Communications Systems.
- G. 27 05 33 - Raceways and Boxes for Communications Systems.
- H. 27 10 00 - Structured Communications Cabling Equipment and Systems.
- I. 27 11 00 - Communications Cabling Interface and Equipment Rooms Fittings.
- J. 27 15 00 - Horizontal and Vertical Communications Cabling Equipment and Systems.
- N. 27 31 31 - Voice Communications Switching and Routing Equipment and System - Extension.
- O. 28 13 16 - Facility Security Management Equipment and System.

## 1.3 DEFINITIONS

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and warranty.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.
- D. Headquarters Technical Review, for National and VA communications and security, codes, frequency licensing, standards, guidelines compliance:  
Office of Telecommunications  
Special Communications Team (0050P2B)

1335 East West Highway - 3rd Floor  
 Silver Spring, Maryland 20910  
 (O) 301-734-0350, (F) 301-734-0360

E. Engineer: FreemanWhite

F. Owner:

G. General Contractor (GC):

H. Contractor: Radio Contractor; successful bidder

#### 1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States Federal Law:

a. Departments of:

1) Commerce, Consolidated Federal Regulations (CFR), Title 15 - Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the:

a) Chapter II, National Institute of Standards Technology (NIST - formerly the National Bureau of Standards). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (Public Law 107-347), NIST develops - Federal Information Processing Standards Publication (FIPS) 140-2-Security Requirements for Cryptographic Modules.

b) Chapter XXIII, National Telecommunications and Information Administration (NTIA - aka 'Red Book') Chapter 7.8 / 9; CFR, Title 47 Federal communications Commission (FCC) Part 15, Radio Frequency Restriction of Use and Compliance in "Safety of Life" Functions & Locations

2) FCC - Communications Act of 1934, as amended, CFR, Title 47 - Telecommunications, in addition to Part 15 - Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/ Locations (also see CFR, Title 15 - Department of Commerce, Chapter XXIII - NTIA):

a) Part 15 - Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/Locations.

- b) Part 58 - Television Broadcast Service.
  - c) Part 90 - Rules and Regulations, Appendix C.
  - d) Form 854 - Antenna Structure Registration.
- 3) Health, (Public Law 96-88), CFR, Title 42, Chapter IV Health & Human Services, CFR, Title 46, Subpart 1395(a)(b) JCAHO "a hospital that meets JCAHO accreditation is deemed to meet the Medicare conditions of Participation by meeting Federal Directives:"
- a) All guidelines for Life, Personal and Public Safety; and, Essential and Emergency Communications.
- 4) Labor, CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standard:
- a) Subpart 7 - Definition and requirements (for a NRTL - 15 c's, for complete list, contact [http://www.osha.gov/dts/otpca/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html)):
- 1) UL:
    - a) 44-02 - Standard for Thermoset-Insulated Wires and Cables.
    - b) 65 - Standard for Wired Cabinets.
    - c) 83-03 - Standard for Thermoplastic-Insulated Wires and Cables.
    - d) 467-01 - Standard for Electrical Grounding and Bonding Equipment
    - e) 468 - Standard for Grounding and Bonding Equipment.
    - f) 486A-01 - Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors
    - g) 486C-02 - Standard for Splicing Wire Connectors.
    - h) 486D-02 - Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
    - i) 486E-00 - Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
    - j) 493-01 - Standard for Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable.
    - k) 514B-02 - Standard for Fittings for Cable and Conduit.
    - l) 1069 - Hospital Signaling and Nurse Call Equipment.

- m) 1333 - Vertical (Riser) Fire Rating.
- n) 1449 - Standard for Transient Voltage Surge Suppressors.
- o) 1479-03 - Standard for Fire Tests of Through-Penetration Fire Stops.
- p) 1863 - Standard for Safety, Communications Circuits Accessories.
- q) 2024 - Standard for Optical Fiber Raceways.
- r) 60950-1/2 - Information Technology Equipment - Safety.
- 2) Canadian Standards Association (CSA): same tests as for UL.
- 3) Communications Certifications Laboratory (CCL): same tests as for UL.
- 4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.
- b) Subpart 35 - Compliance with NFPA 101 - Life Safety Code.
- c) Subpart 36 - Design and construction requirements for exit routes.
- d) Subpart 268 - Telecommunications.
- e) Subpart 305 - Wiring methods, components, and equipment for general use.
- 5) Department of Transportation, CFR, Title 49 (Public Law 89-670), Part 1, Subpart C - Federal Aviation Administration (FAA):
  - a) Standards AC 110/460-ID & AC 707 / 460-2E - Advisory Circulars for Construction of Antenna Towers.
  - b) Forms 7450 and 7460-2 - Antenna Construction Registration.
- 6) Veterans Affairs (Public Law No. 100-527), CFR, Title 38, Volumes I & II:
  - a) Office of Telecommunications:
    - 1) Handbook 6100 - Telecommunications.
      - a) Spectrum Management FCC & NTIA Radio Frequency Compliance and Licensing Program.
      - b) Special Communications Proof of Performance Testing, VACO Compliance and Life Safety Certification(s).
  - b) Office of Cyber and Information Security (OCIS):
    - 1) Handbook 6500 - Information Security Program.

- 2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.
- c) VA's National Center for Patient Safety - Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
- d) VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.
- e) Office of Construction and Facilities Management (CFM):
  - 1) Master Construction Specifications (PG-18-1).
  - 2) Standard Detail and CAD Standards (PG-18-4).
  - 3) Equipment Guide List (PG-18-5).
  - 4) Electrical Design Manual for VA Facilities (PG 18-10), Articles 7 & 8.
  - 5) Minimum Requirements of A/E Submissions (PG 18-15):
    - a) Volume B, Major New Facilities, Major Additions; and Major Renovations, Article VI, Paragraph B.
    - b) Volume C - Minor and NRM Projects, Article III, Paragraph S.
    - c) Volume E - Request for Proposals Design/Build Projects, Article II, Paragraph F.
  - 6) Mission Critical Facilities Design Manual (Final Draft - 2007).
  - 7) Life Safety Protected Design Manual (Final Draft - 2007).
  - 8) Solicitation for Offerors (SFO) for Lease Based Clinics - (05-2009).
- b. Federal Specifications (Fed. Specs.):
  - 1) A-A-59544-00 - Cable and Wire, Electrical (Power, Fixed Installation).
- 2. United States National Codes:
  - a. American Institute of Architects (AIA): Guidelines for Healthcare Facilities.
  - b. American National Standards Institute/Electronic Industries Association/Telecommunications Industry Association (ANSI/EIA/TIA):
    - 1) 568-B - Commercial Building Telecommunications Wiring Standards:

- a) B-1 - General Requirements.
- b) B-2 - Balanced twisted-pair cable systems.
- c) B-3 - Fiber optic cable systems.
- 2) 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
- 3) 606 - Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
- 4) 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.
- 5) REC 127-49 - Power Supplies.
- 6) RS 160-51 - Sound systems.
- 7) RS 270 - Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.
- 8) SE 101-A49 - Amplifier for Sound Equipment
- 9) SE 103-49 - Speakers for Sound Equipment
- c. American Society of Mechanical Engineers (ASME):
  - 1) Standard 17.4 - Guide for Emergency Personnel.
  - 2) Standard 17.5 - Elevator & Escalator Equipment (prohibition of installing non-elevator equipment in Elevator Equipment Room / Mechanical Penthouse).
- d. American Society of Testing Material (ASTM):
  - 1) D2301-04 - Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape.
- e. Building Industries Communications Services Installation (BICSI):
  - 1) All standards for smart building wiring, connections and devices for commercial and medical facilities.
  - 2) Structured Building Cable Topologies.
  - 3) In consort with ANSI/EIA/TIA.
- f. Institute of Electrical and Electronics Engineers (IEEE):
  - 1) SO/TR 21730:2007 - Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
  - 2) 0739-5175/08/@2008 IEEE - Medical Grade - Mission Critical - Wireless Networks.
  - 3) C62.41 - Surge Voltages in Low-Voltage AC Power Circuits.
- g. NFPA:

- 1) 70 - National Electrical Code (current date of issue) - Articles 517, 645 & 800.
  - 2) 75 - Standard for Protection of Electronic Computer Data-Processing Equipment.
  - 3) 77 - Recommended Practice on Static Electricity.
  - 4) 99 - Healthcare Facilities.
  - 5) 101 - Life Safety Code.
  - 6) 1600 - Disaster Management, Chapter 5.9 - Communications and Warning
3. State Hospital Code(s).
  4. Local Town, City and/or County Codes.
  5. Accreditation Organization(s):
    - a. Joint Commission on Accreditation of Hospitals Organization (JCAHO) - Section VI, Part 3a - Operating Features.

#### **1.5 QUALIFICATIONS**

- A. The OEM shall have had experience with three (3) or more installations of systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least one (1) year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.
- D. The Contractor shall display all applicable national, state and local licenses.



- E. The Contractor shall submit copy (s) of Certificate of successful completion of OEM's installation/training school for installing technicians of the System's PA equipment being proposed.

#### **1.6 CODES AND PERMITS**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.
- B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.
- C. The Contractor shall display all applicable national, state and local licenses and permits.

#### **1.7 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

#### **1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS**

(Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining alternate technical approach(s) to the system requirements stated here-in as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein. VA will review and rate each received alternate submittal, which follows this requirement, in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed.)

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and thorough equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-0050P3B) will not review any submittal that does not have this list.
- D. Provide four (4) copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C & D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Provide interconnection methods, conduit (where not already installed), junction boxes (J-Boxes), cable, interface fixtures and equipment lists for the: ENR(s) ( aka DMARC), TER, TCR, MCR, MCOR, PCR, ECR, Stacked Telecommunications Rooms (STR), Nurses Stations (NS), Head End Room (HER), Head End Cabinet (HEC), Head End Interface Cabinet (HEIC) and approved TCO locations Telecommunications Infrastructure Plant (TIP) interface distribution layout drawing, as they are to be installed and interconnected to teach other (REFER TO APPENDIX B - SUGGESTED TELECOMMUNICATIONS ONE LINE TOPOLOGY pull-out drawing).
- F. Headend and each interface distribution cabinet layout drawing, as they are expected to be installed.
- G. Equipment OEM technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- H. Engineering drawings of the System, showing calculated of expected signal levels at the headend input and output, each input and output distribution point, and signal level at each telecommunications outlet.
- I. Surveys Required as a Part of The Technical Submittal:
  - 1. The Contractor shall provide the following System survey(s) that depict various system features and capacities required in addition to the on-site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:

## a. PA Cable System Design Plan:

- 1) An OEM and contractor designed functioning PA System cable plan to populate the entire TIP empty conduit/pathway distribution systems provided as a part of Specification 27 11 00 shall be provided as a part of the technical proposal. A specific functioning PA: cable, interfaces, J-boxes and back boxes shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire PA cable and accessory requirements and engineer a functioning PA distribution system and equipment requirement plan of the following paragraph(s), at a minimum:
- 2) The required PA Equipment Locations:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Master Control Stations		
Telephone Operators Room		
Police Control Room		
Other		
Zone Amplifiers		
All Call (complete Zone 1)		
Admissions (Zone 2)		
Entrance (Zone 2a)		
Pharmacy Dispensing (Zone 2a)		
Agent Cashier (Zone 2a)		
Other (Zone 2a)		
Labs (Zone 3)		
Blood (Zone 3a)		
Dissecting (Zone 3a)		
Other (Zone 3a)		
Clinics (Zone 4)		
Dental (Zone 4a)		
Radiology (Zone 4a)		
Oncology (Zone 4a)		
Other (Zone 4a)		
// _____ (Zone 5)		
_____ (Zone 5a)		
_____ (Zone 5a)		

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Other (Zone 5a)		
Spare (Zones 6, 7 & 8)		
Other (Zone __) //		
Supervisory Panel(s)		
Trouble Panel(s)		
Locations		
Speakers		
Overhead		
Locations		
Other		
Other		
Outside		
Locations		
Other		
Horn		
Locations		
Other		
Power Supply(s)		
Location		
Other		
UPS(s)		
Location		
Other		
Radio Paging Access (when pre-approved by TVE-0050P3B)		
Wireless Access (when pre-approved by TVE-0050P3B)		
Maintenance/Programming Console		
Location(s)		
Other		

3) The required PA Cable Plant/Connections:

The Contractor shall clearly and fully indicate this category for each item identified herein as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Central Control Cabinet/Equipment		
Location		
Power Supply(s)		
UPS(s)		
Essential Electrical Power Panel(s)		
Other		
Cable Plant		
Supply to Locations Identified herein		
Speaker Locations		
Remote Locations		
Telephone Operator Room		
Police Control Room		
Other		
Maintenance/Program Console		
Location(s)		
Other		
LAN (Local Facility) Access/Equipment/Location (when pre-approved by TVE-0050P3B)		
Wireless Access/Equipment/Location (when pre-approved by TVE-0050P3B)		
Other		

#### 1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

- A. Throughout progress of the Work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
  1. All device locations with UL labels affixed.
  2. Conduit locations.
  3. Head-end equipment and specific location.

4. Each interface and equipment specific location.
5. Facility Entrance (aka DEMARC) Room(s) interface equipment and location(s).
6. Telephone Equipment Room (TER) interface equipment and specific location.
7. Main Computer Room (MCR) interface equipment and specific location.
8. Police Control Room (PCR) interface equipment and specific location.
9. Engineering Control Room (ECR) interface equipment and specific location
10. Telecommunication Outlet (TCO) equipment and specific location
11. TIP Wiring diagram(s).
12. Warranty certificate.
13. System test results.
14. System Completion Document(s) or MOU.

#### **1.10 WARRANTIES / GUARANTY**

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of two (2) years from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within four (4) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. The Contractor shall agree to grantee the system according to the guidelines outlined in Article 4 herein.

#### **1.11 USE OF THE SITE**

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

#### **1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

### **1.13 PROJECT CLOSE-OUT**

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
  - 1. Warranty certificate.
  - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
  - 1. Contract Documents have been reviewed.
  - 2. Project has been inspected for compliance with contract.
  - 3. Work has been completed in accordance with the contract.

## **PART 2 - PRODUCTS / FUNCTIONAL REQUIREMENTS**

### **2.0 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS**

- A. Furnish and install a complete and fully functional and operable Nurse Call System for each location shown on the contract drawings and TCOs **WHOSE EMPTY CONDUIT SYSTEM WAS PROVIDED AS A PART OF SPECIFICATION 27 11 00.**
- C. Coordinate features and select interface components to form an integrated PA system. Match components and interconnections between the systems for optimum performance of specified functions.
- D. Expansion Capability: The PA equipment interfaces and cables shall be able to increase number of enunciation points in the future by a minimum of 50 percent (%) above those indicated without adding any internal or external components or main trunk cable conductors.
- E. Equipment: Active electronic type shall use solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied between 110 to 130 VAC, 60 Hz.
- F. Meet all FCC requirements regarding low radiation and/or interference of RF signal(s). The system shall be designed to prevent direct pickup of signals from within and outside the building structure.

- G. Weather/Water Proof Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL - i.e. UL) for duty outdoors or in damp locations.
- H. Deliver a fully functioning and operable PA in the specific locations shown on the drawings.

## 2.1 SYSTEM DESCRIPTION

- A. Furnish and install a complete and fully functional and operable HF Radio System. Provide additional require conduit(s) according to Specification 27 11 00.
- B. The Contractor is responsible for interfacing the **MATV** system with the System and shall be the interface points for connection of the radio interface cabling from the interface unit(s). The interface unit(s) shall be provided by the Contractor.
- C. The Contractor shall continually employ interfacing methods that are approved by the OEM and VA. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection, but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The total PA system shall be configured and installed so that the combination of equipment actually employed does not produce any undesirable visual or aural effects such as signal distortions, noise pulses, glitches, hum, transients, images, etc. The interface points must adhere to all standards described herein for the full separation of Critical Care and Life Safety systems.
- D. It is not acceptable to utilize the telephone cable system for the control of radio signals and equipment. The System Contractor shall connect the Telephone System Remote Control System to the Radio System Paging Control Unit ensuring that all NFPA and UL Critical Care and Life Safety Circuit and System separation guidelines are satisfied. The System Contractor is not allowed to make any connections to the Telephone System. The Owner shall arrange for the interconnection between the PA and Telephone Systems with the appropriate responsible parties.
- E. System hardware shall consist of a **standalone (separate)** PA communications network comprised of amplifiers, mixers, speakers, volume controls, test sets, telephone private branch exchange (PBX) interface equipment, equipment cabinets/racks, wiring and other options such as, sub zoning in addition to "all call" functions, computer interfaces, printer interfaces and wireless network interfaces, (**when**



**specifically approved by 0050P3B and VA Headquarters Spectrum**

**Management 0050P2B - herein after referred to as 0050P2B)** as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.

- F. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two (2) years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved first by 0050P3B).
- G. The PA Head End Equipment shall be located in Telecommunications **PBX/Telephone Room**. The PA shall cover the renovation **areas**. The PA shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PA shall be by zone using the telephone system. **The Nurse Call / Code Blue System may interface the PA system when specifically approved by VA Headquarters 0050P3B during the project approval process prior to contract bidding.**
- H. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Self contained or on board system program memory shall be non-volatile and protected from erasure from power outages for a minimum of 24 hours.
- I. Provide a backup battery or a UPS for the System (including each distribution cabinet/point, CRT, LCD and Monitor) to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of two (2) Hours.
- J. The System is defined as Emergency Service and the Code Blue functions is defined as Life Safety/Support by NFPA (re Part 1.1.A) and so evaluated by JCAHCO. **Therefore, the system shall have a minimum of two (2) additional remote enunciation points in order to satisfy NFPA's Life Safety Code 101 where each enunciation point shall fully function independent of the Facility's PBX.**
  - 1. These two (2) additional remote locations shall be fully manned:
    - a. 24/7/365 for certified Hospital **Clinics**.

- b. As long as other identified VA Medical / Servicing Facilities are open for servicing patients.
- c. The minimum remote enunciation locations shall be:
  - 1) The Telephone / PBX Operator Room.
  - 2) The Police Control / Operations Room.
  - 3) Other location(s) that is specifically approved by VA Headquarters TVE - 0050P3B DURING THE PROJECT DEVELOPMENT STAGES AND PRIOR TO EQUIPMENT PURCHASE.
- d. One (1) global (aka "all call") hard wired zone shall be provided that connects to every system speaker.
- 2. The System shall allow voice pages to be made within a single zone, across programmed multiple zones or a global page (all zones) by using preset codes entered into the keypad of any telephone instrument attached to the PBX.
- K. The System shall interface with the Facility's existing PAS so that a global page (aka "all call" page) is communicated to the existing PAS and the new System of this project. Arrangements for interconnection of the System and the telephone system(s) shall be coordinated with the owner and the PBX provider.
- L. The system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the main supervisory panel, nurse control station and all remote amplifier locations.
- M. When the System is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio raging, wireless systems, etc) the connection point shall be at one location and shall meet the following minimum requirements for each hard wired connection (note each wireless system connection MUST BE APPROVED PRIOR TO CONTRACT BID BY VA HEADQUARTERS 0050P3B AND 0050P2B):
  - 1. UL 60950-1/2.
  - 2. FIPS 142.

3. FCC Part 15 Listed Radio Equipment is not allowed.
- N. All passive distribution equipment shall meet or exceed -80 dB radiation shielding (aka RFI) shielding specifications and be provided with screw type audio connectors.
- O. All equipment face plates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.
- P. All trunk, branch, and interconnecting cables and unused equipment ports or taps shall be terminated with proper terminating resistors designed for RF, audio and digital cable systems without adapters.
- Q. Noise filters and surge protectors shall be provided for each equipment interface cabinet, headend cabinet, control console and local and remote amplifier locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.
- R. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and RF transmission line interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
- S. Audio Level Processing: The control equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each sub-zone in the system and distribute them into the System's RF interfacing distribution trunks and amplification circuits. It is acceptable to use identified Telephone System cable pairs designated for Two-Way Radio interface and control use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor. The use of telephone cable to distribute RF signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce

its designed audio channel capacity at each speaker identified on the contract drawings. The Contractor shall provide: a spare set of telephone paging modules as recommended by the OEM (as a minimum provide one spare module for each installed module); one spare audio power amplifier, one spare audio mixer, one spare audio volume limiter and/or compressor, and one spare audio automatic gain adjusting device, and minimum RF equipment recommended by the OEM.

- T. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

## **2.2 SYSTEM PERFORMANCE:**

- A. At a minimum, each distribution, interconnection, interface, terminating point and TCO shall be capable of supporting the Facility's PA system voice and data service as follows:
1. Shall be compliant with and not degrade the operating parameters of the Public Switched Telephone Network (PSTN) and the Federal Telecommunications System (FTS) at each PSTN and FTS interface, interconnection and terminating locations in the TERS.
  2. Audio Input: The signal level of each audio input channel at each input point shall be a MINIMUM of zero decibels measured (dBm), +0.10 dBm across 150 Ohms, balanced.
  3. Audio Output: The audio signal level at each speaker shall be a MINIMUM of +0.25 Watt (W) and a maximum of +20 W, 600 Ohms balanced impedance, on a 70.7 V audio distribution line Contractor to determine and set each speaker's proper audio signal level (top) based on speaker location and the ambient noise level in speaker coverage area.
  4. The system shall meet the following MINIMUM parameters at each speaker:
    - a. Cross Modulation: -46 dB
    - b. Hum Modulation: -55 dB
    - c. Isolation (outlet-outlet): 24 dB
    - d. Impedance:
      - 1) Distribution: 600 Ohm balanced @ 70.7 V audio line level.
      - 2) Speaker: Selectable, as required.
    - e. Audio Gain: 10 dB minimum @ mid-range measured with a sound pressure level meter (SPL)

- f. Signal to noise (S/N) ratio: 35 dB, minimum
- B. Audio Level Processing: The head-end equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each zone or sub-zone in the system and distribute them into the system's distribution trunks. It is acceptable to use identified telephone system cable pairs designated for PA use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor.
  - 1. THE USE OF TELEPHONE CABLE TO DISTRIBUTE PA SIGNALS CARRYING AC OR DC VOLTAGE IS NOT ACCEPTABLE AND WILL NOT BE APPROVED.
  - 2. Additionally, each remote location shall be provided with the equipment required to ensure the system supervision and designed audio channel capacity at each speaker identified on the contract drawings.

### 2.3 MANUFACTURERS

- A. The products specified shall be new, FCC and UL Listed, labeled and produced by OEM of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
  - 1. Maintains a stock of replacement parts for the item submitted,
  - 2. Maintains engineering drawings, specifications, and operating manuals for the items submitted, and
  - 3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB).
- B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.
- C. Equipment Standards and Testing:
  - 1. The System has been defined herein as connected to systems identified as an Emergency performing Public Safety Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Public and Life Safety Codes

(which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.

2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory (NRTL) where such standards have been established for the supplies, materials or equipment.
3. The provided equipment required by the System design and approved technical submittal must conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards. The placement of the UL Seal shall be a permanent part of the electronic equipment that is not capable of being transportable from one equipment item to another.

## **2.4 PRODUCTS**

### **A. General.**

1. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment.
2. Each cabinet shall be provided with internal and external items to maintain a neat and orderly system of equipment, wire, cable and conduit connections and routing.
3. Contractor Furnished Equipment List (CFEs):
  - a. The Contractor is required to provide a list of the CFE equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.
  - b. The following equipment items are the minimum requirements of VA to provide an acceptable system described herein:

<u>Item</u>		<u>Quantity</u>	<u>Unit</u>
1.	As required	Interface Panel(s)	
1.a	As required	Electrical Supervision	
		Trouble Enunciator	
1.a.1.	As required	Equipment Back Box(s)	
1.a.2.	As required	Telephone Access Equipment	
1.a.3.	As required	Radio Paging Access Equipment	
1.a.3.a.	As required	Radio Pager Equipment	
1.a.4.	As required	Wireless Access Equipment	
1.a.5.	As required	Personal Communicator	
		Equipment	
2.	As required	Lightning Arrestor	
3.	As required	Head End Equipment Locations	
3.a	As required	Cabinet(s)	
3.a.1.	As required	AC Power Conditioner & Filter	
3.a.2.	As required	AC Power Strip	
3.a.3.	As required	UPS	1
3.a.3.a	As required	Main Power Amplifiers	
3.a.3.b	As required	Remote Power Amplifiers	
3.a.3.c	As required	Distributed Amplifiers (When	
		Approved)	
3.a.4.	As required	Interconnecting wire Cable(s)	
3.a.4.a	As required	Wire Cable Connector(s)	
3.a.4.b	As required	Wire Cable Terminator(s)	
3.a.4.c	As required	Wire Management System	
3.b.	As required	Head End Function(s)	
4.	As required	Distribution System(s)	
4.a	As required	Equipment Back Box(s)	
4.a.1.	As required	Speakers	
4.a.1.a	As required	Overhead	
4.a.1.b		Horn	0
4.a.1.c		Outside	0
4.a.1.d	Speaker w Microphone	0	
5.	2 (MIN)	Remote Station(s)	
5.a.	As required	Spare Items	
6.	As required	Mental Health Unit	
6.a.	As required	Interface Panel(s)	
6.b.	As required	Electrical Supervision	
		Trouble Enunciator	
6.c.	As required	Equipment Back Box(s)	
6.d.	As required	Telephone Access Equipment	
6.e.	As required	Radio Paging Access Equipment	
6.e.1.	As required	Radio Pager Equipment	
6.f.	As required	Wireless Access Equipment	
6.g.	As required	Personal Communicator	
		Equipment	
6.h.	As required	Lightning Arrestor	
6.i.	As required	Head End Equipment	
		Location(s)	
6.i.1.	As required	Cabinets	
6.i.2.	As required	AC Power Conditioner & Filter	
6.i.3.	As required	AC Power Strip	
6.i.4.	As required	UPS	
6.i.5.	As required	Main Power Amplifiers	
6.j.	As required	Remote Power Amplifiers	
6.k.	As required	Distributed Amplifiers (When	

6.1.	As required	Approved)
6.1.1.	As required	Interconnecting Wire Cable(s)
6.1.2.	As required	Wire Cable Connector(s)
6.1.3.	As required	Wire Cable Terminator(s)
6.m.	As required	Wire Management System
6.n.	As required	Head End Function(s)
6.n.1	As required	Distribution System(s)
6.n.2	As required	Equipment Back Box(S)
6.n.2(a)	As required	Speakers
6.n.2(b)	As required	Overhead
6.n.2(c)		Horn
6.n.2(d)		Outside 0
6.o	2 (MIN)	Speaker w Microphone 0
6.p.	As required	Remote Station(s)
7.a	As required	Spare Items
7.b	As required	Interface Panel(s)
		Electrical Supervision
		Trouble Enunciator
7.c	As required	Equipment Back Box(s)
7.d.	As required	Telephone Access Equipment
7.e.	As required	Radio Paging Access Equipment
7.e.1.	As required	Radio Pager Equipment
7.f.	As required	Wireless Access Equipment
7.g.	As required	Personal. Communicator
		Equipment
7.h.	As required	Lightning Arrestor
7.i.	As required	Head End Equipment
		Location(s)
7.i.1.	As required	Cabinets
7.i.2.	As required	AC Power Conditioner & Filter
7.i.3.	As required	AC Power Strip
7.i.4.	As required	UPS
7.i.5.	As required	Main Power Amplifiers
7.j.	As required	Remote Power Amplifiers
7.k.	As required	Distributed Amplifiers (When
		Approved)
7.l.	As required	Interconnecting Wire Cable(s)
7.l.1.	As required	Wire Cable Connector(s)
7.l.2.	As required	Wire Cable Terminator(s)
7.l.3.	As required	Wire Management System
7.k.	As required	Head End Function(s)
7.m.	As required	Distribution System(s)
7.m.1.	As required	Equipment Back Box(s)
7.m.2.	As required	Speakers
7.m.2(a)	As required	Overhead
7.m.2(b)		Horn 0
7.m.2(c)		Outside 0
7.m.2(d)		Speaker w Microphone 0
7.n.	2 (MIN)	Remote Station(s)
7.o.	As required	Spare Items

B. ENT (aka DEMARC) Room(s):

Refer to CFM Physical Security Manual (07-2007) for VA Facilities,  
 Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 &



Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

C. TER, TCR, TR, SCC, PCR, STR, HER Rooms and Equipment:

Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

1. Interface Equipment:

a. TER:

1) Paging adaptor:

a) The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility's telephone system with the Facility Telephone Contractor or local telephone company.

b) The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by dialing a telephone number provided by the Facility's Telephone Contractor.

The Paging Adapter shall:

- 1) Monitor each audio input and output on the unit.
- 2) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
- 3) Be provided as part of the head end equipment and shall be located in the Telephone Switch Room
- 4) Be provided with Executive (aka emergency) Paging Override of all routine paging calls in progress or being accessed to allow system "all call" (aka global) and radio paging calls designated as (Code One Blue) functions.
- 5) Be capable of internal time out capability.
- 6) Function completely with the interface module.
- 7) Provide one spare adapter.

c) Time Out Device: A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to two (2) minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.

- 1) Central Processor Module:
- 2) Controls system operations and holds all programmed parameters.
- 3) Data link connection to additional CPU modules.
- d) Power Module: Provides 12V DC @ 800mA to Central Processor Module.
- e) Minimum three (3) Zone Module:
  - 1) Provides a minimum of three (3) paging zone outputs at 70V audio sound level.
  - 2) Background Music inhibit switch for each zone.
- 2) Audio Monitor Panel:
  - a) The panel shall be EIA/TIA standard for 483 mm (19") cabinet mounting.
  - b) It shall be provided in the upper portion of the head-end equipment cabinet.
  - c) Provide one (1) spare panel.
- 3) Trouble Annunciator Panel:
  - a) A trouble annunciator panel shall be provided in the head-end cabinet, and at locations as designated on the contract drawings. The panel(s) shall be compatible with or generate electrical and/or electronic supervising signals to continuously monitor the operating condition for the System head-end audio power amplifier(s), remote power amplifier(s), microphone consoles and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects an amplifier or trunk-line is malfunctioning.
  - b) Provide one (1) spare panel.
- 4) Head-End Equipment
  - a) Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed herein. Head-end components may be rack mounted or wall mounted in a metal enclosure.
  - b) Provide the head end equipment in the closed telecommunications closet where the PA system is installed to include the minimum equipment listed herein.

- c) Provide minimum of 30 minute battery back-up to system components.
- 5) Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions
  - a) Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet):
  - b) 74" (48RU) rack space, Welded Steel construction, Minimum 20" usable depth, Adjustable front mounting rails.
    - 1) Install the following products in rack provided by same manufacturer or as specified:
    - 2) Security screws w/ nylon isolation bushings.
    - 3) Textured blank panels.
    - 4) Custom mounts for components without rack mount kits.
    - 5) Security covers.
    - 6) Copper Bus Bar.
    - 7) Power Sequencer rack mounted power conditioner and (provide as needed) delayed sequencer(s) with two (2) inswitched outlets each and contact closure control inputs.
    - 8) Rack mounting: Provide rack mount kit.
- 6) Amplifier Equipment:
  - a) Paging (aka zone):
    - 1) Inputs for 600-ohm balanced telephone line, LO-Z balanced microphone, and background music.
    - 2) Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations speaker microphones, or handset transmitters
    - 3) Automatic Level Control (ALC) for pages, adjustable background music muting level during page, wall or rack mountable.
    - 4) 16-ohm, 25V, 25V center tapped (CT), and 70V outputs. Amplifier quantity and size (output power) as needed.

Continuous amplifier power rating shall exceed  
loudspeaker load on amplifier by at least 25%.

- 5) Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
- 6) Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- 7) Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
- 8) Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
- b) Output Regulation: Maintains output level within 2 dB from full to no load.
- c) Amplifier Protection: Prevents damage from shorted or open output.
- d) Be provided with electronic supervision function(s).
- e) Provide one spare amplifier.

b. TCR:

1) Microphone Paging Console:

- a) A console shall be provided in the TCR and PCR's.
- b) The console shall contain visual enunciators for each connection to the telephone system's Public Address Paging Adapter. The visual enunciators shall display all the System connections to the telephone system being used.
- c) The console shall be fully independent of the Facility's telephone system so if the telephone system has a catastrophic failure (aka partial, multiple or total system failure) the microphone console will function normally as if the Facility's telephone system was operating normally. The restoration of the Facility's telephone system shall not affect the System.
- d) Each microphone console shall:
  - 1) Be Mounted: Flush unless otherwise indicated, and suitable for mounting conditions indicated.
  - 2) Have a Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.

- 3) Have a system interface Back Box: Minimum Two-gang galvanized steel with 2-1/2 inch minimum depth.
  - 4) Have an Internal Speaker: 3 inches, 2.3 oz. minimum; permanent magnet.
  - 5) Have a Call Switch: Mount on faceplate. Permits calls to The system.
  - 6) When approved - in lieu of a standalone microphone, provide a Handset with Hook Switch: Have a Handset with Hook Switch: Telephone type with 24-inch-long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.
  - 7) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms to the Nurse Call /Code Blue electrical supervision system.
  - 8) Be capable of internal time out capability.
  - 0) Be completely compatible with the Telephone Interface unit(s)
- 2) Electrical Supervision Trouble Annunciator Panel:
- a) The Electrical Supervision Trouble Annunciation Panel shall be located in the TCR and PCR's SCC.
  - b) The panel(s) shall be compatible with the generated electrical and/or electronic supervising signals to continuously monitor the operating condition for the PA system head-end processing equipment, local/remote control consoles, audio power amplifier(s), UPS, power supplies, dome lights and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects a system trouble or trunk-line is malfunctioning.
  - c) TRs: Locate the PA floor distribution equipment within each TR as required by system design and OEM direction. Provide secured and lockable cabinet/rack(s) as required.
- 1) General Equipment: Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed herein. Equipment components may be rack mounted or wall mounted in a metal enclosure.
- 2) Amplifiers:

- a) Panging Amplifier Equipment:
- b) Refer to the Amplifier characteristics described herein Paragraph 2.4.G.f.
- c) Provide one (1) spare amplifier in addition to the spare Head End Amplifier.
- 3) Distributed Amplifier:
  - a) Provide the type and number of the amplifier(S) required to meet the system design. Provide this unit as complete and separate technical submittal during the IFB review portion of the project.
  - b) Provide one spare amplifier for each 20% (or portion thereof) of amplifiers used in the system.
- 4) Provide the equipment in the nearest TER where the System is installed to include the minimum equipment listed herein.
- 5) Provide minimum of 30 minute battery (UPS) back-up to system components.
- 6) Equipment Cabinet: Comply with cabinet requirements as aforementioned.
- 7) Trouble Annunciator Panel: Comply with the panel characteristics identified herein.
- d. SCC, PCR, STR, HER: Refer to PG-18-10, Article 7 for specific required equipment and use minimum aforementioned specifications for population.

D. TIP DISTRIBUTION SYSTEM:

1. System Speakers:

- a. Ceiling Cone-Type:
  - 1) Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
  - 2) Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
  - 3) Minimum Dispersion Angle: 100 degrees.
  - 4) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
  - 5) Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.

- 6) Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.
  - 7) Vandal-Proof, High-Strength Baffle: For flush-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.
  - 8) Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
  - 9) Have a minimum of two (2) safety wires installed to a solid surface or use a flexible conduit from ceiling / wall back box to the speaker back box.
  - 10) The speakers and mounting shall be self contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the RE) the color of the adjacent surfaces.
  - 11) Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.
- b. Wall Mounted Horn-Type:
- 1) Each horn speaker shall be provided with a means of adjusting the output level over the rated horn speaker range to an appropriate audio level in the area installed.
  - 2) Provide horn speakers in equipment rooms, mechanical room, supply warehouse areas, loading dock, entrance and exit areas, and at other areas as indicated on the drawings.
  - 3) Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.
  - 4) Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
  - 5) Minimum Power Rating of Driver: 15 W, continuous.
  - 6) Minimum Dispersion Angle: 110 degrees.
  - 7) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
  - 8) Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.
- c. System Cables: In addition to the TIP provided under Specification Section 27 15 00 - TIP Horizontal and Vertical

Communications Cabling, provide the following additional TIP installation and testing requirements, provide the following minimum System TIP cables & interconnections:

1) Line Level Audio and Microphone Cable:

- a) Line level audio and microphone cable for inside racks and conduit.
- b) Shielded, twisted pair Minimum 22 American Wire Gauge (AWG), stranded conductors and 24 AWG drain wire with overall jacket.

2) Speaker Level (Audio 70.7Volt [V]) Cable, Riser Rated:

- a) For use with 70.7 V audio speaker circuits.
- b) 18 AWG stranded pair, minimum.
- c) UL-1333 listed.

3) Speaker Level Audio Cable, Plenum Rated (70.7V):

- a) For use with 70.7 V audio speaker circuits.
- b) 18 AWG stranded pair, minimum.

4) All cabling shall be riser **//plenum//** rated.

5) Provide one (1) spare 1,000 foot roll of approved System (not microphone) cable only.

2. Raceways, Back Boxes and conduit:

a. Raceways:

- 1) In addition to the Raceways, Equipment Room Fittings provided under Specification Sections 27 15 00 TIP Communication Room Fittings and 27 15 00 - TIP Communications Horizontal and Vertical Cabling, provide the following additional TIP raceway and fittings:
- 2) Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 & 800 to "mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
- 3) Intercommunication System cable infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.
- 4) Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.



- 5) Flexible metal conduit is prohibited unless specifically approved by 0050P3B.

b. System Conduit:

- 1) The PA system is NFPA listed as Emergency / Public Safety Communication System which requires the entire system to be installed in a separate conduit system.
- 2) The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (0050P3B).

3) Conduit Sleeves:

- a) The AE has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.
- b) While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.

3. Device Back Boxes:

- a. Furnish to the electrical contractor all back boxes required for the PA system devices.
- b. The electrical contractor shall install the back boxes as well as the system conduit. Coordinate the delivery of the back boxes with the construction schedule.

4. Telecommunication Outlets (TCO): Populate each TCO that is required to perform system operations in the locations that were provided and cabled as a part of Specifications Sections 27 11 00 and 27 15 00. Provide additional TCO equipment, interfaces and connections as required by System design. Provide secured pathway(s) and TCOs as required.

5. UPS:

- a. Provide a backup battery or a UPS for the System to allow normal operation and function (as if there was no AC power failure) in

the event of an AC power failure or during input power fluctuations for a minimum of four (4) hours.

- b. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the headend location, as long as this function is specifically approved by the Telephone Contractor and the RE.
- c. The PA Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the RE.
- d. Provide UPS for all active system components including but not limited to:
  - 1) System Amplifiers.
  - 2) Microphone Consoles.
  - 3) Telephone Interface Units.
  - 4) TER, TR & Headend Equipment Rack(s).

F. Installation Kit:

- 1. General: The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial, fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:
  - 2. System Grounding:
    - a. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
    - b. This includes, but is not limited to:
      - 1) Coaxial Cable Shields.
      - 2) Control Cable Shields.
      - 3) Data Cable Shields.
      - 4) Equipment Racks.

- 5) Equipment Cabinets.
  - 6) Conduits.
  - 7) Duct.
  - 8) Cable Trays.
  - 9) Power Panels.
  - 10) Connector Panels.
  - 11) Grounding Blocks.
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
  4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
  5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
  6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
  7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.
  8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.
- G. MENTAL HEALTH (aka PSYCHIATRIC) UNIT - when a Mental Health Unit is to be provided as a part of the project, contact TVE 0050P3B for specific system requirements.

## **PART 3 - EXECUTION**

### **3.1 PROJECT MANAGEMENT**

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (0050P3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

### **3.2 COORDINATION WITH OTHER TRADES**

- A. Coordinate with the cabling contractor the location of the PA system faceplate and the faceplate opening for the PA system back boxes.
- B. Coordinate with the cabling contractor the location of TIP equipment in the **TER, TCR, PA, PCR, SCC, ECR, STRs, NSS, HER and TCOs in order to connect to the TIP cable network that was installed as a part of Section Specification 27 11 00. Contact the RE immediately, in writing, if additional location(s) are discovered to be activated that was not previously provided.**
- C. Before beginning work, verify the location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits provided for systems.
  - 2. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
  - 3. System components installed by others.
  - 4. Overhead supports and rigging hardware installed by others.
- D. Immediately notify the Owner, GC and Consultant(s) in writing of any discrepancies

### **3.3 NEEDS ASSESSMENT**

Provide a one-on-one meeting with the particular manager of each unit affected by the installation of the new PA system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns;

and other pertinent details that will affect system programming and training.

### **3.4 INSTALLATION**

#### **A. General**

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.
  - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
  - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
  - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
  - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction.
  - a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
  - b. Speaker back boxes shall be completely filled with fiberglass insulation.
  - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.

7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
  8. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone and data equipment, systems, and service.
  9. Color code all distribution wiring to conform to the PA Industry Standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
  10. Connect the System's primary input AC power to the Facility's Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
  11. Product Delivery, Storage and Handling:
    - a. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
    - b. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.
  12. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
  13. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
- B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
  2. Provide security covers for all devices not requiring routine operator control.

3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway/conduit with no more than 40% fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
6. Ensure a minimum of 36 inches around each cabinet and/or rack to comply with OSHA Safety Standards. Cabinets and/or Racks installed side by side - the 36" rule applies to around the entire assembly

C. Distribution Frames.

1. A new stand-alone (i.e., self supporting, free standing) PA rack/frame may be provided in each TR to interconnect the PA, TER, TCR, PCR, SCC, STRs & ECRs. Rack/frames shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The PA riser cable shall be sized to satisfy all voice/digital requirements plus not less than 50% spare (growth) capacity in each TR which includes a fiber optic backbone.
2. The frames/racks shall be connected to the TER/MCR system ground.

D. Wiring Practice - in addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 - TIP Structured Communications Cabling, 27 11 00 - TIP Communications Rooms Fittings and 27 15 00 - TIP Horizontal and Vertical Communicators Cabling, the following additional practices shall be adhered too:

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
  - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
  - b. 70V audio speaker level audio.

- c. Low voltage DC control or power (less than 48VDC)
- 4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four (4) inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
- 5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
- 6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
- 7. Replace the entire length of the run of any wire or cable that is damaged or abraided during installation. There are no acceptable methods of repairing damaged or abraided wiring.
- 8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
- 9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
- 10. Do not use tape-based or glue-based cable anchors.
- 11. Ground shields and drain wires to the Facility's signal ground system as indicated by the drawings.
- 12. Field wiring entering equipment racks shall be terminated as follows:
  - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
  - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15% spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
  - c. If specified terminal blocks are not designed for rack mounting, utilize  $\frac{3}{4}$ " plywood or  $\frac{1}{8}$ " thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
  - d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.



13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:
- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
  - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
15. Make all connections as follows:
- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
  - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
  - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
16. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
17. Wires or cables **previously approved** to be installed outside of conduit, cable trays, wireways, cable duct, etc:
- a. Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
  - b. Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
  - c. Closer wire or cable fastening intervals may be required to prevent sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage

tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.

- d. Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
  - e. Completely test all of the cables after installation and replace any defective cables.
  - f. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.
- E. Cable Installation - In addition to the **MANDATORY** infrastructure requirements outlined in VA Construction Specifications 27 10 00 - Structured TIP Communications Cabling, 27 11 00 - TIP Communications Rooms and Fittings and 27 15 00 - TIP Communications Horizontal and Vertical Cabling and the following additional practices shall be adhered too:
- 1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
  - 2. Run cables parallel to walls.
  - 3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
  - 4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.

5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
9. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
12. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
13. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
14. Serve all cables as follows:
  - a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2" (minimum) past the Heatshrink and serve as indicated below.

- b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼" past the end of unused wires, fold back over jacket and secure with cable tie.
  - c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
- F. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for PA circuits shall be stenciled using laser printers.
  - 1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams."
  - 2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
    - a. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
    - b. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
    - c. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
  - 3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
  - 4. Termination Hardware: The Contractor shall label TCOs and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams."
  - 5. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
  - 6. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively,

- computer generated labels of the type which include a clear protective wrap may be used.
7. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
  8. Ensure each OEM supplied item of equipment has appropriate UL Labels / Marks for the service the equipment is performed permanently attached / marked. SYSTEM EQUIPMENT INSTALLED NOT BEARING THESE UL MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.
- G. Conduit and Signal Ducts: When the Contractor and/or OEM determines additional system conduits and/or signal ducts are required in order to meet the system minimum performance standards outlined herein, the contractor shall provide these items as follows:
1. Conduit:
    - a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed.
    - b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow PA cables to be installed in partitioned cable tray with voice cables may be granted in writing by the RE if requested). Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.
    - c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
    - d. When "interduct" flexible cable protective systems is specifically authorized to be provided for use in the System,

it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.

- e. Conduit fill (including GFE approved to be used in the system) shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.
  - f. Ensure that Critical Care PA System (as identified by NEC Section 517) is completely separated and protected from all other systems.
2. Signal Duct, Cable Duct, or Cable Tray:
- a. The Contractor shall use GFE signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
  - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
  - c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.
  - d. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible

### **3.5 PROTECTION OF NETWORK DEVICES**

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

**3.6 CUTTING, CLEANING AND PATCHING**

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

**3.7 FIREPROOFING**

- A. Where PA wires, cables and conduit penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls and Telecommunications Rooms floors and ceilings. After the cabling installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.
- D. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.

- E. Use approved fireproofing tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
- F. Secure the tape in place by a random wrap of glass cloth tape.

### **3.8 GROUNDING**

- A. Ground PA cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode returns, noise pickup, cross talk, and other impairments as specified in CFM Division 27, Section 27 05 26 - Grounding and Bonding for Communications Systems.
- B. Facility Signal Ground Terminal: Locate at main room or area signal ground within the room (i.e. head end and telecommunications rooms) or area(s) and indicate each signal ground location on the drawings.
- C. Extend the signal ground to inside each equipment cabinet and/or rack. Ensure each cabinet and/or rack installed item of equipment is connected to the extended signal ground. Isolate the signal ground from power and major equipment grounding systems.
- D. When required, install grounding electrodes as specified in CFM Division 26, Section 26 05 26 -Grounding and Bonding for Electrical Systems.
- E. Do not use "3<sup>rd</sup> or 4<sup>th</sup>" wire internal electrical system conductors for communications signal ground.
- F. Do not connect the signal ground to the building's external lightning protection system.
- G. Do Not "mix grounds" of different systems.
- H. Ensure grounds of different systems are installed as to not violate OSHA Safety and NEC installation requirements for protection of personnel.

## **PART 4 - TESTING / GUARANTY / TRAINING**

### **4.0 SYSTEM LISTING**

The PA System is NFPA listed as an "Emergency / Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support/Safety." Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and OEM.

### **4.1 PROOF OF PERFORMANCE TESTING**

- A. Intermediate Testing:



1. After completion of 25 - 30% the installation of a head end cabinet(s) and equipment, one microphone console, local and remote enunciation stations, two (2) zones, two (2) sub zones prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL Listing and Certification Labels are affixed as required by NFPA -Life Safety Code 101-3.2 (a) & (b) and JCHCO evaluation guidelines, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. All inspections and tests shall be conducted by an OEM-certified contractor representative and witnessed by TVE-0050P3B if there is no local Government Representative that processes OEM and VA approved Credentials to inspect and certify the system. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the RE, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75% of the system construction phase, at the direction of the RE.

B. Pretesting:

1. Upon completing installation of the PA System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
  - a. During the System Pretest the Contractor shall verify (utilizing approved test equipment) that the System is fully operational and meets all the System performance requirements of this standard.
  - b. The Contractor shall pretest and verify that all PA System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
    - 1) Central Control Cabinets.
    - 2) Local Control Stations.
    - 3) Zone Equipment/Systems.
    - 4) Sub-Zone Equipment/Systems.

- 5) Remote Control Panels.
    - a.)TCR.
    - b.)PCR/SCC.
  - 6) All Networked locations.
  - 7) System interface locations (i.e. TELCO, two way radio, etc.).
  - 8) System trouble reporting.
  - 9) System Electrical Supervision.
  - 10)UPS operation.
  - 11)STRs.
  - 12)NSs
  - 13)TCOs.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test:

- 1. After the PA System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 day's written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of TVE 0050P3B and an OEM certified representatives. The System shall be tested utilizing the approved test equipment to certify proof of performance and Emergency / Public Safety compliance. The tests shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
- 2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared

unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.

3. Retesting of the entire System shall be rescheduled at the convenience of the Government and costs borne by the Contractor at the direction of the SRE.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The TVE 0050P3B Representative will tour all areas where the PA system and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, TIP Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the system head end equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Following the head end equipment test, each speaker (or on board speaker) shall be inspected to ensure there are no signal distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.
- c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last speaker in each leg to verify the PA distribution system meets all system performance standards.
- d. If the RED system is a part of the system, each volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the RED system (if installed).
- e. Additionally, each installed head end equipment, microphone console; amplifier, mixer, distributed speaker/amplifier, monitor

speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.

- f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: "all call," three sub-zoned, minimum of 15 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.
- h. Individual Item Test: The TVE 0050P3B Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

### 3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
- b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.

E. Acceptable Test Equipment: The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:

- 1. Spectrum Analyzer.
- 2. Signal Level Meter.
- 3. Volt-Ohm Meter.
- 4. Sound Pressure Level (SPL) Meter.
- 5. Oscilloscope.
- 6. Random Noise Generator.
- 7. Audio Amplifier with External Speaker.

## 4.2 WARRANTY

- A. Comply with FAR 52.246-21, except that warranty shall be as follows:
- B. Contractor's Responsibility:

1. The Contractor shall warranty that all provided material and equipment will be free from defects, workmanship and will remain so for a period of two (2) years from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
  - a. Response Time During the **Two Year** Guaranty Period:
    - 1) The RE (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's ONLY OFFICIAL reporting and contact official for nurse call system trouble calls, during the guaranty period.
    - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the RE (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
    - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
      - a) A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a power supply; one (1) master System control station, microphone console or amplifier to be inoperable.
      - b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call.

The RE (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.

- c) An emergency trouble call within four (4) hours of its report. An emergency trouble is considered a trouble which causes a sub-zone, zone, distribution point, terminal cabinet, or all call system to be inoperable at anytime.
- 4) If a PA System component failure cannot be corrected within four (4) hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate System equipment. The alternate equipment/system shall be operational within a maximum of 12 hours after the four (4) hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.
- b. Required On-Site Visits During the Two Year Guaranty Period
  - 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.
  - 2) The Contractor shall arrange all Facility visits with the RE (or Facility Contracting Officer) prior to performing the required maintenance visits.
  - 3) Preventive maintenance procedure(s) shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the RE (or Facility Contracting Officer) and Contractor.
  - 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE (or Facility Contracting Officer).
  - 5) The Contractor shall provide the RE (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall

provide the RE with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:

- a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to RE (or Facility Contracting Officer) by the fifth (5<sup>th</sup>) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.
  - b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the System. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.
- 6) The RE (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
- a) The RE (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the System's official acquisition documents.
  - b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.
- C. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render an official opinion in writing concerning the supplied information.

#### **4.3 TRAINING**

- B. Provide the following minimum training times and durations:

1. 24 hours prior to opening for BME / Electronic Staff (in 8-hour increments) - split evenly over 3 weeks and day and night shifts. Coordinate schedule with Owner.
3. 8 hours for supervisors and system administrators.

- - - E N D - - -



**SECTION 27 51 23**  
**INTERCOMMUNICATIONS AND PROGRAM SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies a new and fully operating Intercom (IC) System.
- B. Conform to VAAR 852.236.91 and intent of the construction documents, recognizing that it may be impracticable to detail all items because of variances in manufacturers to achieve indicated intent.

**1.2 RELATED WORK**

- A. Connection to Electronic Access Control at doors: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.
- B. Door hardware and operation of doors: 08 71 00 DOOR HARDWARE
- C. Conduit and boxes: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Electrical conductors and cables: Section 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING.
- E. Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- F. When interfaced for Security Emergency Communications: Section 28 52 31, EMERGENCY CALL SYSTEM.
- G. Requirements for interfacing with Facility's SMS: Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

**1.3 SUBMITTALS**

- A. In addition to requirements of SECTION 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, submit:
  - 1. Written certification from OEM proposed provider of contract maintenance is an authorized representative of OEM. Include provider's legal name, address, and OEM credentials.
  - 2. Submit names, locations and point of contact for three installations employing proposed OEM IC Systems of comparable size and complexity performing for at least one year after final acceptance by user.
- B. Certifications:
  - 1. Submit documentation that supplier has been an authorized distributor and service organization for OEM for a minimum of three years and is authorized by OEM to pass thru OEM's warranty of installed equipment to Government.

2. Submit certificate of successful completion of OEM's installation and training program for each installing technician of equipment being proposed. Provide current OEM certifications for installers to be approved by COR before being allowed to commence work on system.
  3. Provide current OEM certification documenting maintenance and supervisory personnel are authorized by OEM to service installed equipment during warranty.
  4. Furnish copies of applicable national, state and local licenses.
- C. Warranty: Submit OEM warranty.
- D. Needs Assessment Report: Provide a summary report of the needs assessment meeting conducted with nursing manager of each unit, as required by this section.
- E. Maintenance Material Submission:
1. Provide one spare 304 m (1,000 foot) roll of accepted system (not microphone) cable.

#### **1.4 QUALITY ASSURANCE**

- A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation and testing of system.
- B. Provide system firmware from OEM with a proven history of product reliability and sole control over all source code.

#### **1.5 WARRANTY**

- A. Comply with FAR clause 52.246-21, except that warranty must be as follows:
  1. Manufacturer shall warranty their equipment and certified installation for a minimum of two years from date of installation and final acceptance by the Government.
  2. Provide, free of charge, product firmware and software upgrades for a period of one year from date of final acceptance by Government for any product feature enhancements.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Provide voice communication between wall-mounted intercom stations and desk or wall-mounted master stations.
- B. Provide accessories and miscellaneous appurtenances required for a complete and operating communications system and network.
- C. Coordinate features and select components to form an integrated IC system. Match components and interconnections for optimum performance of specified functions.

- D. Expansion Capability: Increase number of Room Speaker-Microphone stations in future by 25 percent above those indicated without adding any internal or external components or trunk cable conductors.
- E. Equipment: Modular type, continuous duty rated.
- F. Weather-Resistant Equipment: Listed by a National Recognized Testing Laboratory (NRTL) for operation in wet, damp or outdoor locations.
- G. Install IC head end equipment in Fire Alarm room and connect rooms shown on drawings. Provide zoned, one-way voice paging through distributed, wall-mounted units. Interconnect so voice input into IC is by zone from main building console.

## **2.2 PERFORMANCE CRITERIA**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, the minimum requirements for each system are:
  - 1. Wired IC systems approved to connect to separate communications system (i.e. SMS, WAN, LAN includes: Telephone, Nurse Call, radio paging, wireless systems) minimum requirements:
    - a. NIST FIPS Pub 140/2.
    - b. UL 60950-1, edition 2.
  - 2. IEC 62368-1 ed 2: 2014.
  - 3. Code of Federal Regulations, Title 47, Part 15 (or FCC Part 15) Listed Radio Equipment is not permitted.
- B. Provide system with configuration programming capable of being executed remotely via a remote connection (when specifically accepted by Spectrum Management and COMSEC Services (SMCS 0050P2H3) without any exchange of parts.

## **2.3 EQUIPMENT ITEMS**

- A. Manually Switched System:
  - 1. Master Station Features:
    - a. Communicate selectively with all other master and speaker-microphone stations by actuation of selector switches.
    - b. Communicate simultaneously with other stations by actuation of a single all-call switch.
    - c. Communicate with individual stations in privacy.
    - d. Include other master-station connections in a multiple-station conference call.
    - e. Override any conversation by a designated master station.
  - 2. Room Speaker-Microphone Station Features:

- a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
- b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
- c. Communicate hands free.
- d. Call master station by actuating call switch.
- e. Return busy signal to indicate that station is already in use.
- 3. Speakers: Free of noise and distortion during operation and when in standby mode.

B. Microprocessor-Switched System:

1. Master Station Features:

- a. Communicate selectively with other master and speaker-microphone stations by dialing station's number on a 12-digit keypad.
- b. Communicate simultaneously with all other stations by dialing a designated number on a 12-digit key-pad.
- c. Communicate with individual stations in privacy.
- d. Include other master-station connections in a multiple-station conference call.
- e. Access separate paging speakers or groups of paging speakers by dialing designated numbers on a 12-digit keypad.
- f. Override any conversation by a designated master station.
- g. Display selected station.
- h. Volume Control: Regulate incoming-call volume.
- i. LED: Identify calling stations and stations in use. Remains illuminated until call is answered.
- j. Momentary audible tone signal: Announce incoming calls.
- k. Handset with Hook Switch: Telephone type with 61 cm (24-inch) long, permanently coiled cord. Hook switch to disconnect speaker when handset is lifted.
- l. Reset Control: Cancels call and resets system for next call.
- m. Equipment Cabinet:
  - 1) Comply with EIA/ECA 310-E Cabinets, and Associated Equipment Standard.
  - 2) Lockable.
  - 3) Ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other

switching and control devices required for conversation channels and control functions.

n. Vertical Equipment Rack:

- 1) 28" (16RU) rack space.
  - a) Welded steel construction.
  - b) Minimum 198 cm (78 inches) usable height.
  - c) Adjustable front mounting rails.
- 2) Install the following appurtenances provided by same manufacturer or as specified:
  - a) Security screws w/ nylon isolation bushings.
  - b) Textured blank panels.
  - c) Custom mounts for components without rack mount kits.
  - d) Security covers.
  - e) Copper Bus Bar.
  - f) Power Sequencer- rack-mounted power conditioner and contact closure control inputs.

2. Room Speaker-Microphone Station Features:

- a. Privacy from remote monitoring with a warning tone signal and visual indication at monitored station.
- b. Privacy switches at designated speaker-microphone stations to prevent another station from listening and to permit incoming calls.
- c. Communicate hands free.
- d. Call master station by actuating call switch.
- e. Return busy signal to indicate that station is already in use.
- f. Free of noise and distortion during operation and when in standby mode.

#### **2.4 HEAD END EQUIPMENT**

- A. Provide required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system.
- B. Head end components can be rack mounted or wall mounted in a metal enclosure.
- C. Provide head end equipment in telecommunications room where IC system is installed.
- D. Provide minimum 30 minute battery back-up (or UPS) to system components.

**2.5 SYSTEM CABLES**

- A. Comply with SECTION 27 10 00, CONTROL, COMMUNICATION AND SIGNAL WIRING for specific installation and testing requirements.
- B. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper; sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.
- C. Insulation: Thermoplastic; minimum 0.8 mm (1/32 inch) thick.
- D. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.
- E. Minimum Shielding Coverage on Conductors: 60 percent.
- F. Cabling must be riser rated.

**2.6 RACEWAYS**

- A. Raceways and Boxes: Comply with requirements in Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- B. Each open top raceway must be NRTL listed for telecommunications systems and partitioned with metal partitions in order to comply with NEC Parts 517 and 800 to "mechanically separate" telecommunications systems of different service, protect installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
- C. IC System Cable Infrastructure: EMT and cable tray NRTL classified for suitability and NRTL listed for telecommunications.
- D. Pull boxes must be minimum 63.5 mm (2-1/2 inches) deep and 152.4 mm (6 inches) wide by 152.4 (6 inches) long.

**2.7 SYSTEM CONDUIT**

- A. Provide separate 25.4 mm (1 inch) minimum diameter conduit, for system installation.

**2.8 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

- A. Provide UPS for system to allow normal operation and function (as if there was no AC power failure) in event of an AC power failure or during input power fluctuations for a minimum of 30 minutes.
- B. As an alternative solution, telephone system UPS can be utilized to meet this requirement at head-end location, as long as this function is specifically accepted by telephone contractor and COR.
  - 1. Do not make any attachments or connection to telephone system until specifically directed to do so, in writing, by COR.
- C. Provide UPS for active system components including:

1. System Amplifiers.
2. Microphone Consoles.
3. System Interface Units.
4. Head End Equipment Racks.
5. Control Consoles.

## **2.9 FINISHES**

- A. Provide finishes for exposed work such as plates, racks, panels, speakers, etc. accepted by design professional, COR and 0050P3B.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Review and coordinate with telecommunications cabling installer for location of intercom equipment in Telecommunications Rooms.
- B. Verification of Conditions: Before beginning work, verify location, quantity, size and access for the following:
  1. Isolated ground AC power circuits provided for systems.
  2. Pull boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for systems.
  3. System components installed by others.
  4. Overhead supports and rigging hardware installed by others.
- C. Installer must immediately notify COR, general contractor and design professional in writing of any discrepancies.
- D. Needs Assessment:
  1. Provide a one-on-one meeting with nursing manager of each unit affected by installation of system.
  2. Review floor plans and drawings, educate nursing manager on functions of the equipment and gather details specific to individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that affect system programming and training.
  3. Prepare a summary report of the assessment.

### **3.2 INSTALLATION**

- A. General:
  1. Install work plumb and square and in a manner consistent with standard industry practice.
  2. Protect work from dust, paint and moisture as dictated by site conditions. Contractor is responsible for protection of work until final acceptance by Government.
  3. Install equipment according to OEM's recommendations.

4. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for complete assembly and installation.
  5. Secure equipment firmly in place, including IC stations, speakers, equipment racks, system cables, etc.:
    - a. Supports, mounts, fasteners, attachments and attachment points must support loads with a safety factor of at least 5:1.
    - b. Do not impose weight of equipment on supports provided for other trades or systems.
    - c. Any suspended equipment or associated hardware must be certified by OEM for overhead suspension.
    - d. Contractor is responsible for means and methods in design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
  6. Coordinate cover plates with field conditions. Size and install cover plates to hide joints between back boxes and surrounding wall. Do not allow cable to leave or enter boxes without cover plates installed.
  7. Where cover plates are not fitted with connectors, provide grommets holes in size and quantity required.
- B. Equipment Racks:
1. Fill unused equipment mounting spaces with blank panels or vent panels; match color to equipment racks.
  2. Provide security covers for devices not requiring routine operator control.
  3. Provide vent panels and cooling fans as required for operation of equipment within OEM's specified temperature limits.
    - a. Provide adequate ventilation space between equipment for cooling.
    - b. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
  4. Provide insulated connections of raceway to equipment racks.
  5. Provide continuous conduit with no more than 40 percent fill between wire troughs and equipment racks for non-plenum-rated cable.
  6. Ensure each system is mechanically separated from each other in wireway.
- C. Wiring Practice: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, adhere to the following additional practices:



1. Execute wiring in strict adherence to National Electrical Code, applicable local building codes and standard industry practices.
2. Where raceway and wire way are EMT (conduit), wiring of differing classifications must be run in separate conduit.
3. Where raceway and wire way are an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share same enclosure must be mechanically partitioned and separated by 102 mm (four inches). Where wiring of differing classifications must cross, they must cross perpendicular to one another.
4. Do not splice wiring anywhere along entire length of run.
5. Make sure cables are insulated and shielded from each other and from raceway for entire length of run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs.
7. Do not bend wires to less than radius recommended by manufacturer.
8. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
9. Do not apply wire pulling lubricants unless specifically recommended by cable OEM.
10. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
11. Do not use tape-based or glue-based cable anchors.
12. Bond shields and drain wires to ground.
13. Terminate field wiring entering equipment racks as follows:
  - a. Provide service loops at harness break-outs, plates, panels and equipment to allow plates, panels and equipment to be removed for service and inspection.
  - b. Line level and speaker level wiring can be terminated inside equipment rack using specified terminal blocks.
  - c. Provide 15 percent spare terminals inside each rack.
  - d. Microphone level wiring can only be terminated at equipment served.
  - e. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface.
  - f. Do not mount terminal blocks on bottom of rack.

- g. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.
- 14. Use only balanced audio circuits unless indicated otherwise.
- 15. Make connections as follows:
  - a. Use rosin-core solder or mechanical connectors appropriate to application.
  - b. For crimp-type connections, use only crimp tool specified by manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Spade lugs must be sized to fit wire gauge; do not exceed two lugs per terminal.
  - d. Twist on wire connectors and electrical tape are not permitted for any application.
- D. Cable Installation: In addition to requirements in Section 27 10 00, STRUCTURED CABLING, comply with the following practices.
  - 1. Acceptable means of cable support are cable tray, wire way, and conduit. Hook and loop wrap cable bundles loosely to cable tray with plenum rated Velcro straps. Plastic tie wraps are not permitted as a means to bundle or support cables.
  - 2. Run cables parallel to walls.
  - 3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork.
  - 4. Maintain minimum 61 cm (2'-0") clearance from all shielded electrical apparatus.
  - 5. Test cables after the total installation is complete. Document test results. Remedy any cabling problems or defects in order to pass or comply with testing. This includes re-pull of new cable as required.
  - 6. Terminate both ends of cables per industry and OEM's recommendations.
  - 7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until ready to terminate.
  - 8. Cover end of overall jacket with minimum 25.4 mm (1 inch) length of transparent heat-shrink tubing.
    - a. Cut unused insulated conductors minimum 50.8 mm (2 inches) passed heat-shrink, fold back over jacket and secure with cable-tie.
    - b. Cut unused shield/drain wires minimum 50.8 mm (2 inches) passed heat-shrink cover shield/drain wires with heat-shrink tubing

extending to overall jacket. Extend tubing 6 mm (1/4 inch) passed end of unused wires, fold back over jacket and secure with cable tie.

9. For each solder-type connection, cover bare wire and solder connection with heat-shrink tubing.
10. Terminate conductors; no cable must contain unterminated elements. Make terminations only at outlets and terminals.
11. Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables cannot be spliced.
12. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
13. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps are not permitted.
14. Cable must not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
15. Separation of Wires: (Refer to Raceway Installation)
  - a. Separate speaker-microphone, line-level, speaker-level, and power wiring runs.
  - b. Install in separate raceways or, where exposed or in same enclosure, separate conductors at minimum 30.5 cm (12 inches) apart for speaker microphones and adjacent parallel power and telephone wiring.
  - c. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- E. System Conduit: Install manufactured conduit sweeps and long radius elbows according to wire and cable OEM instructions.
- F. Labeling:
  1. Permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  2. Engrave and paint fill receptacle panels using minimum 3.17 mm (1/8 inch) high lettering and contrasting paint.
  3. For rack-mounted equipment, use engraved Lamacoid labels with white minimum 3.17 mm (1/8 inch) high lettering on black background. Label front and back of rack-mounted equipment.

4. Where multiple pieces of equipment reside in same rack group, label each indicating to which room, channel, receptacle location, etc. they correspond.
5. Permanently label cables at each end, including intra-rack connections. Labels must be covered by same, transparent heat-shrink tubing covering end of overall jacket. Alternatively, provide computer generated labels of type which include a clear protective wrap.
6. Contractor's name cannot appear more than once on each continuous set of racks. Contractor's name cannot appear on wall plates or portable equipment.
7. Ensure each piece of OEM supplied equipment has appropriate NRTL labels for the service equipment is performing. Equipment installed not bearing NRTL label will not be permitted. Contractor is responsible to provide listed replacement equipment with approved NRTL label.

G. Protection during Installation:

1. Protect electronic devices during unpacking and installation by wearing electrostatic discharge (ESD) wrist straps tied to chassis ground.
2. Wrist straps must meet OSHA requirements for prevention of electrical shock, if technician comes in contact with high voltage.

H. Cutting and Patching:

1. Keep work area clear of debris and clean area daily at completion of work.
2. Patch and paint any wall or surface that has been disturbed by execution of this work.
3. Provide any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete work or to make its parts fit together properly.
4. Do not damage or endanger fully or partially completed construction of Government or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor cannot cut or otherwise alter such construction by facility or separate contractor except with written consent of Government or of such separate contractor; such consent cannot be unreasonably withheld. Contractor cannot unreasonably withhold consent to cutting or otherwise altering work, by facility or a separate contractor.

5. Where coring of in-place concrete is specified or required, including coring indicated under unit prices, location of such coring must be identified in the field and accepted by COR prior to commencement of coring work.

I. Fireproofing:

1. Fireproof openings where IC cables penetrate fire rated walls, floors and ceilings.
2. Provide conduit sleeves (if not already provided) for cables that penetrate fire rated walls and floors and ceilings. After cabling installation is complete, install fire proofing material in and around conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal floor and ceiling penetrations.
3. Use only materials and methods that preserve integrity of fire stopping system and its rating.

J. Grounding:

1. Provide grounding system per Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
2. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
3. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
4. Install grounding electrodes as specified in Section 27 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
5. Do not use "3rd or 4th" wire internal electrical system conductors for ground.
6. Do not connect system ground to building's external lightning protection system.
7. Do not "mix grounds" of different systems.

### 3.3 FIELD QUALITY CONTROL

- A. Assign only technicians trained, qualified, and certified by OEM on engineering, installation, operation, and testing of system.

B. Performance Testing:

1. Intermediate Testing:
  - a. After completion of 25 percent of installation of equipment, including one master station, and remote station, and prior to any further work, this portion of system must be pretested, inspected, and certified. Check each item of installed equipment

to ensure appropriate NRTL labels are affixed, NFPA, Life Safety, and Joint Commission guidelines are followed, and proper installation practices are followed. Include a full operational test.

- b. Arrange for inspection and test conducted by a factory-certified representative to be witnessed by Government and SMCS 0050P2H3 at a minimum and COR. An identical inspection can be conducted between 65 and 75 percent of system construction phase, at direction of COR.

## 2. Pretesting:

- a. Upon completing installation of system:

- 1) Align, balance, and completely pretest entire system under full operating conditions.
- 2) Verify (utilizing approved test equipment) system is operational and meets performance requirements of this standard.
- 3) Verify that system functions are operational, and no unwanted aural effects, (e.g. signal distortion, noise pulses, glitches, audio hum, poling noise, etc.) are present. At a minimum, pretest each of the following locations:
  - a) Networked locations.
  - b) System trouble reporting.
  - c) System electrical supervision.
  - d) UPS operation.

- b. Provide recorded system pretest measurements and written certification that system is ready for formal acceptance test to COR.

## 3. Acceptance Test:

- a. Schedule acceptance test date giving COR 30 days' written notice prior to date acceptance test is expected to begin. System must be tested in the presence of a Government representative and OEM-certified representative. System must be tested utilizing approved test equipment to certify proof of performance and emergency compliance. Test must verify that the total system meets specification requirements. Notification of acceptance test must include expected duration of time of the test.

## 4. Acceptance Test Procedure:

- a. Physical and Mechanical Inspection:

- 1) Government representative may tour areas where system and sub-systems are completely and properly installed to ensure they are operationally ready for proof of performance testing. Prepare system inventory including available spare parts. Each item of installed equipment must be checked to ensure appropriate NRTL labels are affixed.
  - 2) System diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results must be inventoried and reviewed.
  - 3) Failure of system to meet installation requirements of this specification can be grounds for terminating all testing.
- b. Operational Test:
- 1) Contractor must demonstrate full functionality of system including:
    - a) Station to master calls.
    - b) Station to station calls.
    - c) Broadcast calls.
    - d) Location identification of stations at intercom master station.
- c. Test Conclusion: Government will accept results of the test or require additional testing on deficiencies and shortages. Retesting to comply with these specifications must be done at Government's convenience and contractor's expense.

### 3.4 TRAINING

- A. Provide training of facility-identified staff assigned to units receiving communications by an IC system. Implement training from master console operator's perspective, and likewise, for any person whose specific responsibilities include answering IC calls and dispatching an appropriate response, provide operational training from their perspective. A separate training room may be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of new system.
- B. Provide the following minimum training times and durations:
  1. 24 hours prior to facility opening,
  2. 8 hours during the standard work week, and
  3. 8 hours for supervisors and system administrators.

### 3.5 MAINTENANCE

- A. Provide Government personnel with ability to contact contractor and OEM for maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time, during warranty period.
- B. Response Time during Warranty Period:
  - 1. COR is contractor's only official reporting and contact official for IC system trouble calls, during the warranty period.
  - 2. A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by COR, Monday through Friday exclusive of Federal holidays.
  - 3. Respond and correct on-site trouble calls, during the standard work week:
    - a. A routine trouble call within one working day of its report. A routine trouble is considered a trouble which causes one IC station, or master IC station to be inoperable.
    - b. An emergency trouble call within four hours of its report.
      - 1) An emergency trouble is considered a trouble which causes a IC sub system or equipment cabinet, to be inoperable at any time.
      - 2) Emergency trouble calls include routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.). COR must notify contractor of this type of trouble call.
  - 4. If an IC component failure cannot be corrected within four hours (exclusive of the standard work time limits), provide alternate IC equipment.
  - 5. Complete installation of alternate equipment/system within sixteen hours after the four hour trouble shooting time and restore operation of effected location to system performance standards.
  - 6. Replace any sub-system or major system that cannot be corrected within one working day, with compatible temporary equipment returning system or sub-system to full operational capability, until repairs are complete.

- - - E N D - - -



**SECTION 27 52 31**  
**SECURITY EMERGENCY CALL, DURESS ALARM, AND TELECOMMUNICATIONS**

**PART 1 - GENERAL**

**1.1 SECTION SUMMARY**

- A. Work covered by this document includes design, engineering, labor, material, products, guaranty, training and services for, and incidental to, the complete installation of a new and fully operating National Fire Protection Association (NFPA) Listed Critical Service Nurse-Call and Life Safety Code Blue communication system as detailed herein.
- B. Work shall be complete, tested, labeled, certified and ready for operation.

**1.2 RELATED SECTIONS**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 Volts and Below).
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- D. Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- E. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- F. Section 27 10 00, STRUCTURED CABLING.
- G. Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- H. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.

**1.3 DEFINITIONS**

- A. Provide: Design, engineer, furnish, install, connect complete, test, certify and warranty.
- B. Work: Materials furnished and completely installed.
- C. Review of contract drawings: A service by the engineer to reduce the possibility of materials being ordered which do not comply with contract documents. The engineer's review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute permission for the Contractor to proceed in error.
- D. Headquarters (aka VACO) Technical Review, for National and VA Communications and Security, Codes, Frequency Licensing Standards, Guidelines and Compliance:

Office of Telecommunications  
 Special Communications Team (0050P3B)  
 1335 East West Highway - 3rd Floor

Silver Spring, Maryland 20910,  
(O) 301-734-0350, (F) 301-734-0360

E. Engineer: FreemanWhite

F. Owner:

G. General Contractor (GC):

H. Contractor: Systems Contractor; successful bidder

#### 1.4 REFERENCES

A. The installation shall comply fully with all governing authorities, laws and ordinances, regulations, codes and standards, including, but not limited to:

1. United States:

a. Department of Commerce:

- 1) National Telecommunications and Information Administration (NTIA), Red Book, Chapter 7.8/9 Radio Frequency Restriction of Use and Compliance.
- 2) National Institute of Standards Technology (NIST), Federal Information Processing Standards Publication (FIPS) 140-2, Security Requirements for Cryptographic Modules.

b. Department of Labor, Occupational Safety and Health

Administration (OSHA): All standards for personnel physical and life safety.

c. Department of Veterans Affairs, Office of Cyber and Information Security (OCIS):

- 1) Handbook 6500, Information Security Program.
- 2) Spectrum Management Radio Frequency Compliance and Licensing Program.
- 3) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.

d. Federal Communications Commission (FCC): Part 15, Restrictions of use for Part 15 listed Radio Equipment in Safety of Life / Emergency Functions / Equipment/Locations.

2. American National Standards Institute/Electronic Industries

Association/Telecommunications Industry Association (ANSI/EIA/TIA):

568-B	Commercial Building Telecommunications Wiring Standards:
569	Commercial Building Standard for Telecommunications Pathways and Spaces.

606	Administration Standard for the Telecommunications Infrastructure of Communications Buildings.
607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
REC 1 2 7 - 4 9	Power Supplies.
RS 2 7	Tools, Crimping, Solderless Wiring Devices, Recommended Procedures for User Certification.

3. Institute of Electrical and Electronics Engineers (IEEE):

SO/TR 21730:2 007	Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices.
0739- 5175/08 /\$25.00 ©2008IE EE	Medical Grade - Mission Critical - Wireless Networks.
C62.41	Surge Voltages in Low-Voltage AC Power Circuits.

4. Joint Commission on Accreditation of Healthcare Organizations  
(JCAHO): All guidelines for Life and Public Safety and Emergency  
Communications.

5. NFPA:

70	National Electrical Code (current date of issue) - Articles 517, 645 and 800.
75	Standard for Protection of Electronic Computer Data- Processing Equipment.
77	Recommended Practice on Static Electricity.
99	Healthcare Facilities.
101	Life Safety Code.

6. Underwriters Laboratories (UL):

65	Standard for Wired Cabinets.
468	Standard for Grounding and Bonding Equipment.
1449	Standard for Transient Voltage Surge Suppressors.
1069	Hospital Signaling and Nurse Call Equipment.
60950-1/2	Information Technology Equipment - Safety.

7. State Hospital Code(s).

8. Local Codes.

### 1.5 QUALIFICATIONS

- A. The OEM shall have had experience with three or more installations of Public Address Systems of comparable size and complexity concerning type and design as specified herein. Each of these installations shall have performed satisfactorily for at least 1 year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of 3 years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the system. This documentation, along with the system Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the system shall be fully trained, qualified, and certified by the OEM on the

engineering, installation, operation, and testing of the system. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the Resident Engineer before being allowed to commence work on the system.

- D. Applicable national, state and local licenses.
- E. Certificate of successful completion of OEM's installation/training school for installing technicians of the equipment being proposed.

#### **1.6 CODES AND PERMITS**

Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.

#### **1.7 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying Contractor with other trades.

#### **1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS**

Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.

- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the

system, with spares, as a part of the submittal. Special Communications (0050P3B - herein after referred to as 0050P3B) will not review any submittal that does not have this list.

- D. Provide four copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C and D, at a minimum for compliance review as described herein where each responsible individual(s) should respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).

#### **1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)**

- A. Throughout progress of the work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
  - 1. All device locations with labels.
  - 2. Conduit locations.
  - 3. Head-end equipment and specific location.
  - 4. Wiring diagram.
  - 5. Labeling and administration documentation.
  - 6. Warranty certificate.
  - 7. System test results.

#### **1.10 WARRANTIES/GUARANTY**

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of 1 year from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within 8 hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. Refer to Part 4 for applicable System warranty requirements.

#### **1.11 USE OF THE SITE**

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-Contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

#### **1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.

- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

### **1.13 PROJECT CLOSEOUT**

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
  - 1. Warranty certificate.
  - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
  - 3. Project record documents.
  - 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
  - 1. Contract Documents have been reviewed.
  - 2. Project has been inspected for compliance with contract.
  - 3. Work has been completed in accordance with the contract.

## **PART 2 - PRODUCTS AND FUNCTIONAL REQUIREMENTS**

### **2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS**

- A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
- C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- D. Weather-Resistant Equipment: Listed and labeled by an OSHA certified National Recognized Testing Laboratory (NRTL - i.e. UL) for duty outdoors or in damp locations.

### **2.2 SYSTEM DESCRIPTION**

- A. System hardware shall consist of an indoor or outdoor enclosures, poles, strobe lights, intercom system, intercom stations, intercom

master stations, and power supplies. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse and patient communications network.

- B. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two year from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved by 0050P2B).

### **2.3 EMERGENCY CALL STATIONS (NOT USED)**

### **2.4 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

- A. Provide a backup battery or a UPS for the system to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of 15 minutes.
- B. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the head-end location, as long as this function is specifically approved by the Telephone Contractor and the Resident Engineer.
- C. The Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the Resident Engineer.
- D. Provide UPS for all active system components including but not limited to:
  - 1. Intercom head-end
  - 2. Master intercom stations
  - 3. Remoted intercom stations

## **PART 3 - EXECUTION**

### **3.1 PROJECT MANAGEMENT**

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with



the General Contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.

- C. Contact the Office of Telecommunications, Special Communications Team (0050P3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

### **3.2 COORDINATION WITH OTHER TRADES**

- A. Coordinate with the cabling contractor the location of security emergency call and duress alarm equipment in the Telecommunications Closets.
- B. Before beginning work, verify the location, quantity, size and access for the following:
  - 1. Isolated ground AC power circuits provided for systems.
  - 2. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
  - 3. System components installed by others.
  - 4. Overhead supports and rigging hardware installed by others.
- C. Immediately notify the Owner, General Contractor and Engineer in writing of any discrepancies.

### **3.3 INSTALLATION**

- A. General:
  - 1. Execute work in accordance with National, State and local codes, regulations and ordinances.
  - 2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
  - 3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
  - 4. Secure equipment firmly in place, including intercom stations, equipment racks, system cables, etc.
    - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.

- b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
  - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
  - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
- 5. Finishes for any exposed work such as plates, racks, panels, towers, enclosures, intercom stations, etc. shall be approved by the Architect, Owner and 0050P3B.
- 6. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
- B. Equipment Racks:
  - 1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
  - 2. Provide security covers for all devices not requiring routine operator control.
  - 3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
  - 4. Provide insulated connections of the electrical raceway to equipment racks.
  - 5. Provide continuous raceway and conduit with no more than 40 percent fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
- C. Wiring Practice:
  - 1. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
  - 2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.

3. Wiring shall be classified according to the following low voltage signal types:
  - a. Voice audio
  - b. Low voltage DC control or power (less than 48VDC).
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four (4) inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
8. Use wire pulling lubricants and pulling tensions as recommended by the OEM.
9. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
10. Do not use tape-based or glue-based cable anchors.
11. Ground shields and drain wires as indicated by the drawings or recommended by the OEM.
12. Field wiring entering equipment racks shall be terminated as follows:
  - a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
  - b. If specified terminal blocks are not designed for rack mounting, utilize 3/4 inch plywood or 1/8 inch thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
  - c. Employ permanent strain relief for any cable with an outside diameter of 1 inch or greater.

13. Make all connections as follows:

- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
- b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
- c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
- d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.

D. Cable Installation - In addition to the mandatory infrastructure requirements outlined in VA Construction Specification, Section 27 10 00, STRUCTURED CABLING, the following additional practices shall be adhered to:

- 1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
- 2. Run cables parallel to walls.
- 3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
- 4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
- 5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
- 6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
- 7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off the floor until you are ready to terminate.

8. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the Heat-shrink and serve as indicated below.
9. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
10. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.
11. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
12. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
13. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
15. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
16. Separation of Wires: (Refer to Raceway Installation) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
17. Serve all cables as follows:
  - a. Cover the end of the overall jacket with a 1 inch (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2 inches (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2 inches (minimum) past the heat-shrink and serve as indicated below.

- b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing 1/4 inch past the end of unused wires, fold back over jacket and secure with cable tie.
- c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

F. Labeling:

- 1. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
- 2. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
- 3. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
- 4. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
- 5. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
- 6. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
- 7. Provide printed labels at both ends of the cable.
- 8. Ensure each OEM supplied equipment has appropriate UL Labels/Marks for the service the equipment is performed permanently attached/marked. Equipment installed not bearing these UL marks will not be allowed to be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

### 3.4 SYSTEM PROGRAMMING

Provide all programming required for a complete and operational system. Coordinate programming parameters with Owner and Engineer.

### 3.5 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge

(ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

### **3.6 CLEANING AND PATCHING**

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

### **3.7 FIREPROOFING**

- A. Where cables penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls. After the cabling installation is complete, install fireproofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.
- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.

### 3.8 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Install grounding electrodes as specified in Division 26, Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- D. Do not use "3<sup>rd</sup> or 4<sup>th</sup>" wire internal electrical system conductors for ground.
- E. Do not connect system ground to the building's external lightning protection system.
- F. Do not "mix grounds" of different systems

## PART 4 -TESTING/GUARANTY/TRAINING

### 4.1 PROOF OF PERFORMANCE TESTING

- A. Intermediate Testing:
  - 1. After completion of 25 - 30 percent of the installation of a head end cabinet(s) and equipment, one IC master station, local and remote intercom stations, and prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed, NFPA, Life Safety, and JCAHCO guidelines are followed, and proper installation practices are followed. The intermediate test shall include a full operational test.
  - 2. The inspection and test will be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75 percent of the system construction phase, at the direction of the Resident Engineer.
- B. Pretesting:
  - 1. Upon completing installation of the system, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.



2. Pretesting Procedure:

- a. During the system pretest the Contractor shall verify (utilizing approved test equipment) that the system is fully operational and meets all the system performance requirements of this standard.
  - b. The Contractor shall pretest and verify that all system functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
    - 1) Central Control Cabinets.
    - 2) All Networked locations.
    - 3) System trouble reporting.
    - 4) System electrical supervision.
    - 5) UPS operation.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the system is ready for the formal acceptance test shall be submitted to the Resident Engineer.

C. Acceptance Test:

1. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test date and give the Resident Engineer 30 days written notice prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative and an OEM certified representative. The system shall be tested utilizing the approved test equipment to certify proof of performance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed system does comply with all requirements of this specification under operating conditions. The system shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the system that precludes completion of

system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the system. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire system to be declared unacceptable. Retesting of the entire system shall be rescheduled at the convenience of the Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The Government Representative will tour all major areas where the system is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The system diagrams, record drawings, equipment manuals, Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the system to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the central terminating and nurse call master control equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Individual Item Test: The Government Representative will select individual items of equipment for detailed proof of performance testing until 100 percent of the system has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.

3. Test Conclusion:

- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the Resident Engineer. Any retesting to comply with these specifications will be done at the Contractor's expense.

- b. If the system is declared unacceptable without conditions, all rescheduled testing expenses will be born by the Contractor.

E. Acceptable Test Equipment:

1. The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:
2. Spectrum Analyzer.
3. Signal Level Meter.
4. Volt-Ohm Meter.
5. Sound Pressure Level (SPL) Meter.
6. Oscilloscope.

#### 4.2 WARRANTY

- A. Comply with FAR clause 52.246-21, except that warranty shall be as follows:

B. Contractor's Responsibility:

1. The Contractor shall warranty that all provided material and equipment will be free from defects, workmanship and will remain so for a period of one year from date of final acceptance of the system by the VA. The Contractor shall provide OEM's equipment warranty documents, to the Resident Engineer (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
  - a. Response Time During the Two Year Guaranty Period:

- 1) The Resident Engineer (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's ONLY OFFICIAL reporting and contact official for Security Emergency Call and Duress Alarm system trouble calls, during the guaranty period.
  - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the Resident Engineer (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
  - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
    - a) A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a single intercom station inoperable.
    - b) An emergency trouble call within four hours of its report. An emergency trouble is considered a trouble which causes a sub-system (ward), distribution point, terminal cabinet, to be inoperable at anytime.
- b. Required On-Site Visits During the Two Year Guaranty Period
- 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the system according the descriptions identified in this document.
  - 2) The Contractor shall arrange all Facility visits with the Resident Engineer (or Facility Contracting Officer) prior to performing the required maintenance visits.
  - 3) Preventive maintenance shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the Resident Engineer (or Facility Contracting Officer) and Contractor.
  - 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the Resident Engineer (or Facility Contracting Officer).
  - 5) The Contractor shall provide the Resident Engineer (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call.

The Contractor shall provide the Resident Engineer with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:

a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to Resident Engineer (or Facility Contracting Officer) by the fifth (5th) working day after the end of each month. The report shall clearly and concisely describe the services rendered, parts replaced and repairs performed. The report shall prescribe anticipated future needs of the equipment and systems for preventive and predictive maintenance.

b) The Contractor shall maintain a separate log entry for each item of equipment and each sub-system of the system. The log shall list dates and times of all scheduled, routine, and emergency calls. Each emergency call shall be described with details of the nature and causes of emergency steps taken to rectify the situation and specific recommendations to avoid such conditions in the future.

6) The Resident Engineer (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.

a) The Resident Engineer (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the system's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the system's official technical record documents.

C. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the Resident Engineer or Facility Contracting Officer in writing upon the discovery of these incidents. The Resident Engineer or Facility Contracting Officer will investigate all reported incidents and render

#### 4.3 TRAINING

- A. Provide thorough training of all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.
- B. Provide the following minimum training times and durations:
1. 16 hours during the opening week for security staff - both day and night shifts.
  2. 8 hours for supervisors and system administrators.

- - - E N D - - -

## SECTION 27 53 19

## DISTRIBUTED RADIO ANTENNA (WITHIN BUILDING) EQUIPMENT AND SYSTEM

## PART 1 - GENERAL

- A. Pursuant to the Department of Veterans Affairs (VA), General Council's (GC) Decision (FY1998 and Grand-Fathered to be fully implemented in FY2000) directing VA that all VOICE (aka TELEPHONE) and DATA (aka DIGITAL) Low Voltage Communications Wires and Cables have been "DECLARED AS BUILDING FIXTURES;" AND are to be provided as a part of the BUILDING STRUCTURE Installed During Construction by Construction and Facilities Management's (CFM) AND each Facility's (VAMC, OPC, CBOPC, etc.) Construction / Renovation Projects.
- B. **VA** - IS REQUIRED TO INSTALL AND MAINTAIN A STRUCTURED AND FULLY FUNCTIONING COMMUNICATIONS WIRE, CABLE AND SIGNAL DISTRIBUTION TIP CONTAINING ALL LOW VOLTAGE COMMUNICATIONS SYSTEMS, EQUIPMENT, PATHWAY(S), DISTRIBUTION AND INTERFACE POINT[S] THAT RENDERS A FULLY FUNCTIONING TIP FOR EACH VA FACILITY THROUGHOUT ITS MEDICAL CARE NETWORK.
- C. THIS DOCUMENT FORMS BUT ONE (1) PART OF CFM'S REQUIRED FOUR (4) PART TIP TECHNICAL SPECIFICATION REQUIREMENTS REQUIEMENTS OUTLINED HEREIN AND IN SECTIONS: 27 10 00 - COMMUNICATIONS ROOMS FITTINGS (that included all Outside and Inside TIP Conduit Systems and Equipment; 27 13 00 - COMMUNICATIONS STRUCTURED (aka Backbone) TIP CABLING EQUIPMENT AND SYSTEMS; AND 27 15 00 - COMMUNICATIONS HORIZONTAL TIP CABLING SYSTEMS AND EQUIPMENT.
- D. ADDITONALLY, THIS DOCUMENT CONTAINS COMMON REFERENCE(S) ADDRESSING ALL DIVISION 27 & 28 SECTIONS AND IS TO BE INCLUDED AS THE BASIC PART OF EACH LOW VOLTAGE SYSTEM'S CONTRACT DOCUMENTS. EACH DIVISION 27 & 28 SECTION WILL REFER BACK TO THE APPROPRIATE PARAGRAPH(S) HEREIN IN-LIEU OF REPEATING THE SAME INFORMATION AND WRITING OVER AN OVER. THE SPEC WRITER IS CAUTIONED TO *INSURE* EACH APPROPRIATE DIVISION 27 & 28 SECTION IS MADE A PART OF THE CONTRACT PACKAGE WHERE THIS DOCUMENT FORMS THE BASIS FOR ALL (re PART 1.1 STATEMENT). THEREFORE, IN ADDITION TO THE REQUIREMENTS OF SECTION 01 42 19-REFERENCE STANDARDS, THESE DOCUMENTS AND THE INFORMATION DEPICTED HEREIN SHALL BE THE MINIMUM STANDARD(S), CODES AND REQUIREMENTS FOR EACH DIVISION 27 AND 28 COMMUNICAITONS SYSTEM SO IDENTIFIED (re PART 1, PARAGRAPH 1.3.A.1 for VA HEADQUARTERS [aka VACO], and other required project contact information DO NOT DELETE)

## 1.1 DESCRIPTION

- A. This Section describes the interfacing, technical and performance requirements for a fully installed, functioning and operating Distributed RF Antenna (Within House) Equipment and System (hereinafter will be referred to as "the system").

The system is based upon outside antenna(s), inside plant, active amplification functions and architecture to support local two way communications for Public Safety Radio (aka Emergency Responder, local and state police, sheriff, ambulance, etc) Radio Coverage, other RF (VA radios) commercial Wireless Service Providers (WSP), and wireless (Cell) equipment and systems when approved by the **AHJ** via IWS architecture for the VA Facility. The Contractor:

- B. SHALL USE ALL SECTIONS IDENTIFIED IN PART 1, PARAGRAPH 1.2 THAT HAVE BEEN DETERMINED, BY VA, NECESSARY FOR THE COMPLETE SYSTEM PROJECT(S), TO THE EXTENT THAT IS DESCRIBED HEREIN AND IN EACH SECTION, IN ORDER TO PROVIDE THE VA FACILITY A STATE-OF-THE-ART, VIABLE, COMPLETE AND FULLY FUNCTIONAL REQUIRED LOW VOLTAGE COMMUNICATIONS SYSTEM(S).
  - 1. IF A REFERENCED SECTION APPEARS NOT NEEDED, THE CONTRACTOR SHALL NOTIFY THE RE, IN WRITING, OF EXACTLY WHY HE/SHE FEELS THAT PARTICULAR SECTION APPEARS NOT NECESSARY,
  - 2. THE RE, IN TURN, WILL RESEARCH THE ISSUE AND CONTACT VA'S SMCS (0050P2H3a) FOR AN OFFICIAL TECHNICAL DETERMINATION AND WILL REPLY TO THE CONTRACTOR, IN WRITING, OF THE OFFICIAL CONTRACT DECISION CONCERNING THE REQUEST AFFECTING THE PROJECT, and
  - 3. Is cautioned to obtain, in writing, all approvals for system changes (ie corrections, updates, additions, subtractions, etc.) relating to the published bid contract specifications, drawings and other approved contract document(s), from CFM'S PE, PM and / or the RE BEFORE proceeding with the change.
- C. The voice (telephone) and data portion of the horizontal TIP is managed by VA and/or the Facility's OI&T. The FMS (low-voltage special communications) portion of the TIP is managed by the Facility's FMS with technical assistance provided by VA OI&T's SMCS 0050P2H3.
- D. The system Contractor shall provide all system design, project management, coordination with WSPs and Public Safety, Radio Enhancement / Emergency Responder Services, and with VAMC Entities (ie Police, FMS, OI&T (local for wireless LAN/VoIP) and VACO Spectrum Management (SMCS 0050P2H3B) for technical and RF authorization compliance).
- E. The DAS is designated by VA as an "Emergency and Public Safety" Communications System.

## 1.2 RELATED WORK

- A. (re PART 1, PARAGRAPH 1.1.): In addition to the requirements identified in SECTION 01 00 01, GENERAL CONDITIONS; the following SECTIONS, that are not bracketed (i.e. // \_\_\_\_\_ //), ARE THE MINIMUM REQUIRED FOR ALL SYSTEMS). The



bracketed (i.e. // \_\_\_\_\_ //) SECTIONS MAY - ALL, PART OR NONE be required to form a complete and functioning system depending system design, present and approved future requirements.

- B. In the event of conflict or discrepancy between this Section and the requirements of the PSRAS Code, the requirements stated herein for PSRAS shall govern unless the local PSRAS requirement is more stringent and is furthermore not contrary to the National Requirements for PSRAS.
- C. The Contractor shall identify the portion(s) of this Section that has exceeded the requirements and receive approval from the AHJ and RE for acceptance. The following SECTIONS are the minimum required
  - 1. 00 01 15 - List of Drawing Sheets.
  - 2. 01 00 01 - General Conditions.
  - 3. 01 33 23 - Shop Drawings, Product Data and Samples.
  - 4. 01 42 19 - Reference Standards.
  - 5. 01 57 19 - Temporary Environmental Controls.
  - 6. 01 74 19 - Waste Management.
  - 7. 07 02 00 - Joint Sealants.
  - 8. 07 84 00 - Firestopping.
  - 9. 26 05 11 - Requirements for Electrical Installations.
  - 10. 26 05 21 - Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
  - 11. 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 12. 26 05 33 - Raceways and Boxes for Electrical Systems.
  - 13. 26 05 41 - Underground Electrical Construction.
  - 14. 26 41 00 - Facility Lightning Protection.
  - 15. 27 05 11 - Requirements for Communications Installations.
  - 16. 27 05 26 - Grounding and Bonding for Communications Systems.
  - 17. 27 05 33 - Raceways, Conduits and Boxes for Communications Systems.
  - 18. 27 11 00 - Communications Equipment Room Fittings.
  - 19. 27 13 00 - Communications Backbone Cable Equipment and System.
  - 20. 27 15 00 - Communications Horizontal Cable Equipment and Systems.
  - 21. 28 05 13 - Conductors and Cables for Electronic Safety and Security.
  - 22. 28 05 26 - Grounding and Bonding for Security Systems.
  - 23. 28 05 28.33 - Conduits and Back boxes for Electronic Safety and Security.
  - 25. 27 31 31 - Voice (Telephone PBX) Communications Switching Equipment and Systems - EXTENSION.
  - 26. 27 32 41 - Two Way Radio Equipment.
  - 27. 27 41 31 - Master Antenna Television Equipment and System.

28. 27 51 16 - Public Address Equipment and Systems.

30. 27 51 23 - Intercommunications and Program Equipment and System.

C. The following information is in addition to those identified herein: AHJ Ordinance and / or Supplemental Rules for Public Safety Radio Enhancement / Emergency Responder Amplification Systems.

### 1.3 DEFINITIONS

A. In addition to the requirements of SECTION 01 00 01, GENERAL CONDITIONS; the following are made a part of this document:

B. REVIEW OF CONTRACT DOCUMENTS - a service by the CFM AE, PM, RE AND VACO SMCS to reduce the possibility of materials being ordered which do not comply with contract documents. The review shall not relieve the Contractor of responsibility for dimensions or compliance with the contract documents. The reviewer's failure to detect an error does not constitute VA's permission for the Contractor to proceed in or with the error.

1. VA Headquarters (aka VACO) Project Review: Is required for National and Local Building Codes, Standards and Guidelines Compliance, contact:

- a. RE: CFM, Resident Engineer,
- b. SRE: CFM, Senior Resident Engineer,
- c. PM: CFM, Project Manager (may be intermixed with the Facility's PM),
- d. PE: CFM, Project Executive (also relates to the "Professional Engineer" Certification),
- e. CO: CFM, Contracting Officer (may be intermixed with the Facility's CO), and
- f. Owner: Typically (VA, VAMC, OPC, CBOC, etc.).
- h. AE: FreemanWhite CFM's, Contracted Project's Architectural Engineering Firm.

2. VACO Technical Review: Is required for VA Security; Low Voltage Telecommunications, RF, FAA, FCC and other Spectrum Coordination, Licensing and operating permits; Life and Public Safety, Critical and Emergency Codes, Standards and Guideline Compliance; AND, System(s) Interim and Proof of Performance Testing, VA Final Technical Acceptance, Functional and Operational Certification, contact:

- a. VACO: Department of Veterans Affairs Office of Telecommunications (005) Telecommunications Engineering (005OP) Spectrum Management and COMSEC Service Special Communications Team (005OP2H3a)  
810 Vermont Avenue NW, (1100 1st NW, Area 501L) Washington, DC 20420  
301-734-0376, 202, 632, 7754 or 202-461-5897

b. VACO, OFFICE OF TELECOMMUNICATIONS, ENTERPRISE ENGINEERING, SPECTRUM MANAGEMENT AND COMMUNICATIONS SECURITY (COMSEC) SERVICE (SMCS) IS THE AUTHORITY HAVING JURISDICTION (AHJ - see SME PART 1, PARAGRAPHS 1.3.A.2, 1.3.B.41 & 1.4.B.1.a.[7][a]) FOR THE LOW VOLTAGE SPECIAL COMMUNICATIONS AND COMSEC SYSTEMS AND EQUIPMENT (EXCEPT FIRE ALARM, Telephone and Data); PLUS, RF CO-ORDINATION REQUIRED THROUGH-OUT VA'S MEDICAL SYSTEM BY ORDER OF THE SECRETARY (RE PART 1, PARAGRAPH 1.4.B.1.a.(7)(a): VICE THE SIGNED AND EXECUTED MP-6, PART VIII - TELECOMMUNICATIONS, CHAPTER 5-AUDIO, RADIO AND TELEVISION COMMUNICATIONS SYSTEMS.

- 1) For each of the DIVISION 27 & 28 Publication referred and used here-in, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should and will" where it appears.
- 2) Interpret references in these publications to the "AHJ," or words of similar value, to mean the CFM: PE, PM, RE or CO for Project / Contract Guidance; AND VACO SMCS for Technical Concurrence.

3. Construction Responsible Entities: The following firms / individuals form the Project / Contract's primary core for the building / construction:

- a. PC: Prime Contractor (aka General Contractor),
- b. System Contractor: The Contractor; you - the successful bidder,
- c. OEM: The Systems' "Original Equipment Manufacturer,"
- d. Project Engineer(s): **The System OEM's:**

Lead Designer,

//XXXXXXXX//	Lead Engineer,
//XXXXXXXX//	Lead Technician,
//XXXXXXXX//	Other OEM Technicians, and
//XXXXXXXX//	Project Manager

B. **THE FOLLOWING ACRONYMS** are made a part of this document and are in addition to the ones aforementioned and later herein:

1. AHJ - Authority Having Jurisdiction - SMCS (0050P2H3) for Low Voltage Telecommunications Systems (Re PART 1, PARAGRAPHS 1.3.A.2.a & b; 1.4.b.1.a. (7) (a) and 1.8.A. & B,
2. AWG - American Wire Gauge (originally North American Wire Gauge; see STP & UTP) - also known as the Brown & Sharpe wire gauge, is a system used for standardizing all wire and cable conductors cross-sectional area (diameters) that has been in use since 1857 pre-dominantly in the United States and Canada,
3. AWS - Advanced Wireless Services (synonymous with AWS and UMTS),
4. BDA - Bi-Directional Amplifier,

5. BICSI - Building Industries Communications Services Installation,
6. BIM - Building Information Modeling (aka Model),
7. BOM - CFE or GFE Bill of Materials,
8. BUCR - Back-up Computer Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-4),
9. BTS - Base Transceiver Station,
10. CFE - Contractor (or OEM) Furnished Equipment,
11. CFR - Consolidated Federal Regulations - that governs ALL Federal Contracts / Projects.
12. CUP - Conditional Use Permit(s)-Federal/GSA for VA,
13. DBm - Deci-Bell, Measured.
14. DBmV - Deci-Bell per Mili-Volt,
15. ECC - Engineering Control Center; sometimes referred to The Emergency Control Center, - (see EMCR, re PG 18-10, Page B-5),
16. EMCR - Emergency Management Control Room" - (see ECC, re PG 18-10, Page B-5),
17. EMI - Electromagnetic Interference - also called Radio Fre-quency Interference or RFI when a high frequency (or radio frequency) disturbance affects an electrical cir-cuit due to either electromagnetic induction or electro-magnetic radiation emitted from an external source (see ESI, RFI),
18. EMT - Electrical Metallic Tubing - relates to "thin wall" non-rigid metal conduit,
19. ENTR - Utilities Entrance Location (see DEMARC, POTS, LEC)" - (re PG 18-10, Page B-5),
20. ESI - Electrostatic Interference - also called "Electro-static Discharge Interference (ESD) - ESD is the tran-sfer of static charge between bodies of different elec-trostatic potential, in the proximity or through direct contact (see EMI, RFI),
21. ESR - Vendor Engineering Service Report,
22. ERTF - Real Time Location System,
23. FA - Fire Alarm - is a system that is installed in VA Facili-ties to protect the building and installed property,
24. GFE - Government Furnished Equipment,"
25. HE - Antenna Head End Room - (re PG 18-10, Page B-5; OI&T De-sign Guide PG 18-12, Page 4-76; see HEC, HEIC, PA, RPEC),
26. HEC - Head End Cabinet(s) - (re PG 18-10, Page B-5; OI&T De-sign Guide PG 18-12, Page 4-76; see HE, HEIC, PA, RPEC),

27. HEIC - Head End Interface Cabinet(s) - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-76; see HE, HEC, PA RPEC),
28. HSPA - High Speed Packet Access,
29. iDEN - Integrated Digital Enhanced Network,
30. ICRA - Infection Control Risk Assessment,
31. ILSM - Interim Life Safety Measures,
32. ISM - Industrial, Scientific, Medical,
33. LAN - Local Area Network (see VoIP, WAN) - is a digital / data based network localized within a given structure (VA'S LAN IS NOT AUTHORIZED FOR LIFE AND PUBLIC SAFETY, CRITICAL OR EMERGENCY FUNCTIONS UNTIL IT'S CERTIFIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY AN AP-PROVED UDOC NRTL - SEE PART 1, PARAGRAPH 1.4.B.1.a. [5]),
34. LBS - Location Based Services,
35. LEC - Local Exchange Carrier - (aka the Local Telephone Company; see DEMARC, PBX & POTS),
36. LMR - Land Mobile Radio,
37. LTE - Long Term Evolution,
38. MCR - Main Computer Room - (re PG 18-10, Page B-5, OI&T De-sign Guide PG 18-12, Pages 2-18, 4-9),
39. MCOR - Main Computer Operators Room - (re PG 18-10, Page B-5),
40. MH - Man Hole (aka Maintenance Holes) are structures used to provide access to outside buried conduit runs in or-der to allow compliance for signal interconnection, pro-tecton and long run operations across wide areas and multiple buildings/locations,
41. MOU - Memorandum of Understanding,
42. MW - Microwave (RF Band, Equipment or Services),
43. NID - Network Interface Device - (see DEMARC),
44. NEC - National Electric Code - is the main part of NFPA's Standards and Guides referenced herein,
45. NFPA - National Fire Protection Association - establishes min-imum standards for the protection of life and buildings in VA Projects,
46. NOR - Network Operations Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-54),
47. NS - Nurse Station(s) - (re PG 18-10, Page B-5),
48. OI&T - VA's Office of Information and Telecommunications (re OI&T Design Guide PG 18-12, Page 2-1),
49. OSHA - Occupational Safety and Health Administration,

- 50. OTDR - Optical Time Domain Reflectometer relating to the primary piece of test equipment for evaluating fiberoptic cable plants,
- 51. PA - Public Address / Cabinet(s) (re PG 18-10, Page B-5; see HE, HEIC, RPEC),
- 52. PBX - Private Branch Exchange (see DEMARC, LEC, POTS; aka EPBX or Electronic Private Branch Exchange - a reference that is being phased out and will no longer be used in VA) is the typical acronym for a Telephone Switch not owned by the Telephone Company that is NFPA CRITICAL SERVICE LIST-ED AND VA APPROVED FOR THE DIRECT MANAGEMENT OF THOSE LIFE SAFETY CODE AND OSHA REQUIRED FACILITIES MANAGEMENT SERVICE'S (FMS) LIFE & PUBLIC SAFETY, CRITICAL AND EMERGENCY COMMUNICATIONS SYSTEMS (re OI&T Design Guide PG 18-12, Page 4-20),
- 53. PCR - Police Control Room (see SPCC), could be designated SCC" (re PG 18-10, Page B-5),
- 54. PCS - Personal Communications Service,
- 55. POE - Power over Ethernet,
- 56. POTS - Plain Old Telephone System (see DEMARC, LEC, PBX),
- 57. PSRAS - Public Safety Radio Amplification Systems,
- 58. PTS - Pay Telephone Station (may or may not be required); OR may be provided on as a portable station controlled by the using Service Chief (re PG 18-10, Page B-5),
- 59. PVC - Poly-Vinyl Chloride" - relates to a form of plastic,
- 60. RAN - Radio Access Network,
- 61. RFI - "Radio Frequency Interference" is the Electromagnetic Radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits (see EMI, ESI),
- 62. RFID - RF Identification,
- 63. RPEC - Radio Paging Equipment Cabinet(s) - (see HE, HEC, HEIC, PA; PG 18-10, Page B-5),
- 64. RUS - The DoA's - "Rural Utilities Service" which is technical standards issued (for telecommunications services here-in). Also, RUS BULL is "Rural Utilities Service Bulletin" applied for the aforementioned telecom service,
- 65. RSSI - Mobile Telecommunications System,
- 66. RTLS - Real Time Location Service / System,

- 68. SME - Subject Matter Expert - (re, PART 1-GENERAL, PARA-GRAPHS 1.3.A.2-[VACO SMCS] and 1.4.B.1.a. [7] [a] - VACO SMCS as AJS),
- 69. SMR - Specialized Mobile Radio,
- 70. STP - Shielded Twisted Pair (see AWG & UTP)- relating to communications wire and cable that has copper conductors that are twisted to reduce or eliminate interference and crosstalk with an internal cable shield necessary for installation in locations susceptible to high levels of interference,
- 71. STR - Stacked Telecommunications Rooms; also just Telecommunications Room (see TR)" - this term replaces "Signal and/or Telecommunications Closet" that are no longer used. Additionally, each TR shall be designed to provide occupancy for all OI&T AND FMS Low Voltage Communications Systems/Equipment (re Electrical Design Manual, PG 18-10, Sections 7 & 8, Physical Security Design Manual for VA Facilities, PG 18-10 AND OI&T Design Guide PG 18-12, Pages 2-20 & 4-84),
- 72. TCO - Telecommunications Outlet - is a device that is specifically constructed to afford the TIP a place to terminate in a useable apparatus in designated locations. The TCO's design is detailed herein,
- 73. TOR - Telephone Operators Room - (re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-92),
- 74. TER - Telephone Equipment Room - (see PBX; re PG 18-10, Page B-5; OI&T Design Guide PG 18-12, Page 4-50),
- 75. TR - Telecommunications Room - is a standalone room that houses OI & T and FMS equipment and systems cross-connections for servicing a specific area (see STR),
- 76. UMTS - Universal Mobile Telecommunications System,
- 77. UPCS - Unlicensed Personal Communications Service
- 78. UL - Underwriters Laboratories - is one of the approximate 15 USDC approved NRTLs (see PART 1, PARAGRAPH 1.4.B.1.a. [5]),
- 79. UTP - Unshielded Twisted Pair (see AWG & TWP) - relates to communication wire and cable that has copper conductors and are twisted to reduce or eliminate interference and cross-talk without an internal cable shield,
- 80. UV - Ultra Violet,
- 81. VoIP - Voice over Internet Protocol (see PBX, LAN, WAN) - is an emerging technology that is replacing POTS & PBX voice equipment (VA'S VoIP IS NOT AUTHORIZED FOR LIFE & PUBLIC SAFETY, CRITICAL, EMERGENCY OR SAFETY FUNCTIONS UNTIL IT'S CERTIFIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY

AN APPROVED UDOC NRTL - SEE PART 1, PARA-GRAPH 1.4.C.1.e.; OI&T Design Guide PG 18-12, Page 4-14),

82. WAN - "Wide Area Network (see LAN, VoIP)" is a digital (data) network that transcends localized LANs within a given structure (VA'S WAN IS NOT AUTHORIZED FOR LIFE & PUBLIC SAFETY, EMERGENCY OR SAFETY FUNCTIONS UNTIL IT'S CERTI-FIED AND LISTED MEETING NFPA'S LIFE SAFETY CODE BY AN APPROVED UDOC NRTL - SEE PART 1, PARAGRAPH 1.4.C.1.e; see LAN),
83. WiFi - Wireless Fidelity,
84. WiMAX - Worldwide Interoperability for MW Access,
85. WMTS - Wireless medical Telemetry Service, and
86. 24/7 - Is the shortened designation of 24 hours a day, seven days per week and 52 weeks per year.

C. **ADDITIONALLY:** The following language is required to form a part of this document (re SECTION 27 05 26, GROUNDING AND BONDING FOR COM-MUNICATIONS SYSTEMS for additional required information). The terms:

1. Provide is considered as being: Designed, engineered, furnished, installed, tested and guaranteed by the Contractor AND the system equipment's OEM; plus, being concurred and certified by SMCS-0050P2H3,
2. Supervision:

a. <u>Electrical</u>	Is the electrical and/or electronic operation of completely (aka full time) analyzing a system's functional components (ie cable breaks / shorts), in-operative stations, lights and state(s) of change (ie from primary to backup) functions 24/7/365; <b>and</b> provides aural and visual emergency notification signals to at least two remote designated / approved monitoring stations,
b. <u>Government</u>	It is the responsibility of the RE or the RE's assigned inspector to observe the Contractor's employees <b>installing cable, conduit &amp; pathway(s)/ wire way(s), System Ground develop-ment and installation</b> , inside and outside plant housings, splices, cleanup, and other related work items associated with the system(s) construction project.
c. <u>Contractor</u>	It is the responsibility of the Contractor to directly manage the Contractor's employees work as outlined by this document throughout the system(s) project.
d. <u>OEM</u>	It is the responsibility of the OEM or the OEM's assigned liai-son to assist the Contractor in all functions / requirements / operations outlined herein throughout the project.



3. System: Used interchangeably with "The System" is the common word that is applied for each SECTION's specific system in order to shorten each SECTION's written NOT TECHNICAL content,
4. Work: Materials furnished and completely installed by the Contractor. The System work shall be complete, OSHA NRTL (i.e. [UL]) - Listed AND Labeled on each item of installed equipment / part; AND VACO SMCS 0050P2H3a tested, certified and designated ready for operation (re "Work Performance," PART 1, PARAGRAPH 1.12).
5. Grounding and Bonding (re SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS):

a. <u>Grounding electrode conductor</u>	Shall refer to the earth grounding electrode that is connected to the separate circulating telecommunications grounding conductor, to the equipment grounding conductor at the source of a separately derived system.
b. <u>Grounding electrode system</u>	Refers to an electrode(s) as specified in the National Electrical Code, Article 250. All electrodes required by NEC, as well as including supplementary, telecommunications system grounding electrodes.
c. <u>Telecommunications Bonding Backbone</u>	Or " <b>TBB</b> " shall refer to a conductor(s) of appropriate size (minimum 1/0 Stranded AWG), which connects each telecommunications main grounding busbar ( <b>TMGB</b> ) and circulates to interconnect various telecommunications grounding busbars ( <b>TGB</b> ) and in the locations shown on the drawings.
d. <u>Connect and bond</u>	Are used interchangeably herein and shall mean "the permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed" having the same meaning.
e. <u>effectively grounded</u>	Shall mean intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or persons.
f. <u>Grounding equalizer</u>	Shall refer to the conductor that interconnects elements of the telecommunications grounding infrastructure.

#### 1.4 APPLICABLE PUBLICATIONS AND VESTED FEDERAL, STATE AND LOCAL LAWS (DO NOT DELETE):

- A. In addition with the requirements in SECTION 01 00 01, GENERAL CONDITIONS; the following is made a part of this document:

1. ORDER OF PRECEDENCE OF APPLYING STANDARDS AND CODES: In the case of a conflict or duplicate code or standard (re PART 1, PARAGRAPHS 1.8.A), use the following deciding guidance for:
  - a. Duplicate Codes / Standards: Use the most recent Federal Code / Standard (unless the State and Local Code addresses increased specific regional safety requirements [ie roof construction in Florida, increased Seismic requirements in California, etc.]), and
  - b. Conflict of Codes / Standards: Use the more stringent Code / Standard.
- B. **IN ADDITION TO THE REQUIREMENTS OF SECTION 01 42 19 - REFERENCE STANDARDS (DO NOT DELETE)**: The following information is made a part of the System's design and installation minimum requirements; and the installation shall fully comply with all governing authorities, laws and ordinances, regulations, and including, but not limited to UNITED STATES FEDERAL LAW and The following Agencies' requirements form a part of the System's Project Documents a directed by formal regulations vested in United States Federal Law:
  - C. **US Departments of Agriculture, (USDA** - Title 7, USC, Chapter 55, Sections 2201, 2202 & 2202) - organized in 1862 by President Abraham Lincoln and formally established by Congress in 1820 & 1825 and final establish Law on February 9, 1889. The following USDA Standards apply to this document:
    - RUS 1755 .....Telecommunications Standards and Specifications for  
Materials, Equipment and Construction,
    - RUS Bull 1751F-630 .....Design of Aerial Cable Plant(s),
    - RUS Bull 1751F-640 .....Design of Buried Cable Plant, Physical Considerations,
    - RUS Bull 1751F-643 .....Underground Plant Design,
    - RUS Bull 1751F-815 .....Electrical Protection of Outside Plant(s),
    - RUS Bull 1753F-201 .....Acceptance Tests of Telecommuni-cations Plant(s) (PC-4),
    - RUS Bull 1753F-401 .....Splicing Copper and Fiber Optic Cables (PC-2),
    - RUS Bull 345-50 .....Trunk Carrier Systems (PE-60),
    - RUS Bull 345-65 .....Shield Bonding Connectors (PE-65),
    - RUS Bull 345-72 .....Filled Splice Closures (PE-74),
    - RUS Bull 345-83 .....Gas Tube Surge Arrestors (PE-80).
  - D. **US Department of Commerce, (USDC** - Public Law 426-62, CFR, Title 15 - Under the Information Technology Management Reform Act; Public Law 104-106, the Secretary of Commerce approves standards and guidelines that are developed by the):  
**National Institute of Standards Technology, (NIST** - formerly the National Bureau of Standards, now P/O Com-merce). Under Section 5131 of the Information Technology Management Reform Act of 1996 and the Federal Information Security Management Act of 2002 (*Public Law 107-347*), NIST develops **Federal Information**

**Processing Standards Publication (FIPS)** requirements, Chapter II. The following NIST FIPS Documents forms a part of this document:

FIPS PUB 1-1 ..... Telecommunications Information Ex-change,  
 FIPS PUB 100/1 ..... Interface between Data Terminal Equipment (DTE) Circuit Termining Equipment for operation with Packet Switched Networks, or Between Two DTEs, by Dedicated Circuit,  
 FIPS PUB 140/2 ..... Telecommunications Information Security Algorithms,  
 FIPS PUB 143 ..... General Purpose 37 Position Interface between DTE and Data Circuit Terminating Equipment,  
 FIPS 160/2 ..... Electronic Data Interchange (EDI),  
 FIPS 175 ..... Federal Building Standard for Telecom-munications Pathway and Spaces,  
 FIPS 191 ..... Guideline for the Analysis of Local Area Network Security,  
 FIPS 197 ..... Advanced Encryption Standard (AES)  
 FIPS 199 ..... Standards for Security Categorization of Federal Information and Information Systems.

E. **Federal Communications Commission, (FCC, P/O Commerce - The Communications Act of 1934 [as amended], CFR, Title 47, Telecommunications)** - the following FCC Rules / Regulations / Requirements applies to this document:

Part 15 ..... Restrictions of use for Part 15 listed RF Equipment in Safety of Life Emergency Functions and Equipment Locations (also see CFR, Title 15 - Department of Commerce, Chapter XXIII - NTIA below),  
 Part 47 ..... Chapter A, Paragraphs 6.1-6.23, Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment,  
 Part 58 ..... Television Broadcast Service,  
 Part 73 ..... Radio and Television Broadcast Rules,  
 Part 90 ..... Rules and Regulations, Appendix C,  
 Form 854 ..... Antenna Structure Registration.  
 Chapter XXIII ..... National Telecommunications and Information Administration (NTIA - aka 'Red Book') Chapters 7. 8. / 9; CFR, Title 47 FCC Part 15, RF Restriction of Use and Compliance in "Safety of Life" Functions & Locations.

F. **Department of Defense, (DoD, The National Security Act of 1947)** - formed the National Military Establishment; re-organized to The Department of Defense (DoD)

on August 10, 1949 as an Amendment to the 1947 Law. The following DoD guidelines apply to this document:

MIL-STD-188-110 ..... Interoperability and Performance Standards for Data Modems,

MIL-STD-188-114 ..... Electrical Characteristics of Digital Interface Circuits,

MIL-STD-188-115 ..... Communications Timing and Synchronizations Subsystems,

MIL-C-28883 ..... Advanced Narrowband Digital Voice Terminals.

- G. Department of Health, (HHS, Public Law 96-88, CFR, Title 42, Chapter IV Health & Human Services [HHS], CFR, Title 46, Subpart 1395[a], [b] defines the Joint Commission of Accreditation of Hospital Organization [JCAHO - RE PART 1, PARAGRAPH 1.4.E.1] - **The Secretary of HHS has decreed "a hospital that meets JCAHO accreditation is deemed to meet the Medi-care conditions of Participation by meeting Federal Directives" in:**

**Life Safety System References,**

**Critical Safety System References,**

**Public Safety System References,**

**Telephony System Engineering References,**

**Data / Digital Systems Engineering References,**

**Information Security References.**

- H. Department of Labor, (DoL, Public Law 426-62 - CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards). The following OSHA Standards apply to this document:

**Subpart 7** - defines the requirements for a Nationally Recognized Testing Laboratory (NRTL) - for complete list, of authorized NRTLs contact their below WEB Site. The following are four (4) of the approximate 15 approved NRTLs (obtain a copy at):([http://www.osha.gov/dts/otpc/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpc/nrtl/faq_nrtl.html))

**UL** (re Part 1, Paragraph 1.4.B.8): The following UL Standards apply to this document:

UL01 ..... Flexible Metal Conduit,

UL05 ..... Surface Metal Raceways and Fittings,

UL06 ..... Rigid Metal Conduit,

UL44 ..... Standard for Thermoset-Insulated Wires and Cables,

UL50 ..... Enclosures for Electrical Equipment,

UL65 ..... Standard for Wired Cabinets,

UL83 ..... Standard for Thermoplastic-Insulated Wires and Cables,

UL96 ..... Standard for Lightning Protection Components,



UL1863 ..... Standard for Safety, communications Circuits  
Accessories,  
UL1865 ..... Standard for Safety for Vertical-Tray Fire Protection  
and Smoke-Release Test for Electrical and Optical-Fiber  
Cables,  
UL2024 ..... Standard for Optical Fiber Raceways,  
UL2196 ..... Standard for Test of Fire Resistive Cable,  
UL60950-1/2 ..... Standard for Safety of Information Technology Equipment  
Safety.

Canadian Standards Association, (CSA - same tests as presented by UL),  
Communications Certifications Laboratory, (CCL - same tests as presented by UL),  
Intertek Testing Services NA, Inc., (ITSNA - formerly Edison Testing Laboratory  
[ETL] - same tests as presented by UL),

Subpart 35 - Compliance with NFPA 101, Life Safety Code,

Subpart 36 - Design and construction requirements for exit routes,

Subpart 268 - Telecommunications,

Subpart 305 - Wiring methods, components, and equipment for general use.

- I. Department of Transportation, (DoT, Public Law 85-625, CFR, Title 49, Part 1,  
Subpart C - Federal Aviation Administration [FAA]) - the following FAA  
requirements form a part of this document:

AC 110/460-ID & AC 707 / 460-2E - Advisory Circulars Standards for Construction  
of Antenna Towers,

7450 and 7460-2 - Antenna Construction Registration Forms.

Federal Specifications for Signal / Communications Standards (FED SPEC) - the  
following FED SPECS forms a part of this document:

A-A-59544-00 ..... Cable and Wire, Electrical (Power, Fixed Installation),

1003 ..... Synchronous Bit Oriented Data Link Control Procedures,

1020 ..... Electrical Characteristics of Balanced Voltage Digital  
Interface Circuits,

1030 ..... Electrical Characteristics of Un-Balanced Voltage  
Digital Interface Circuits, and

1037 ..... Glossary of Telecommunications Terms.

- J. Department of Veterans Affairs (USDVA or VA, Public Law No. 100-527), CFR, Title  
38, Volumes I & II) - the following VA requirements form a part of this  
document:

OFFICE OF TELECOMMUNICAITONS, MP-6, PART VIII, TELECOMMUNICAITONS, CHAPTER 5,  
AUDIO, RADIO AND TELEVISION (and COMSEC) COMMUNICATIONS SYSTEMS (RE PART 1,  
PARAGRAPH B):

Spectrum Management and COMSEC Service (SMCS):

FAA, FCC, & NTIA RF Compliance and Licensing Program,

COMSEC co-ordination and control of security / classified communication assets,

CoG, "Continuance of Government" communications guidelines and compliance,

COOP, "Continuance of Operations" emergency communications guidelines and compliance,

Wireless and Handheld Device(s) guidelines and compliance,

SATCOM - "Satellite Communications" guidelines and compliance,

Low Voltage Special Communications - Construction Contract Specifications and

Drawings Conformity, Proof of Performance Testing, VACO Compliance and Life

Safety Certification(s) for CFM and VA Facility Low Voltage Special

Communications Projects (EXCEPT Fire Alarm, Telephone and Data Systems).

Handbook 6100 - Telecommunications: - Cyber and Information Security (OCIS),

Handbook 6500 - Information Security Program.

VA's National Center for Patient Safety - Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.

VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.

#### OFFICE OF CFM:

PG-18-1, Master Construction Specifications (See Paragraph 1.1.2),

PG-18-4, Standard Detail and CAD Standards

PG-18-5, Equipment Guide List

PG-18-10, Manuals by Discipline

Electrical Design Manual,

Physical Security, Mission Critical Facilities

Physical Security, Life-Safety Protected,

VA Directive 0730, Security and Law Enforcement,

PG-18-3,.Design and Construction Production Procedures

Fire Protection,

Heating, Air, Ventilation and Cooling (HAVC),

PG-18-12, OI&T Design Guide

Additional CFM Design Guides & Manuals (re Part 1, Paragraph 1.2),

PG-18-15, Minimum Requirements of A/E Submissions:

Volume B - Major New Facilities, Major Additions; and Major Renovations, Article VI, Paragraph B,

Volume C - Minor and NRM Projects, Article III, Paragraph S,

Volume E - Request for Proposals Design/Build Projects, Article II, Paragraph F,

Solicitation for Offerors (SFO) for Lease Based Clinics (05-2009).

- K. Local and Regional Codes (LRC): The following Regional requirements form a part of the System's Project Documents as directed by each formal regulation(s) vested in State, City /Town Local Law and Jurisdictional Code(s) / Regulations (re PART 1, PARA-GRAPHS 1.4.A,E, 1.6 & 1.8.A). The following LRC's apply to this document:

State:

Law,

Hospital Code(s),

Regulations,

Directives,

Codes,

Town:

Ordinances,

Regulations,

Codes,

City:

Ordinances,

Regulations,

Codes,

County:

Ordinances,

Regulations,

Codes.

- L. COMMERCIAL / NATIONAL CODES: The following Agencies' requirements have been accepted to form a part of the System's Project Documents as provided by formal agreement(s) by VA and each Agency (re PART 1, PARAGRAPHS 1.4.A,D, 1,6 & 1.8.A):
- JCAHO - Re PART 1, PARAGRAPH 1.4.C.1.d,
- American Institute of Architects (AIA) - Guidelines for Health Care Facilities,
- American National Standards Institute / Electronic Industries Association / Telecommunications Industry Association (ANSI/ EIA / TIA) - the following ANSI/EIA/TIA Standards apply to this document:
- ANSI-C2 .....National Electrical Safety Code, Part 2 - Safety Rules  
for Overhead Lines,
- TIA/EIA-423 .....Electrical Characteristics of Unbalanced Voltage Digital  
Interface Circuits,
- TIA-455-46A .....Spectral Attenuation Measurement for Long Length, Graded  
Index Optical Fibers,



TIA/EIA-455 ..... Standard Test Procedure for Fiber Optic Fibers, Cables,  
 Transducers, Sensors, Connecting and Terminating  
 Devices, and Other Fiber Optic Components,  
 TIA-455-78B ..... Optical Fibres - Part 1-40: Measurement Methods and Test  
 Procedures - Attenuation,  
 TIA-455-107 ..... Determination of Component Reflectance or Link/ System  
 Return Loss using a Loss Test Set,  
 TIA/EIA-455-204 ..... Standard for Measurement of Bandwidth on Multimode  
 Fiber,  
 TIA/EIA 455-213 ..... Optical Fiber Amplifiers, Basic Specifi-cation Test  
 methods for Out-of-Band Insertion Losses Fil-tered  
 Optical Power Meter,  
 TIA-472D-000 ..... Fiber Optic Communications Cable for Outside Plant Use,  
 IA-492AAA ..... 62.5-Um Core Diameter/125-um Cladding Diameter Class 1a  
 Graded-Index Multimode Optical Fibers,  
 TIA-492AAAB ..... 50-Um Core Diameter/125-Um Cladding Diameter Class IA  
 Graded-Index Multimode Optically Optimized AMERICAN  
 STANDARD Fibers (DO NOT SUBSTITUTE; re PART 2, PARAGRAPH  
 2.4.E.2.b.),  
 TIA-492CAAA ..... Detail Specification for Class IVa Dispersion- Unshifted  
 Single-Mode Optical Fibers,  
 TIA-492E000 ..... Sectional Specification for Class IVd Nonzero-  
 Dispersion Single-Mode Optical Fibers for the 1,550 nM  
 Window,  
 EIA/TIA 496A ..... Interface between Data Circuit Terminating Equipment and  
 the Public Switched Telephone Network,  
 TIA 526-7 ..... Measurement of Optical Power Loss of Installed Single  
 Mode Fiber Cable Plant,  
 EIA 526-14 ..... Optical Power Loss Measurements of Installed Multimode  
 Fiber Cable Plant,  
 EIA 530 ..... High Speed 25 Position interface for Data Terminal  
 Equipment and Data Circuit Terminating Equipment,  
 TIA 562 ..... Electrical Characteristics for an Unbalanced Digi-tal  
 Interface,  
 TIA 568/0 ..... Standard for Installing Commercial Building  
 Telecommunications Cabling,  
 TIA 568/2 ..... Commercial Building Telecommunications Cabling Standard,  
 Part 2: Balanced Twisted Pair Cable Components,

TIA 568-C0 ..... Telecommunications Cabling for Customer Premises,  
TIA 568-C1 ..... Commercial Building Telecommunications Cabling Standard,  
TIA 568-C2 ..... Balanced Twisted-Pair Telecommunications Cab-ling and  
                    Components Standards,  
TIA 568-C3 ..... Optical Fiber Cabling Components Standard,  
TIA 569-A ..... Commercial Building Standard for Telecom-munications  
                    Pathways and Spaces,  
TIA 569-B ..... Commercial Building Standard for Telecommunica-tions  
                    Pathways and Spaces,  
TIA 569-B.1 ..... Part 1, General Requirements, Commercial Building  
                    Telecommunications Cabling,  
TIA 574-9 ..... Position Non-Synchronous Interface between Data Terminal  
                    equipment and Data Circuit Terminating Equipment  
                    Employing Serial Binary Interchange,  
TIA-590 ..... Standard for Physical Location and Protection of Below  
                    Ground Fiber Optic Cable Plant,  
TIA 606A ..... Administration Standard for the Telecommuni-cations  
                    Infrastructure of Communications Buildings,  
TIA J-STD-607 ..... Commercial Building Grounding (Earthing) and Bonding  
                    Requirements for Telecommunications,  
EIA 613 ..... High Speed Serial Interface for Data Terminal Equipment  
                    and Data Circuit Terminal Equipment,  
TIA 668-527 ..... Wireless Features Description,  
TIA 758 ..... Customer Owned Outside Plant Telecommunications  
                    Infrastructure Standard,  
TIA 942 ..... Telecommunications Infrastructure Standard for Data  
                    Centers,  
TIA 1152 ..... Requirements for Field Testing Instruments and  
                    Measurements for Balanced Twisted Pair Cabling,  
TIA 1179 ..... Healthcare Facility Telecommunications Infras-tructure  
                    Standard,  
BS EN 50109-2(\*) ..... Hand Crimping Tools - Tools for The Crimp Termination  
                    of Electric Cables and Wires for Low Frequency and Radio  
                    Frequency Applications - All Parts & Sections.

American Society of Mechanical Engineers (ASME) - the follow-ing ASME Standards  
apply to this document:

Standard 17.4 ..... Guide for Emergency Personnel,

Standard 17.5 ..... Elevator & Escalator Equipment (prohibited of installing non-elevator equipment in Elevator Equipment Room / Mechanical Penthouse).

American Society of Testing Material (ASTM) - the following ASTM Standards apply to this document:

B1 ..... Standard Specification for Hard Drawn Copper Wire,  
 B8 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft,  
 B258 ..... Standard Specification for Standard Nominal Diameters and Cross-Sectional Areas AWG Sizes of Round Wires Used as Electrical Conductors,  
 D709 ..... Laminated Thermosetting Materials,  
 D1557 ..... Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>) (2700 kN-m/m<sup>3</sup>),  
 D2301 ..... Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape,  
 D4566 ..... Standard Test Methods for Electrical Performance Properties of Insulation and Jackets for Telecommunications Wire and Cable.

American Telephone and Telegraph Corporation (AT&T)- the following AT&T Publications apply to this document (copies may be obtained at <https://ebiznet.sbc.com/SBCNEBS/>):

ATT-TP-76200 ..... Network Equipment and Power Grounding, Environmental, and Physical Design Requirements,  
 ATT-TP-76305 ..... Common Systems Cable and Wire Installation and Removal Requirements - Cable Racks and Raceways,  
 ATT-TP-76300 ..... AT&T Installation Requirements (and ICRN's Change Notices),  
 ATT-TP-76306 ..... Electrostatic Discharge Control,  
 ATT-TP-76400 ..... Detail Engineering Requirement (and ICRN's Change Notices),  
 ATT-TP-76402 ..... AT&T Raised Access Floor Engineering and Installation Requirements,  
 ATT-TP-76405 ..... Technical Requirements for Supplemental Cooling Systems in Network Equipment Environments,  
 ATT-TP-76416 ..... Grounding and Bonding Requirements for Network Facilities,

ATT-TP-76440 ..... Ethernet Copper Cable & Ethernet Copper Assembly  
Specification,  
ATT-TP-76450 ..... Common Systems Equipment Interconnection Standards for  
the AT&T Local Exchange Companies and AT&T Corporation,  
ATT-TP-76461 ..... Fiber Optic Cleaning,  
ATT-TP-76900 ..... AT&T Installation Testing Requirement,  
ATT-TP-76911 ..... AT&T LEC Technical Publication Notice,  
ATT-812-000-705 ..... Technical Requirements for Thermal Management Systems in  
Network Equipment Environments.

(NOTE: SMCS-0050P2H3a - will evaluate contractor considered and produced equal document(s) to the aforementioned AT&T Commercial Publications, on a case-by-case basis as long as each supplied document is complete and on the originator (not the contractor or OEM) letterhead and enclosed in its published technical binder.

Building Industries Communications Services Installation (BICSI) - the following BICSI Standards apply to this document:

All standards for smart building wiring, connections and devices for commercial and medical facilities,

Standards for Structured Building Cable Topologies,

Standards in consort with ANSI/EIA/TIA.

Institute of Electrical and Electronics Engineers (IEEE) - the following IEEE Standards apply to this document:

C62.41 ..... Surge Voltages in Low Voltage AC Power Circuits

SO/TR 21730 ..... Use of mobile wireless communication and computing technology in healthcare facilities, Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices,

81-1983 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System,

100 ..... The Authoritative Dictionary of IEEE Standards and Terms,

0739-5175 ..... Medical Grade, Mission Critical and Wireless Networks,

1100 ..... Powering and Grounding Sensitive Electronic Equipment.

Insulated Cable Engineers Association (ICEA) - the following ICEA Standards apply to this document:

S-87-640 ..... Optical Fiber Outside Plant Communications Cable,

S-98-688 ..... Broadband Twisted Pair Telecommunication Cable, Aircore,  
Polyolefin Insulated, Copper Conductors Technical  
Requirements,

S-99-689 ..... Broadband Twisted Pair Telecommunication Cable Filled,  
Polyolefin Insulated, Copper Conductors Technical  
Requirements.

National Electrical Manufacturers Association (NEMA) - the following NEMA  
Standards form a part of this document:

C62.61 ..... American National Standard for Gas Tube Surge Arresters  
on Wire Line Telephone Circuit,

FB-1 ..... Fittings, Cast Metal Boxes and Conduit Bodies for  
Conduit, Metallic Tubing and Cable,

OS-1 ..... Sheet Steel Outlet Boxes, Device Boxes, Covers and Box  
Supports,

TC-3PVC Fittings for Use with Rigid PVC Conduit and Tubing.

NFPA - the following NFPA Standards apply to this document:

69 ..... National Electrical Safety Code (NES, current date of  
issue),

70 ..... NEC (current date of issue); Articles 300, 517, 645, 700  
& 800,

72 ..... National Fire Alarm and Signaling Code,

75 ..... Standard for Protection of Electronic Computer Data  
Processing Equipment,

76 ..... Standard for the Fire Protection of Telecommunications  
Facilities,

77 ..... Recommended Practice on Static Electricity,

99 ..... Healthcare Facilities,

101 ..... Life Safety Code,

1221 ..... Emergency Communications Systems.

The Society for Protective Coatings (SSPC) - the following SSPC Standard apply  
to this document: SSPC SP 6/NACE No.3 - Commercial Blast Cleaning.

International Telecommunication Union (ITU) - the following ITU Standard applies  
to this document: Telecommunication Standardization Sector (ITU-T).

#### 1.5 QUALIFICATIONS (OEM AND SERVICES)

- A. MANUFACTURERS (refer to SECTION 2, PARAGRAPH 2.3): The OEM shall have had  
experience with three (3) or more installations of systems of comparable size  
and interfacing complexity with regards to type and design as specified herein.  
Each of these installations shall have performed satisfactorily for at least two

(2) years in serial after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the technical submittal (see PART 1, PARAGRAPH 1.8).

1. The Contractor shall submit certified documentation they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years; the:
  - b. Contractor shall provide OEM certification they are authorized to pass thru the OEM's warranty of the installed equipment to VA,
  - c. OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System.
2. The Contractor's Communications Engineers and Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the technical submittal (see PART 1, PARAGRAPH 1.8). VA will not approve technical submittals without this information.
3. The OEM shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this document before the system is provided. The Contractor shall furnish a written statement attesting this requirement as a part of the technical submittal (see PART 1, PARAGRAPH 1.8) that includes each name and certification, including the OEMs. VA will not approve technical submittals without this information.

#### B. SERVICES

1. The System will be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
2. Provide communications cabling, systems, communications equipment fittings, equipment, conduits, wireways and accessories in accordance with the specifications and drawings. Capacities and ratings of conduit, wireways, cable, locations, other items and arrangements for the specified requirement(s) shall be shown on drawings AND CO-ORDINATED WITH AND LIKE IDENTIFIED IN THE SPECIFICATION CHAPTERS/PARAGRAPHS FOR THE PARTICULAR SYSTEM.

**1.6 CODES AND PERMITS (RE PART 1, PARAGRAPHS 1.4.A, D&E. & 1.8.A)**

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by VA.
- B. The OEM and Contractor are responsible to adhere to all codes, standards and requirements described herein.
- C. The Contractor shall display all applicable national, state and local licenses and permits on the Job Site at the direction of the RE.

**1.7 SCHEDULING**

- A. After the award of contract, the Contractor shall prepare detailed and proposed Contractor Project Schedule (CPS - aka milestone chart) using "Microsoft Project" software (or RE approved equivalent). The CPS shall:
  - 1. Indicate detailed activities for the projected life of the project,
  - 2. Consist of specific activities and their restraining relationships,
  - 3. Detail manpower usage throughout the project,
  - 4. Show expected completed portions of the system, in percentage of the total system, which will be available for interim testing / technical investigation at the direction of the RE.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The VA will not be liable for any additional costs due to missed dates or poor coordination of the Contractor or their supplying trades.

**1.8 REVIEW OF CONTRACT DRAWINGS, EQUIPMENT DATA AND SYSTEM OPERATION SUB-MITTALS (AKA TECHNICAL SUBMITTAL[S] - DO NOT DELETE)**

- A. SPECIFICATION ORDER OF PRECEDENCE (Re PART 1, PARAGRAPHS 1.4.A,D,E & 1.6): In the event of a conflict between the text of these documents and the Project's Contract Drawings outlined and / or cited herein; THE TEXT OF DIVISION 27 SECTIONS TAKES PRECEDENCE OVER THE CONTRACT DRAWINGS. HOWEVER, NOTHING HEREIN WILL SUPERSEDE APPLICABLE EMERGENCY AND SAFETY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND / OR LOCAL LIFE AND PUBLIC SAFETY CODES.
  - 1. The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document's EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing, with consensus with CFM's PM, PE and/or RE AND SMCS-0050P2H3a.
  - 2. CFM's PM, PE & RE are the only approving authority's for amendments to this document that may be granted, on a case by case basis, in writing, with technical consensus by SCMS-0050P2H3a and identified Facility Project Personnel.

3. It is the responsibility of the VA to clarify all issues with this document. When a concern arises - the Contractor shall notify the RE, in writing, on a case by case basis. The RE will render the VA's Official clarification and answer to the Contractor, in writing, covering each submitted question.
  4. The Contractor is again cautioned to obtain in writing, all ap-provals for system changes relating to the published contract specifications and drawings, from the RE BEFORE proceeding with the change.
  5. Interpret references in these publications to the "AHJ (Re PART 1, PARAGRAPHS D, 1.3.B.1 & 1.4.B.a. (7) (a)," or words of similar value, to mean the CFM: PM, RE or CO for Project / Contract Guidance; AND VACO SMCS for Technical Concurrence.
- B. SUBMITTALS - in addition with the requirements with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- (Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining additional or separate technical approach(s) to the system requirements stated here-in as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein and meets the System Performance Standards. VA will review and rate each received alternate technical submittal in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed)
1. VA reserves the right to request the OEM to arrange for a VA Re-presentative (that includes SMCS-0050P2H3a) to see typical active systems in operation, when there has been no prior experience with the OEM or the type of equipment being submitted.
  2. VA's approval (that includes SMCS-0050P2H3a certifications) shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.
  3. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
    - a. Mark the submittals, "SUBMITTED UNDER SECTION \_\_\_\_\_ ."
    - b. Submittals shall be marked to show specification reference including the section and paragraph numbers ALONG WITH CON-TRACT DRAWING REFERENCE.
    - c. Submit each section separately.
  4. Each submittal shall include the following: Information that confirms compliance with contract require-ments. Include the OEM's name, model or



catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required drawings, and other Contractor data necessary for VA to ascertain the proposed equipment, materials and system design comply with the system's specification requirements.

- a. OEM Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted THAT INCLUDES ALL NECESSARY CODE COMPLIANCE FOR EACH ITEM OF SUBMITTED EQUIPMENT.
- b. IF THE SUPPLIED CUTS DO NOT CONTAIN CODE COMPLIANCE (ie FCC, UL, IEEE, etc.), THE CONTRACTOR SHALL PROVIDE THE TESTING LABORATORY COMPLIANCE SHEETS FOR EACH SUBMITTED EQUIPMENT ITEM.
- c. Submittals are required to include all equipment anchors and supports, weights, dimensions, center of gravity, standard connections, OEM's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment, pathway or piping so the proposed installation can be properly reviewed.
  - 1) Manufacturer's Literature and Data: Showing each cable type, rating, testing criteria and performance.
  - 2) Show each physical equipment item(s) (ie conduit [outside and inside], conduit connections, penetrations, pathway/ wireway/ cabletrays, routes, etc.).
- d. Surveys Required as a Part of the Technical Submittal:
  - 1) The Contractor shall provide the following System surveys that depict various system features and capacities required in addition to the on-site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:
  - 2) DAS Cable Design Plan: The DAS Communications Cabling System is in addition to the OEM and Contractor designed functional "Outside and Inside Vertical Riser (Backbone)" Conduit and shall occupy only conduits that were designated "for the DAS Communications Cable System."
    - a) The DAS Communications Cable System is to be provided as a part of the technical proposal that will form a fully viable and functioning TIP system.

b) DAS Communications Cable Plant Grounding: REFER TO 27 05 26, GROUNDING AND BONDING for COMMUNICATIONS SYSTEMS for MINIMUM DAS Grounding and Bonding requirements.

- 3) The minimum required DAS Cable Plant Equipment Locations (these are in addition to CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12) are:

(Indicate here and at each point on the contract drawings)

EQUIPPED ITEM	CAPACITY	LOCATIONS
<b>SPEP Points of Presence</b>		
Required Location "A"		
Required Location "B"		
DAS Interface Location(s)		
Weatherproofing		
Security Requirements (Physical)		
<b>ENTRs (aka DEMARC - NOTE : THE DEMARC IS TO BE LOCATED IN THE TER //MCR//)</b>		
Required Location "A"		
Required Location "B"		
Weatherproofing		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>TER (if used)</b>		
DAS Interface Location(s)		
Backup Batteries (aka UPS)		
Backup Generators (if needed)		
Telephone Console Operators Room		
Telephone Supervisor's Room / Office		
Main Power Source / Location		
Security Requirements (Physical)		
Emergency Systems Management		
Elevator Cab(s)		
Emergency Room		

Boiler Plant		
Security Control Room		
Nurses Station(s)		
Others		
<b>MCR</b>		
MCROR		
Backup Computer Room (if required)		
MCR Supervisor's Room / Office		
MCR's Operations Room / Office		
MCR's Sectional Room / Offices		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>PCR</b>		
SSCR		
Control Console(s) locations		
DAS Interface Location(s)		
Security Requirements (Physical)		
Others		
<b>ECR</b>		
Control Console(s) locations		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>Emergency / Disaster Control Room</b>		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>STR(s), Equipment Rack/Cabinet(s) Location(s) &amp; UPS Cabinet(s)</b>		
1.		
2.		

Others		
Main Power Source / Location		
IDF & TIP Interface Location(s)		
Security Requirements (Physical)		
DAS interface location(s)		
<b>NSS</b>		
1.		
2.		
Others:		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>HER</b>		
HEC(s)		
Emergency Communication Cabinet(s), Wall Enclosure(s), Roof, PCR & MCR cabling		
Others		
Main Power Source / Location		
DAS Interface Location(s)		
Security Requirements (Physical)		
<b>Other locations required to meet system design</b>		
1.		
2.		
3.		
<b>DAS Telecommunications Outlets (TCOs) Locations</b>		
<u>Depict each DAS TCO size and activated jacks here AND on the contract drawings for each TCO used in each room served by the Outside and Inside TIP</u>		
<b>DAS Interface Location(s)</b>		
1. Basement		

2. Ground Floor		
3. Each Additional Floor		
4. Interstitials		
5. Roof		
6. Others		

4) Vertical Riser (Backbone) DAS Cable System Design Plan:

- a) An OEM and Contractor designed functional DAS Cable System in accordance to the overall plan and plants that will form a part of the Facility's TIP shall be provided as a part of the technical proposal. A specific functioning Voice, Data and Special (FMS) DAS Communications cable distribution system shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire DAS Cable System and accessory requirements and engineer a functional DAS distribution system and equipment requirement plan.
- b) The minimum required DAS System Backbone Communications Cable and Equipment Locations are in addition to the locations described in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the same document's end as a pull-out and Acronym Explanations.
- c) The minimum required "Vertical" DAS Cable Plant Equipment Locations (these are in addition to those described in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12) are:

**(Indicate here and at each point on the contract drawings)**

EQUIPPED ITEM	CAPACITY	50% GROWTH
STRs (each floor's vertical stacked TR)		
Elevator Core		
Penthouse(s)		
Basement		
Other		

5) Horizontal DAS Cable System Design Plan:

- a) An OEM and Contractor designed functional DAS Cable System in accordance to the overall plan and plants shall be provided as a part of the technical proposal. A specific functioning Voice, Data

and Special (FMS) Communications DAS cable distribution system shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire DAS Cable System and accessory requirements and engineer a functional TIP distribution system and equipment requirement plan.

- b) The minimum required DAS System Horizontal Communications Cable and Equipment Locations are in addition to the ones identified in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the same document's end as a pull-out and Acronym Explanations.
- c) The minimum required "Horizontal" DAS Cable Plant Equipment Locations are in addition to the ones identified in CFM PG 18-10, Electrical Design Manual, Articles 7 & 8, and Telecommunications One-Line Topology found in the end as a pull-out and Acronym Explanations; AND THE EQUIPMENT ROOM SIZING & LOCATIONS DEPICTED IN OI&T DESIGN GUIDE PG-18-12).
- d) Horizontal DAS Lateral Cables, at a minimum:

(Indicate here and at each point on the contract drawings)

EQUI P P E D I T E M	EXPLANATION		5
TR NR	Identifies the number of cable pairs required to be provided for each floor.		
N	Identifies the number of cable pairs required to be provided for each floor.		

NUMBER OF CABLES	Identifies the number of strands in each run of fiber optic cable (TWO STRANDS PER CABLE PAIR)		
TCOS (Room, Ceiling, Wall, etc)	Identifies the number of cable pairs required to be provided for each TCO.		
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein		
D	Interface Location(s)		

e. DAS Devices(s): The Contractor shall clearly and fully indicate this category for each device location and compare the total count to the locations identified as a part of the technical submittal and the contract drawings. Additionally, the Contractor shall indicate the total number of spares.

EQUIP PE	EXPLANATION		S
-------------	-------------	--	---

D IT EM			
BUILD IN G	Identifies the building by number, title, or location, and MDF or IDF cabling is provided from		
BUILDING FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)		
TR RM NR	Identifies the room, by number, from which cabling shall be installed		
NUMBER OF ACTIVE TCOs	Identifies the number of jacks activated on each TCO along the DAS distribution horizontal and vertical cable plant		
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein		
DA S / T I E	Interface Location(s)		

## f. Equipment Parts List (aka BOMs)

- 1) Each interface / connection point shall be provided with internal and external items to maintain a neat and orderly system of DAS equipment, wire, cable and conduit connections and routing that are in addition to the locations in CFM's PG-18-10 Electrical Design Manual for VA Facilities Table 7-1 and Appendix B, Suggested Telecommunications Online Topology for technical assistance in identifying required TIP Interface Points and interconnecting conduit requirements. Identify and record for each SPDP and ENTR(s - aka DEMARC), TER, TOR, MCR, MCOR,



PCR, SSC, ECR, ST(s), NS(s), HER, HEC, HEIC RPEC and DAS Cable Plant / Room / Area TCOs.

2) Contractor Furnished Equipment Lists (CFELs-BOMS): (See PART 1, SECTION 27 15 00, PARAGRAPH 1.8.4.f.1) for additional instructions)

- a) The Contractor is required to provide a list of the DAS CFE equipment to be furnished. The quantity, make and model number of each DAS item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.
- b) The following equipment items are the minimum requirements of VA to provide an acceptable system described herein.

CONTRACTOR NOTE: Select the required equipment items quantities that will satisfy the needs of the system and edit between the // - - - - // . Do not delete equipment items that are not required - place a "0" in the appropriate Item location.

<u>1.</u> CFE ITEM NUMBER	NUMBER OF UNITS	DESCRIPTION
1.	//As Required//	SPEP Point(s) of entrance
2.	//As Required//	ENT (DEMARC to be in the //TER// //MCR//
2.	//As Required//	TER / TOR
3.	//As Required//	TCR
4.	//As Required//	MCR
5.	//As Required//	PCR
6.	//As Required//	ECR
7.	//As Required//	SSC
8.	//As Required//	PTS
9.	//As Required//	STRs for each floor
10.	//As Required//	NSs
11.	//As Required//	NER
12.m	//As Required//	HE
12.a	//As Required//	DAS TCO(s)
12.a.1	//As Required//	DAS Conduit(s)
12.a.1.a	//As Required//	Rigid
12.a.1.b	//As Required//	PVC
12.a.1.c	//As Required//	Interduct
12.a.1.d	//As Required//	Greenfield

12.a.1.e	//As Required//	Plastic Covered Flex
12.a.1.f	//As Required//	BX
<b>12.a.1.g</b>	//As Required//	<b>OTHER TYPES</b>
13.	//As Required//	DAS Cable Duct
13.a	//As Required//	Wire Duct
13.b	//As Required//	Path Ways
13.c	//As Required//	Race Ways
13.d	//As Required//	Wire Ways
14.	//As Required//	Telecommunications Approved Partitioned Cable Trays
14.a	//As Required//	Telecommunications Approved "Baskets"
14.b	//As Required//	Telecommunications Approved "Cable Ladders"
14.c	//As Required//	"Cable Hook(s) - ONLY WHEN SMCS 005OP2H3 APPROVED
14.d	//As Required//	"Cable Hanger(s) - ONLY WHEN SMCS 005OP2H3 APPROVED
15.e	//As Required//	"O" Ring(s) - ONLY WHEN SCMS 005OP2HE APPROVED
16.	//As Required//	Mounting Assembly(s)
16.a	//As Required//	Terminating Assembly(s)
17.	//As Required//	Cabinet(s) Assembly(s)
17.a	//As Required//	Environmental Cabinet(s) Assembly(s)
17.b	//As Required//	Distribution / Interface Cabinet(s)
17.c	//As Required//	Equipment Rack (aka Radio Relay)
18.	//As Required//	CCS Assembly(s)
18.a	//As Required//	Vertical
18.b	//As Required//	Horizontal
18.c	//As Required//	Room
18.d	//As Required//	Special Interface
19.	//As Required//	Distribution Frames
19.a	//As Required//	DAS Voice
19.b	//As Required//	DAS Data
19.c	//As Required//	Security

19.d	//As Required//	Emergency
19.e	//As Required//	Critical
20.	//As Required//	DAS Distribution Cables
20.a	//As Required//	Voice
20.b	//As Required//	Data
20.c	//As Required//	TWP
20.d	//As Required//	STP
20.e	//As Required//	Fiber-optic
20.f	//As Required//	Multi-mode
20.g	//As Required//	Single-mode
20.h	//As Required//	Baseband
20.i	//As Required//	Audio
20.j	//As Required//	Video
<b>20.k</b>	//As Required//	<b>Other</b>
21.a	//As Required//	DAS Security
21.b	//As Required//	TWP
21.c	//As Required//	STP
21.d	//As Required//	Fiber-optic
21.e	//As Required//	Multi-mode
21.f	//As Required//	Single-mode
21.g	//As Required//	Baseband
21.h	//As Required//	Audio
21.i	//As Required//	Video
<b>21.j</b>	//As Required//	<b>Other</b>
22.	//As Required//	DAS Emergency
22.a	//As Required//	TWP
22.b	//As Required//	STP
22.c	//As Required//	Fiber-optic
22.d	//As Required//	Multi-mode
22.e	//As Required//	Single-mode
22.f	//As Required//	Baseband
22.g	//As Required//	Audio
22.h	//As Required//	Video
<b>22.i</b>	//As Required//	<b>Other</b>
22.	//As Required//	DAS Critical
23.a	//As Required//	Emergency

23.b	//As Required//	TWP
23.c	//As Required//	STP
23.d	//As Required//	Fiber-optic
23.e	//As Required//	Multi-mode
23.f	//As Required//	Single-mode
23.g	//As Required//	Baseband
23.h	//As Required//	Audio
23.i	//As Required//	Video
<b>23.j</b>	//As Required//	<b>Other</b>
24.	//As Required//	DAS Special Communications
24.a	//As Required//	TWP
24.b	//As Required//	STP
24.c	//As Required//	Fiber-optic
24.d	//As Required//	Multi-mode
24.e	//As Required//	Single-mode
24.f	//As Required//	Baseband
24.g	//As Required//	Audio
24.h	//As Required//	Video
24.i	//As Required//	Coaxial (RF, Video, etc)
<b>24j.j</b>	//As Required//	<b>Other</b>
25.	//As Required//	DAS TCO(s) Connections / Patch
26.	//As Required//	STR(s)
27.	//As Required//	<b>Environmental Requirements</b>
28.	//As Required//	<b>UPS Requirements</b>
29.	//As Required//	<b>Communications Grounding System</b>
30.	<b>1 each</b>	Installation Kit
31.	<b>1 each</b>	Wire Management System
32.	//As Required//	DAS / TIP Interface Points and Systems
33.	//As Required//	<b>OTHER</b>
<b>34. SPECIAL</b>	<b>Number Required by Specification and OEM</b>	<b>Provide System Spares as indicated in each equipment description</b>

3) Government Furnished Equipment Lists (GFELs): (See PART 1, SECTION 27 15 00, PARAGRAPH 1.8.4.f.2) for additional instructions)

- a) The Contractor is required to provide a list of the DAS GFE equipment that has been approved to be used in the system. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the RE's & OEM's concurrence applied to the list(s), in writing. All GFE that is approved to be used in the system will have the same system Quantity applied as described herein.
- b) The following DAS GFE equipment items are the ones that have been approved to meet the minimum requirements of VA to provide an acceptable system described herein.

c) GFE ITEM NUMBER	NUMBER OF UNITS	DESCRIPTION
<u>1.</u>		

- g. Shop Drawings: Shall include wiring diagrams and installation details/pictorial of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork and other items that must be shown to ensure a co-ordinated installation.
- 1) Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
    - a) Include elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies.
    - b) All terminal points and wiring shall be identified on wiring diagrams and cross referenced to the appropriate SPECIFICATION REQUIREMENT
  - 2) Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
  - 3) Submittals shall include each nameplate data, size, capacity, applicable federal, military, industry, and technical society publication references.
  - 4) The Contractor shall "update" the submitted shop drawings and wiring diagrams to form a "finished" system technical package as described herein.
- h. Singular Number: Where any device or part of equipment is referred to herein in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

5. Certificates - provide the following certifications:
  - a. Written certification from the OEM indicating the proposed supervisor of the installation and the proposed provider of the contract maintenance are authorized representatives of the OEM. Include the individual's exact name and address and OEM credentials in the certification.
  - b. Written certification from the OEM the installed wiring and connections/diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. VA will not approve any tech-nical submittal without this certification.
  - c. Pre-acceptance Certification: This Contractor written certifi-cation shall be made in accordance with the test procedure out-lined in PART 3 and the material, system and test readings are in accordance with the specifications and drawings and have been properly installed. The Contractor shall include a statement He/ She understands this requirement and will comply at the time stated herein and approved by the RE. VA will not approve any final testing/ system proof of performance and SMCS compliance without this certification.
6. Manuals - Submit in addition to the requirements outlined in SECTION 01 00 00, GENERAL REQUIREMENTS, provide:
  - a. Maintenance and Operation Manuals - submit as required for systems and equipment specified in the technical sections. Furnish four (4) copies, bound in hardback binders, (manufact-urer's standard binders) or an approved equivalent. Furnish one (1) complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
  - b. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
  - c. Provide a "Table of Contents" and assemble the manual to con-form to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded.

d. The manuals shall include:

- 1) Internal and interconnecting wiring and control diagrams with data to explain detailed system operation and control of the equipment.
- 2) A control sequence describing startup, operation, and shut-down.
- 3) Description of the function of each principal item of equipment.
- 4) Installation and maintenance instructions.
- 5) Safety precautions.
- 6) Drawings and illustrations.
- 7) Testing methods.
- 8) Performance data.

9) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.

10) Appendix - list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

7. Approvals will be based on complete submission of manuals together with shop drawings.

8. Samples - A sample of each of the following items shall be furnished to the RE for approval and inventory prior to installation:

- a. One (1) each TCO Wall Outlet Box 4" x 4"x 2.5" with a six (6) // 8" x 8" x 2.5" with an eight (8)// // 12" x 12" x 4" with a twelve (12)// jack outlet body with:

a. Two (2) each	telephone (or voice) RJ45 jacks installed and activated.
b. Two (2) each	multi-pin (or data) RJ45 jacks installed and activated.
c. Cover Plate	installed and each jack/port labeled.

b. One (1) each data patch panel, punch block or connection device CROSS CONNECTION SYSTEM (CCS) with RJ45 connectors installed.

c. One (1) each telephone CCS with Insulation Displacement Connectors (IDC) and/or RJ45 connectors and cable terminal and management equipment installed.

e. 305 mm (1 ft.) section of each type of conduit and pathway coupling, bushing and termination fitting indicating the UL or approved alternate testing seal.

- f. 610 mm (2 ft.) section of each raceway and pathway anchors, clamps and supports.
- g. One (1) each package of duct sealing compound.
- h. One (1) sheet of labeling and nomenclature design(s) and scheme(s).
- i. 610 mm (2 ft.) section of each copper cable to be used with OEM cable sweep tags specified herein with RJ-45 connectors installed.
- k. 610 mm (2 ft.) section of each analog RF, video coaxial and audio cable to be used with OEM cable sweep tags as specified herein and OEM specified connectors installed.
- l. Baseband video CCS patch panel or breakout box with cable management equipment and "BNC" connectors installed.

#### **1.9 PROJECT RECORD DOCUMENTS (AKA AS BUILTS):**

- A. In addition to the requirements of SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, the following information is made a part of this document's requirements:
- B. Throughout progress of the Work, maintain an accurate record of changes in and on Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- C. The floorplans shall be marked in pen to include the minimum following:
  - 1. Device locations with applied UL labels.
  - 2. Conduit, Cable, Junction Boxes, Interface Points and specific locations.
  - 3. SPSP and specific locations.
  - 7. TER interface equipment and specific location.
  - 8. PA interface equipment and specific location
  - 9. TCR interface equipment and specific location.
  - 10. MCR interface equipment and specific location.
  - 11. MCOR interface equipment and specific location.
  - 12. PCR interface equipment and specific location.
  - 13. ECR interface equipment and specific location.
  - 14. PTS interface equipment and specific location.
  - 15. SSC interface equipment and specific location
  - 16. STR interface equipment and specific locations.
  - 17. NS interface equipment and specific locations.
  - 18. HER interface equipment and specific location.
  - 19. HEC interface equipment and specific location.
  - 20. HEIC interface equipment and specific location.
  - 21. RPEC interface equipment and specific location.
  - 22. TCO equipment and specific locations.



- 23. Inside Vertical and Horizontal conduit locations.
  - 24. Wiring diagram(s).
  - 25. Labeling and administration documentation.
  - 26. Warranty certificate.
  - 27. System test results.
  - 28. System Completion MOU (if accomplished).
- D. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four (4) complete sets of the Record Wiring Diagrams of the System to the RE. The diagrams shall show all inputs and outputs of electronic and passive equipment correctly identified according to the markers installed on the interconnecting cables, Equipment and room / area locations.
- E. The Record Wiring Diagrams shall be in hard copy and two (2) compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD)//Rev IT 3D// system. The RE will verify and inform the Contractor of the version of AutoCAD being used by the Facility.

#### 1.10 USE OF THE SITE

- A. Use of the site shall be at the PC's direction.
- B. Coordinate with the PC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the PC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the PC.

#### 1.11 EQUIPMENT

- A. EQUIPMENT REQUIREMENTS: Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. EQUIPMENT PROTECTION - equipment and materials shall be protected during shipment and storage against theft, physical damage, dirt, moisture, cold and rain:
  - 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
  - 2. Damaged equipment shall be, as determined by the RE placed in first class operating condition or be returned to the source of supply for repair or replacement.

3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
  4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas is not obvious.
- C. EQUIPMENT INSTALLATION (for additional requirements, see PART 3): Equipment location shall be as close as practical to locations shown on the drawings.
1. Inaccessible Equipment - where the Government determines the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and re-installed as directed by the RE at no additional cost to the Government.
  2. "Conveniently accessible" - equipment is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to: motors, pumps, belt guards, transformers, piping, ductwork, hard ceiling, piping, conduit, raceways, etc.
- D. EQUIPMENT IDENTIFICATION - shall be installed with identification sign(s) and nameplate(s) which clearly indicate information required for use and maintenance of equipment; including, but not limited to:
1. Service Panels,
  2. Faceplates.
  3. Cross-connecting and jacks,
  4. TIP cables,
  5. Conduits and sleeves,
  6. Telecommunication Grounding Bars, Conductors, Connections and System,
  7. Firestop certifications,
  8. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by the manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions that will be considered by the RE and if approved, the Contractor will be given the RE's decision in writing.
- E. DELIVERY, STORAGE, AND HANDLING
1. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
  2. Store products in original containers.
  3. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.

4. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

#### 1.12 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the Contractor.
- B. For work on existing stations, arrange, phase and perform work to assure communications service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and pathways with other trades to minimize interferences. See the GENERAL CONDITIONS.

#### 1.13 VA ACCEPTANCE OF SYSTEM MEMORANDUM OF UNDERSTANDING (MOU), CONTRACTORS WARRANTY/ GUARANTEE

- A. MOU - shall be accomplished with written consensus and signatures of the PC; CFM RE / PM / PE / A/E; Facility's PM, CO / COTR & where re-required, SMCS 0050P2H3a.
  1. Clearly states each system / equipment item / condition(s) need-ing attention.
  2. Attach the Punch List:
    - a. Initial Inspection document developed by SMCS 0050P2H3 during system proof of performance testing,
    - b. Contractor's documented compliance - listed item by item recorded and verified by VA's RE and Facility's Manager on the original Punch List.
  3. VA's Condition of Acceptance of the system language to be the last paragraph of the MOU stating (see PART 3, 3.2.E, Acceptance Test Conclusion for VA "Conditions of Acceptance").
    - a. Without acceptance - until the system fully meets the condi-tions of the contract; and the system's ownership / use / operation / Warranty / Guarantee to commence at the final acceptance date,
    - b. With conditional acceptance - stating condition(s) that needs addressed by the Contractor / OEM stating the system's owner-ship / use / operation may commence immediately and its Warranty / Guarantee will commence at the final extended acceptance date,
    - c. Full acceptance - with the system's Ownership / Use / Operation / Warranty / Guarantee to commence at the agreed date of final acceptance.
- B. SYSTEM WARRANTY / GURANTY - Telecommunication systems are subject to the terms of "Warranty of Construction", FAR clause 52.246-21.

1. Warranty - The Contractor shall pass through the OEM's equipment warranty for a period of one (1) year and (2) years for Life & Public Safety and Emergency System, from the date of acceptance of the system by VA.
2. Guaranty - the Contractor shall guarantee that system operation, all installed material and equipment will be free from defects, workmanship, and will remain so for a period of one (1) year and (2) years for Life & Public Safety, Critical and Emergency System from date of final acceptance of the System by the VA.

#### 1.14 SYSTEM PERFORMANCE

A. GENERAL GUIDELINES: The IWS, herein referred to as the system shall be a DAS.

The system shall reliably distribute RF signals and wireless services throughout the specified RF ranges / bands / channels and throughout the specified coverage spaces / areas.

1. The System shall be implemented based on proven state-of-the-art technology that can seamlessly integrate with the rapid evolution of RF, Wireless Technologies and Business Applications.
2. The System shall include a head-end subsystem. The head-end shall include a wideband RF transceiver(s) for each required RF for the DAS and be a common interface node. The DAS Head End shall be located in the HE Equipment Room and co-located with VA's FMS RF paging and two way radio systems, DAS PSRAS RF equipment, VA and other RF base stations from multiple cellular common carriers.
3. The IWS shall have all active elements (aka remote units) in secured TRs located in the FMS portion to simplify maintenance and increase system physical security.
  - a. Locating active elements in or above ceilings is not acceptable.
  - b. Locations for active equipment outside the TRs shall be approved by the AHJ and RE.
4. Radiating or "leaky" coax systems are not acceptable.
5. Single Mode Fiber Optic cable, protected by conduit and telecommunications listed "partitioned" cable tray is the preferred transmission media for the DAS "trunk lines."
6. DAS antenna coverage shall be depicted on the Contractor's Required Survey(s) and additionally shown on the contract drawings as described herein.
7. The Contractor shall provide coverage antennas and/or "nodes" to meet the RF coverage and operational requirements described herein.

8. The Contractor shall provide a predictive modeling coverage plan(s) showing the design RF coverage (signal strength) for each RF band required for the System.
  9. The Contractor shall provide plans indicating equipment, antenna, and / or component location(s), cable route(s) and other installation information - identify construction elements that would affect the System's performance (ie metallic ceiling materials, air ducts, piping, structural beams, rebar, etc).
  10. The Contractor shall provide detail system one-line and functional block / line diagram(s).
- B. Where possible every building DAS should have two independent connections to the TIP Backbone Raceway.
1. Each DAS connection should enter the building from opposite ends of the building.
  2. Each DAS connection should be brought in through separate TIP paths that provide two distinct DAS connections to the TIP backbone raceway giving each building a redundant connectivity in the case of a cable plant damage.
  3. Due to the number of critical, emergency and safety systems that are now run on the VA Low Voltage TIP it is imperative that we provide redundancy into the TIP. Services such as DAS, fire alarm signaling, Security swipe card door locks, Emergency Phones, Emergency 911, Code Blue, Duress Alarm, Patient / Staff Location, etc. require a highly available, high quality TIP.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS:**

- B. TCO(s): Deliver at all TCOs fully functional DAS communications cables and 4ea operational jacks (2ea for voice, 2ea for data) in the specific locations shown on the drawings (Note - the inside vertical (Backbone) functional communications cables are in addition to those provided by SECTION 27 10 00 - STRUCTURED (BACKBONE) COMMUNICATIONS CABLING EQUIPMENT AND SYSTEMS; and, horizontal (lateral) functional cables provided by SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLE EQUIPMENT AND SYSTEMS). IF THESE CABLES AND EQUIPMENT ARE FOUND NOT INSTALLED, IMMEDIATELY CONTACT THE RE FOR SPECIFIC DIRECTION[S]).
1. IN THE ABSENCE OF A/E IDENTIFIED TCO LOCATIONS / COUNTS SUBMITTED DURING THE PROJECTS' DESIGN PHASE(S) - PROVIDE A MINIMUM OF ONE (1) EACH FUNCTIONAL AND OPERATING TCO ON EACH WALL OF EACH DAS ROOM / AREA.
  2. Provide activated special communications DAS functional jacks and corresponding plant, as dictated by the approved system design, in the unused jack space in each of the aforementioned TCOs.

C. The System shall include, but not be limited to: Directional (a.k.a. Hy-Gain), interior Omi-Directional and outdoor antenna(s); coaxial (a.k.a. spiral line)cable and connectors; antenna masts; antenna multi-couplers; lightning protection system; HE and interface cabinets; RF terminals and amplifiers; UPS; electronic supervision functions and control consoles; system management, status reporting functions and control consoles; audio volume limiter or compressor; audio amplifiers; audio modulator, adapter, cable, wire and connectors; conduit, cable duct and/or partitioned cable tray; and, necessary passive devices such as fiberoptic and TWP (shielded or unshielded) cable with connectors; attenuators, combiners, traps, filters and splitters: microphones, headphones and/or speakers.

1. The System shall provide DAS two way radio communications from a minimum of the following services:

REQUIREMENTS	FUNCTIONS
a. Three (3) each	Emergency two-way emergency radio responder sub-systems (ie local fire department, police and EMS) to be operated by a separate RF connection to a common antenna coupling network, RF transmission line, and single outside antenna and provide appropriate interconnecting cabling to the system's control units.
b. Three (3) each	VAMC radio sub-systems (ie police, disaster/emergency, code blue paging) by only adding appropriate transmission lines and connecting them to three (3) ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system's control units.
c. Three (3) each	Future commercial cellular or radio sub-systems by only adding appropriate transmission lines and connecting them to three (3) unused ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system control units.

e. Three (3) each	Future radio sub-systems by only adding appropriate transmission lines and connecting them to three (3) unused ports on the aforementioned antenna coupler and provide appropriate interconnecting cabling to the system control units.
f. Plus,	The three (3) emergency responder radio sub-systems; three (3) VAMC radio sub-systems; three (3) future cell/commercial radio sub-systems and three (3) unused (or spare) antenna coupler port(s) shall function from the same outside antenna. <u>The system shall allow the installation of an additional antenna coupler at the present or future time when system expansion is require above the numbers identified herein.</u>

D. Please see PART 2, PARAGRAPH 2.1, SECTION 27 05 00 for additional requirements.

## 2.2 SYSTEM DESCRIPTION

A. The System shall meet the requirements of the AHJ for PSRAS functions and operation.

1. The DAS shall have active signal handling by using active element(s) that filter and amplify signals on RF specific band/channel basis to consistently deliver In House RF Services at the appropriate power levels in the locations described herein, depicted on the Contractor's Surveys and on as shown the contract drawings. When any of these mandatory requirements are found missing, contact the RE who will contact SMCS 0050P2H3 for directions.
2. Frequency Range: The system shall support all RFs between 150 MHz to 5,700 MHz.
3. The system shall distribute RF coverage at levels described herein in the following minimum areas of the building(s) and as listed herein:

REQUIREMENT	FUNCTION
a. Floor areas	Corridors, Lobbies, Concourse, Interstitial Spaces, Penthouses, Restrooms / Bathrooms, Elevator Lobbies & Shafts

b. External Building lobbies and floor area(s)	Bridges, tunnels and Building links, public spaces (ie courtyards, patios, etc)
c. General use spaces	ie break, staff, public, multipurpose rooms, etc
d. Excluded Areas	NO AREAS ARE EXCLUDED

4. The system shall be able to simultaneously support the following VA APPROVED minimum RF, wireless services, applications and / or technologies. The System shall:

- a. Distribute cellular channels with signal strength at least +8.0 dBm greater than the signal outside the building and at least -85 dBm "wall to wall" inside the building.

- b. Meet the:

REQUIREMENT	FUNCTION
1) Wireless Providers needs	ie NEXTELL/SPRINT, VERIZON, AT&T, T-MOBILE, ANY METRO PCS, ETC

- c. Support VA's FMS and other RF systems (RFs for the following radio systems shall be supported, at a minimum. The DAS Contractor shall confirm the RFs required at the time technical submittal submission and again at Facility opening):

REQUIREMENT	FUNCTION
1) Radio Pagers (aka pocket pagers) in the RF of //____//	coordinate with SMCS 0050P2H3 for FCC Restrictions
2) 700 - 800 mHz	FCC Part 15- <u>Safety of Life</u> Restrictions
a) LTE	700 mHz
b) LMR	700 - 800 mHz
3) 800 - 900 mHz)	FCC Part 15- <u>Safety of Life</u> Restrictions
a) SMR	800 - 900 mHz
b) iDEN	800 / 900 mHz
c) Cellular	850 mHz
d) Broadband ISM	800 mHz - 2.4 GHz
e) Super Broadband	800 mHz - 2.9 GHz
f) Extreme Broadband	2.5 GHz - 5.7 GHz



4) One / two way radio paging (900 mHz)	FCC Part 15- <u><b>Safety of Life</b></u> Restrictions
5) AWS (1,700 / 2,100 mHz)	FCC Part 15- <u><b>Safety of Life</b></u> Restrictions
6) UPCS (1,920 - 1,930 mHz)	FCC Part 15- <u><b>Safety of Life</b></u> Restrictions
7) PSRAS Responder(s)	
a) The system shall distribute <b>Public Safety Channels</b>	with a signal strength that exceeds the minimum requirements specified herein and by the AHJ
b) 99 - 100% in house coverage	is expected in all areas of each building
<u>1.</u> Cellular coverage information	shall include expected dBm levels above the exterior macro
<u>2.</u> Note - 700 mHz based systems	now requires a minimum -75 dBm MIMO 2X2 throughout the cellular coverage areas.
c) Public Safety includes	VA, Local, City and State Police, County Sheriff, Emergency Medical Services (EMS), and Fire Departments
<u>1.</u> VHF (150 mHz)	no FCC restriction(s) if RF is assigned to VA
<u>2.</u> UHF (450 - 520 mHz)	no FCC restriction(s) if RF is assigned to VA
<u>3.</u> VA Police _____ mHz	no FCC restriction(s)
<u>4.</u> VA Engineering _____ mHz	no FCC restriction(s)
<u>5.</u> VA Emergency _____ mHz	no FCC restriction(s)
<u>6.</u> VA Disaster _____ mHz	no FCC Restriction(s)
<u>7.</u> Federal Trunking _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
<u>8.</u> Local PD _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
<u>9.</u> City PD _____ mHz	FCC restriction(s), FCC Part 25 listed requires MOU & CUP
<u>10.</u> State PD _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
<u>11.</u> County Sheriff _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
<u>12.</u> Fire Department(s) _____ mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP

13. Local EMS(s) _____mHz	no FCC restriction(s), FCC Part 25 listed requires MOU & CUP
d) Other(s) _____mHz	coordinate with SMCS 0050P2H3 for FCC Restrictions)

B. Specific Subsystems' Requirements: The system shall have the capability for separate control over each service (and wireless operator) to all the ability to adjust and control power levels without disturbing other services / operators.

The System shall:

1. Support multiple services in modular architecture so services can be added or removed without:
  - a. Requiring new infrastructure,
  - b. Readjustment of signal power levels,
  - c. Disturbing existing services.
2. Enable services to be added without requiring additional cabling or antennas.
3. Not impede any management feature(s) or functionality or any attached network and / or device management system.
4. Allow for proactive management and end-to-end alarming of active equipment components, resulting in rapid problem identification and resolution.
5. Be able to be integrated with third party SNMP based element management system(s) vial a separate internet/POE and provide fault management information and functions throughout the DAS.
6. Cellular Services:
  - a. The System's transmission media will take many forms, from traditional of-air radio repeater, or Base Transceiver Station (BTS) to a tethered architecture consisting coaxial, fiber optic and/or hybrid fiber optic / coaxial base/trunk solution.
  - b. The DAS shall extend the common wireless carrier services from the head end equipment/system by interfacing to either a passive or active DAS that is deployed to and within each of the building structures. The following system design(s) are meant to be typical only. Prospective Contactors are expected to describe their DAS solution in detail described herein:
    - 1) The System shall support the use of Legacy Cellular Enhancement and technologies such as:
      - a) GSM,
      - b) EDGE,
      - c) UMTS-HSPA.
    - 2) The GPS Navigational Signal must be brought to the Base Station at the System's Head End to support LBS functionally.

7. The System shall support:
  - a. VA's Single ended and two-way, Non-IP communications radio systems,
  - b. Associated wireless devices that comply with FCC's and Regional regulatory authorities' emission rules for wireless devices.

(Note - refer to: FCC Advisory #A, Local Government Official's Guide to Transmitting Antenna RF Emission Safety Rules, Procedures and Practical Guidance, FCC's OET Bulletin 65, FCC Rule 47, Part 15 "Safety of Life prohibitions" and ANSI/IEEE C95.1-1992, Hazardous Emission document)
8. The System's input AC power shall be provided with and connected to an UPS. The UPS shall support the System operation (under a full load) for a minimum of one (1) hour. The UPS shall be connected to the Facility's Essential Generator Backed-up Electrical System (Note: depending on System design - there may be necessary to provide multiple UPS for the System).
9. The System shall be provided with an Electrical Supervision Capability that shall monitor all operating states of the System and each UPS. The supervision panel shall contain audible and visual and other devices that will notify maintenance personnel of System Failure(s) and types. The supervision function may be an integral part of the System's component(s); or a separate provided function / capability. The supervision system shall report to two (2) Alarm Panels at two (2) Facility locations (ie Telephone Operator, Security Console, Boiler Plant, MAS Duty Officer, etc) operated 24/7/365 via a System integrated or stand alone plant. Their locations are:
  - // a. \_\_\_\_\_,
  - b. \_\_\_\_\_. //
  - c. It is not acceptable to use the Facility's LAN/WAN for the supervision transportation media and management function until it is certified to meet NFPA Life Safety Code 101 and listed or label so accordingly by a NRTL (ie UL).
  - d. The electrical (or electronic) supervision function and alarm(s) shall be provided to a separate Supervision Alarm panel(s) in the FMS Bio-Medical Engineering Shop (or electronic shop //or \_\_\_\_\_ shop// if Bio-med does not provide support for the System).
  - e. The Supervision Alarm(s) shall not be cancelled until the trouble / fault has been corrected and the System has been restored to normal operation. The Visual Alarm(s) shall be continuous and the Audible Alarm(s) may be silenced via a controlled circuit that will re-occur the alarm at designated time intervals (ie adjustable form 2 - 30 minutes Maximum).

10. The System shall be designed to minimize cross talk, background processor noise, inter-modulation and other signal interference. The HE equipment shall be installed and interfaced according to the OEM HE schematic diagram for adjacent audio, video, data and RF channel operation.
11. The contractor shall provide one (1) spare outside antenna with 100' of RF coaxial cable with connectors installed to be coiled, located and secured in the HE Room and be labeled "DAS EMERGENCY RESPONDER SPARE ANTENA."
12. The System shall be able to be accessed via the internet for remote monitoring, software upgrades and maintenance assistance. The internet connection shall be at only one location at the System Headend and controlled by the Facility's OI&T Service. The failure of this approved "external connection" shall not affect the Systems' Performance and Operation.

#### C. Cabling

1. Fiber Optic cabling is specified herein and shall be provided on Special System Fiber Optic DAS / TIP Backbone diagrams. The Contractor shall identify in shop drawing submittal one-line riser diagram(s) indicating the mode and number of strands required.
2. 50 Ohm coaxial cable and terminations as specified herein.
3. A system distribution design that promotes "looping" the fiber optic and coaxial cables from location to location shall not be permitted. Each location and/or floor fiber optic and coaxial cable transmission line system shall be a "tap" design where each cable is fed from a device provided from a centrally corridor located lateral DAS trunk-line cable(s). Each location or floor lateral DAS trunk-line cable shall be connected to a vertical DAS trunk-line riser cable in the associated TR. Each vertical riser DAS trunk-line cable shall be connected to the HE input and/or output, depending on system design. Distribution (floor or riser) DAS amplifiers may be needed to satisfy the System's DAS received and/or transmit signal level requirements at each location. The provided DAS trunk line that routes throughout the interior of the Facility shall be separated from other systems and protected from damage by conduit and partitioned cable tray.
4. Each floor and/or office control and interface system shall be protected using conduit and partitioned cable tray. The use of open ladders, "J" hook, "O" rings, "U" clamps, etc is not allowed for installation of Emergency, and/or Support system cables.
5. Each floor and/or office control and interface system shall be provided in a "buss" design where each location's and/or floor's radio control console and/or control equipment is fed from centrally located (usually in the

corridor) lateral trunk-line cables. Each signal closet shall contain a MIN of one terminal cabinet capable of connection to vertical trunk-line riser cables to lateral trunk-line cables in the associated signal closet and as shown on the drawings or recommended by the OEM.

6. Interface Cabinet Location (Consult Design Guide PG-18-10, Chapters 7 & 8 for specific instructions): Each cabinet shall be provided, protected, and located at the most central distribution system signal closet location to insure optimum origination, reception and control of all system signals. Each cabinet shall be provided with an internal active 120 VAC quad receptacle. Each cabinet shall be provided with a MIN of 610 mm (two feet) clearance from all obstructions in the signal closet where located. Each cabinet shall be provided as required to meet the multiple audio channel and RF requirements and system performance standards.

D. Interference: There shall be no interference between the applications and wireless operators specified herein and with the Facility's equipment.

E. Telecommunication Rooms (TR): refer to CFM's EDM and OI&T Design Guide for this requirement if not specifically identified in the projects' construction documents.

## 2.3 MANUFACTURERS

A. The products specified shall be new; FCC AND NRTL (aka UL) listed, labeled and produced by OEM of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:

1. Maintains a manufacturer and bench stock of replacement parts for the item(s) submitted,
2. Maintains technical drawings and specifications; architectural, engineering, depot level repair and operating manuals for the items submitted,
3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB),
4. Shall have equipment items that have been in satisfactory operation, on a minimum of three (3) installations of similar size, complexity and type as this project.
  - a. Materials and equipment furnished shall be of current production by OEM(s) regularly engaged in the manufacture of such items, for which replacement parts shall be available for at least five (5) years from the date of acceptance by VA.

- b. When more than one unit of the same class of equipment is re-quired, the: equipment, cabling, terminating hardware, TCOs, and patch cords shall be sourced from the certifying OEM; OR at the OEM's direction, and support the System design, the OEM's quality control and validity of the OEM's warranty.
- 5. VA reserves the right to require the Contractor to submit a list of installations and contact information where the products have been in operation before approval as described in Paragraph 1.8 - "Technical Submittal" portion of this document.
  - a. Equipment Assemblies and Components
    - 1) Components of assembled units need not be products of the same OEM.
    - 2) OEMs of equipment assemblies, which include components made by others, shall assume complete responsibility, warranty and guarantee for the final assembled unit as described herein.
    - 3) Components shall be compatible with each other and with the total assembly for the intended service.
    - 4) Constituent parts which are similar shall be the product of a single OEM.
  - b. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- B. Specifications contained herein detail the SALIENT operating and performance characteristics of equipment in order for VA to distinguish acceptable items from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, that item of equipment offered or furnished shall meet or exceed the specification.
- C. Equipment Standards and Testing
  - 1. The System has been defined herein as connected to systems identified and listed as Emergency Care performing Life Support, Emergency and Safety Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
  - 2. The provided equipment required by the System design and approved technical submittal must conform with each NRTL (aka UL) standard in effect for the equipment, as of the date of acceptance of the technical submittal (OR the date when the RE approved system equipment necessary to be replaced) and was technically reviewed and approved by SMCS.

- a. Where a NRTL (aka UL) standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL Seal or Mark; OR the Seal or Mark of the NRTL Testing Laboratory that warrants the equipment has been tested in accordance with, and conforms to the UL standard(s).

Contact DoL (OSHA) for an up to date list of NRTLs at:

[http://www.osha.gov/dts/otpc/nrtl/faq\\_nrtl.html](http://www.osha.gov/dts/otpc/nrtl/faq_nrtl.html)

- b. The placement of the NRTL (aka UL) Seal or Mark shall be on a permanent part of the equipment that is not capable of being transported from one equipment item to another.

D. When Factory Testing is Determined Necessary:

1. VA shall have the option of witnessing factory tests. The Contractor shall notify the VA through the RE a minimum of 21 days (aka three [3] weeks) prior to the OEMs making the factory tests.
2. The OEM shall furnish four (4) copies of certified test reports containing all test data to the RE prior to final inspection and not more than 30 days after completion of the tests.
3. When equipment fails to meet factory test and reinspection is required, the OEM shall be liable for all additional expenses, including expenses of the Government.

## 2.4 EQUIPMENT ITEMS

A. GENERAL REQUIREMENTS (see PART 2, PARAGRAPH 2.4, SECTION 27 05 11 for additional requirements): The equipment identified in this SECTION shall be the standard product(s) of an OEM regularly engaged in the manufacture of DAS and related products. All components used in the System shall be commercial quality products that comply with this document. Each component of equipment shall identify the OEM's name, model, serial number, FCC Listing and NRTL (aka UL) label or equal. The RE retains the right to reject products which reflect, in the RE's opinion, sub-standard design practices, manufacturing procedures, support services, or warranty/guarantee policies. Refer to contract drawing(s) note(s) for additional OEM information.

1. All copper cables are not required to be plenum rated if run in protective conduit and not installed "Air Plenum Areas" designated by the RE. If run outside of conduit, each fiber optic cable shall contain an inner wrap of Kynar or Teflon (or equal) plus a metal protective wrap (sometimes called 'armor') just inside the outside protective jacket.
2. Fiber Optic Transport: are not required to be plenum rated if run in protective conduit and not installed "Air Plenum Areas" designated by the RE.

When Fiber Optic Transport media is utilized; the IWS shall utilize single-mode with angle polished connectors (APC) to distribute DAS signals.

3. Broadband (Coaxial) Distribution: When Broadband Distribution is utilized; the IWS shall use coaxial cable in the horizontal runs and passive (ie non-powered) broadband antenna(s) in the respective area(s). The coaxial cables are not required are not required to be plenum rated unless installed in designated "Air Plenum Locations."
4. Baseband (Video and Audio) Distribution: When Baseband Distribution is utilized; the IWS shall use TWP or STP cable in the horizontal runs and passive (ie non-powered) baseband equipment to compliment the DAS in respective area(s). The baseband cables are not required are not required to be plenum rated unless installed in designated "Air Plenum Locations."
5. The Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating DAS system (and sub - systems) with 40% growth / expansion THAT IS BASED ON THE TOTAL NUMBER OF WIRED HORIZONTAL ANTENNA POINTS PLUS THE CAPABILITY OF ADDING AN ADDITIONAL 40% OF ANTENNA POINTS AND SUPPORT EQUIPMENT WITHOUT DISTURBING THE SYSTEM'S INFRASTRUCTURE DESCRIBED HEREIN.
  - a. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment where all shall be listed on the BOM.
  - b. Each system interface point shall be provided with internal and external items to maintain a neat and orderly system of equipment and conduit connections and routing (Refer to CFM's PG-18-10 Electrical Design Manual for VA Facilities, Table 7-1 and Appendix B, Suggested Telecommunications Oneline Topology; AND OI&T Design Guide for technical assistance in identifying required Interface Point(s) and interconnecting DAS internal plant conduit requirements.
  - c. Conduit, 1.0" minimum (¾" may be allowed on a case by case basis by the RE in writing) is required for all Life, Patient, Staff and Public Safety, Critical Service and Emergency Systems.
  - d. Equipment Functional Characteristics

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ ±2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

6. SPECIFIC EQUIPMENT DESIGNATED BY THE DAS SYSTEM DESIGN



## a. Antenna Equipment and Materials

- 1) Antenna Site(s) & Installation: It is the responsibility of the Contractor to re-verify and certify each external and internal antenna installation required by the system, in writing (four [4] copies MIN), to the RE 30 days prior to construction. The Contractor is required to provide all FAA, FCC and local licenses and permits for each radio antenna item(s) requiring such licenses and permits. Additionally, at a MIN, for each external antenna site that is 75' above average ground level (AGL) or taller than appurtenances and closer buildings or objects, the Contractor shall accomplish FCC Form 854, Application for Antenna Structure Registration, FAA Advisory Circular AC 70/7460-1, Obstruction Marking and Lighting and FAA Form 7460-1, Notice of Proposed Construction and Alteration for each item requiring this registration. It is the Contractor's responsibility to contact the local licensing authority(s) to determine if the antenna installation requires additional hazard registration and accomplish all necessary documents.
- 2) THE SYSTEM PROOF OF PERFORMANCE AND VA CERTIFICATION TESTS WILL NOT BE CONDUCTED UNTIL THESE FORMS ARE ACCOMPLISHED AND SUBMITTED TO THE APPROPRIATE FEDERAL AUTHORITIES WITH COPIES PROVIDED TO THE RE, OR VAMC CO AND VACO SMCS (0050P2H3). The Contractor shall obtain onsite technical assistance from the OEM for installation of the external antenna(s) selected during the Field Site Visit. The Contractor shall provide the RE a detailed written report of the findings of this visit for approval. The site visit and report shall be completed during the 30 days after issuance of the notice to proceed.
- 3) Wherever possible, external antenna equipment shall be mounted so that maintenance can be accomplished without the need to climb towers, ladders, cherry pickers, etc.
- 4) External Antenna Masts: Wall mounted DAS antenna mast(s) shall be rigid thick wall and have a minimum 3.0 inch (75mm) outside diameter (OD), of hot dip galvanized steel and capable of surviving MIN wind loads of 100 miles per hour (160 kilometers per hour) sustained winds with all DAS antenna equipment and mounting hardware installed, with up to 1/2 inch (12.7 mm) radial ice at the height required to provide the System performance, as described herein.

- a) Wall mounted external masts shall be attached to building walls, penthouse walls or other solid parts of the building exterior free of all obstructions.
  - b) For building and penthouse walls, attach masts with not less than three (3) rust proofed brackets three (3) inches (76.2 mm) wide, 5/16 inch (7.79375 mm) thick, eight (8) inches (177.8254 mm) wide and spaced not less than 20 inches (508.0 mm) apart. Do not attach masts to catwalks or metal structures unless specifically approved. If allowed, masts shall be welded or bolted to the structure using an approved method of attachment. All connections shall be rustproof and painted to match the existing structure(s).
  - c) Fasten the mounting brackets with rust proofed through bolts of a minimum 7/16 inch (11.1125 mm) diameter, each anchored with two (2 - one on the inside and one on the outside of the wall), (8 inch (203.2 mm) square, 5/16 inch (7.9375 mm) thick rust proofed steel back plates. Attachments to mortar or grout joints with lag bolts are not permitted. Securely tighten all mounting hardware, antenna hardware and terminals.
  - d) Do not mount the mast(s) directly on the roofs of the building or penthouse unless specifically approved in writing by the RE prior to installation. Any approved roof attachment or penetration shall be resealed to prevent water leakage; using pitch pocket or other method approved by the roof OEM and Roofing Contractor.
  - e) Do not install more than two (2) antennas on a single mast. Install separate masts, as required, with proper physical and frequency spacing between them and the antenna(s) installed. A MIN spacing shall be 1/2 wavelength ( $\lambda$ ) vertically and 5/8  $\lambda$  horizontally (element tip to element tip) for the lowest operating frequency.
  - f) Orient the antenna(s) to insure optimum signal receive level and S/N ratio.
  - g) Weatherproof all connections with approved sealing compound. Electrical cloth or plastic tape are not acceptable and will not be approved.
- 5) Antenna Site Physical Protection
- a) External
    - (1) Roof and/or Wall Type: When an antenna is installed on a building roof or wall that is accessible from the roof, signs shall be placed on all roof access points that say "Warning, Radio Antenna

Radiation Hazard." The signs shall be professionally prepared, neat and permanent. The roof area where the antenna is installed shall be painted yellow or roped off with a yellow marker tape that indicates the approximate area of RF radiation.

(2) Each roof or attic access for the each antenna shall be controlled by the VA Police SMS Access Control System. The Police Chief will determine the appropriate number and individual(s) that are to be granted access in these areas.

- b) Internal DAS: The antenna shall be placed inside a protective enclosure designed specifically for the product. The antenna shall not be visible when installed in the enclosure in the area located. DAS cables to each antenna shall be installed in protective conduit (EMT or Flex) from each Antenna Enclosure to the associated "J" Box. Each DAS Antenna Enclosure shall be provided with two (2) safety wires connected between each enclosure to solid building supports.
- 6) Antenna Site Lightning Protection System: Each protection system shall be provided in its entirety totally and externally to the building. The use of internal electrical or communications grounding systems is not acceptable, will not be approved; and if found during the system's proof-of-performance tests, it will be removed and the test may be terminated and rescheduled at the contractor's expense.
  - a) Antenna, Mount & Mast: The antenna, antenna mount or mast and transmission line shall be grounded with cooper wire run external to the building and connected to the earth ground. If the antenna is to be installed in an area not protected by lightning rods or if the antenna is to be elevated above existing building's lighting rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.
  - b) RF Transmission Line and/or Coaxial Cable Lightning Protector: The protector shall be an in-line device equipped with screw type connectors to match the coaxial cable and dimensions specified. It shall be able to shunt high current surges to the earth ground protecting the system signal RF equipment. The protector shall have a minimal effect on the quality of the signal being received or transmitted. It shall be made of non-corrosive metal and be waterproof.

(1) Technical Characteristics

FUNCTIONS	CHARACTERISTICS
-----------	-----------------

<u>a.</u> Peak Pulse Power	1,500 W @ 77° F
<u>b.</u> Protection Device	Gas Tube or as required by OEM
<u>c.</u> Dissipation	1.0 Milliseconds (mS)
<u>d.</u> Response Time	5.0 nano-Seconds (nS)
<u>e.</u> Connectors	As Specified
<u>f.</u> Ground Connection(s)	The protector shall be directly mounted, by a #4 ga. MIN self tapping sheet metal screw, on a MIN 5/16" (7.9375 mm) thick, 4.0" (101.6 mm) high X 22.0" (609.6 mm) Long solid copper buss grounding plate mounted directly inside and anchored to the wall at the exact coaxial cable entrance. The grounding plate shall be connected by a #0 AWG Stranded Copper Wire, MIN, or as required by the OEM, and/or the RE connected to the FACILITY'S OUTSIDE LIGHTNING PROTECTION SYSTEM.

(2) Each lightning major ground point shall be connected with MIN #0 AWG stranded copper wire run external to the building and connected to the antenna site lightning ground described herein.

#### 7) Antennas

a) External: The external antenna shall be specified by the OEM for the specific system function and physical location. Acceptable designs are: ground plane fed with continuous polarization adjustment and or spread spectrum type. The antenna size, gain and beam width shall be chosen for optimum performance to meet the specified path and System reliability parameters.

(1) Each antenna shall be installed to meet the wind load specifications and environmental conditions.

(2) Technical Characteristics

FUNCTIONS	CHARACTERISTICS
<u>a.</u> Operating Standards	As herein outlined and specified
<u>b.</u> Size	As required to fully satisfy system design
<u>c.</u> Gain	25 dB
<u>e.</u> Half Power Beam Width	As specified by the OEM
<u>f.</u> Front-to-Back Ratio (FBR)	40 dB
<u>g.</u> VSWR	1.15 or Less
<u>h.</u> RFI	None measurable
<u>i.</u> Wind Load Rating	40 LBS Per Square Foot (PSF) or 100 (160 kilometers) per hour

(3) RF Transmission Line (External) - Coaxial: The provided transmission line shall be coaxial, jacketed with fire resistant material when run outside of conduit and/or cable tray, or as required by system design and described by the OEM; and, if required, pressurized to the OEM's specifications.

(i) The cable shall be as specified by the OEM. If not specified by the OEM, it shall be provided with the proper impedance, be double shielded, and contain other characteristics to satisfy all equipment and system requirements.

(ii) Technical Characteristics

(1 Outside Diameter	As specified by the OEM
(2 Center Conductor	Solid (Stranded when OEM specified) Copper, Silver Coated
(3 Outer Conductor (or Braid)	Braided Copper (solid when OEM specified) providing 100% coverage and EMI shielding
(4 Insulation	Cellular Polyethylene with air passages
(5 Jacket	Polyethylene; Teflon or Kynar (when required)

(iii) Attenuation:

Frequency (mHz)	Attn/dB per 100 ft (MAX)
100	2.5
200	3.5
400	5.0
890	8.0

(iv) External Antenna Feed Through: A feed through shall be provided for all Coaxial, Spiral line and/or other System wire/cable penetrations of exterior building walls or roofs. The feed through(s) shall be waterproof, sleeved, OEM recommended and RE approved.

b) Internal: Each DAS antenna shall be specified by the OEM for the specific system function and physical location. Acceptable designs are: ground plane fed with continuous polarization adjustment and or spread spectrum type. The antenna size, gain and beam width shall be chosen for optimum performance to meet the specified path and System reliability parameters. Each antenna shall be installed to meet the local environmental (outside and inside) conditions.

(1) Environmental

FUNCTIONS	CHARACTERISTICS
-----------	-----------------

(a Application	Indoor
(b Operating Temperature	40°C to +60°C (40°F to +140°F)
(c Relative Humidity	Up to 100%

## (2) Mechanical

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(a Application	50 Ohm "N" type
(b Mounting	Thru-hole ceiling (typical)
(c Relative Humidity	Up to 100%
(d Radome	Required, ABS, UV resistant
(e Pigtail Cable	Required, plenum (if not protected) flexible with connectors installed

## (3) Regulatory Compliance

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(a RoHS	2002/95/EC (minimum)

(4) Omni-Directional Antenna: Omni-Directional Coverage Antenna(s) shall feature a multi-band design that accommodates multiple RF band and channels in a single unit.

## (i) RF Band One (1)

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	690 - 800 mHz
(2 VSWR	$\leq 1.8:1$
(3 Gain	$\geq 1.5$ dBi
(4 Max input power	OEM Specified
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	80° nominal
(b Horizontal	360° Omni-directional
(7 Return Loss	$\leq 11$ dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

## (ii) RF Band Two (2)

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	
(a	710 - 2,700 mHz

(b	800 – 950 mHz
(2 VSWR	$\leq 1.8:1$
(3 Gain	
(a $\geq 1.5$ dBi	800 – 950 mHz
(b $\geq 5.0$ dBi	1,710 – 2,700 mHz
(4 Max input power	OEM Specified
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	70° nominal
(b Horizontal	360° Omni-directional
(7 Return Loss	$\leq 14$ dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

(iii) RF Bands Three (3) and four (4):

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	
(a 150 – 250 mHz,	(or per OEM direction)
(b 260 – 400 mHz	(or per OEM direction)
(c 450 – 750 mHz	(or per OEM direction)
//(d _____ mHz	(or per OEM direction)//
(2 VSWR	$\leq 1.5:1$ all bands
(3 Gain	
(a $\geq 1.5$ dBi	150 – 750 Mhz
(b $\geq 3.0$ dBi	800 mHz – 2.8 GHz (broadband)
(c $\geq 7.0$ dBi	2.4 – 4.5 GHz (very broadband)
(d $\geq 18.0$ dBi	3.0 – 5.7 GHz (extreme broadband)
(4 Max input power	OEM Specified
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	70° nominal
(b Horizontal	360° Omni-directional
(7 Return Loss	$\leq 14$ dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	

(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

(5) Directional Coverage Antenna(s): shall feature a multi-band design that accommodates multiple RF band and channels in a single unit.

(i) RF Band One (1):

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	690 - 800 mHz
(2 VSWR	$\leq 1.8:1$
(3 Gain	$\geq 5.0$ dBi
(4 Max input power	50W MAX
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	Polarization
(b Horizontal	110° nominal
(7 Return Loss	$\leq 11$ dB, maximum,
(8 RFI	None measurable
(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(c Internal	Not Applicable

(ii) RF Band Two (2):

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	
(a	710 - 2,700 mHz
(b	800 - 950 mHz
(2 VSWR	$\leq 1.5:1$
(3 Gain	
(a $\geq 1.5$ dBi	All channels
(4 Max input power	50W MAX
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	Polarized
(b Horizontal	90° nominal
(7 Return Loss	$\leq 14$ dB, maximum,
(8 RFI	None measurable



(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

(iii) RF Bands Three (3) and four (4):

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
(1 RF Range	
(a 150 - 250 mHz,	(or per OEM direction)
(b 260 - 400 mHz	(or per OEM direction)
(c 450 - 750 mHz	(or per OEM direction)
(d 800 mHz - 2.8 GHz (broadband)	(or per OEM direction)
(e 2.4 - 4.5 GHz (very broadband)	(or per OEM direction)
(f 3.0 - 5.7 GHz (extreme broadband)	(or per OEM direction)
//(g _____ mHz	(or per OEM direction)//
(2 VSWR	$\leq 1.5:1$ all bands (or per OEM direction)
(3 Gain	
(a $\geq 1.5$ dBi	150 - 750 mHz
(b $\geq 3.0$ dBi	800 mHz - 2.8 GHz (broadband)
(c $\geq 7.0$ dBi	2.4 - 4.5 GHz (very broadband)
(d $\geq 18.0$ dBi	3.0 - 5.7 GHz (extreme broadband)
(e $\geq 7.0$ dBi	2.4 - 4.5 GHz (very broadband)
(f $\geq 3.0$ dBi	800 mHz - 2.8 GHz (broadband)
(4 Max input power	50W MAX
(5 Impedance	50 Ohms
(6 Beamwidth:	
(a Vertical	Polarized
(b Horizontal	60 - 70° nominal
(7 Return Loss	$\leq 14$ dB, maximum,
(8 RFI	None measurable

(9 Wind Load Rating:	
(a External	40 LBS Per Square Foot (PSF) or 100 MPH
(b Internal	Not Applicable

b. Head End (HE) Equipment

1) DAS Equipment Room/Location

- a) The Contractor shall confirm each HE room/location depicted on the contract drawings conforms to the MIN requirements outlined in CFM's Design Manual PG-18-10 - Chapter 7 and OI&T Design (a copy can be obtained from the RE or SMCS [0050P2H3]).
- b) Any noted deviation(s) shall be provided to the RE in writing for an official determination concerning each noted item and how it/they will affect the system.
- c) The RE shall contact SMCS (0050P2H3) for technical assistance and the A/E for structural assistance.

B. CABINET WITH INTERNAL EQUIPMENT MOUNTING RAIL(S)(DO NOT DELETE): shall be lockable, fabricated of heavy 16 gauge (ga) steel, and have fully adjustable internal equipment mounting racks and/or rails that allows front panel equipment mounting and access.

1. Each equipment mounting rail shall be able to provide an internal cabinet ground for each installed equipment when the equipment is properly bolted to the rail.
2. Additionally, connect each equipment grounding terminal to a separate mounting hole on the equipment mounting rail to the right as one looks at it from the rear with a minim #12 AWG stranded copper wire with protective jacket.
3. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the RE or FMS Service Chief.
4. It shall be floor or wall mounted with knock-out holes for cable entrance(s) and conduit connections, contain ventilation ports and a quiet fan with non disposable air filter for equipment cooling.
5. Each cabinet shall be keyed alike and four (4) keys shall be provided to the RE for each 10 cabinets used when the VA accepts the System.
6. A minimum of one (1) cabinet shall be provided with blank rack space, for additional expansion equipment. Blank panels shall be installed to cover any open or unused rack space. In addition, provide two (2) 120 VAC power strips connected to surge protector(s), a ventilation fan with non-disposable air

filter, and a conduit or cable duct interfaced to adjacent cabinet(s) and local room wire management system, as part of this cabinet.

- a. Blank panels shall be color matched to the cabinet, 1/8in. (3.175 mm) thick aluminum with vertical dimensions in increments of one rack unit (RU) or 1.75in. (44.8469 mm) with mounting holes spaced to correspond to EIA 19in. (482.6 mm) rack dimensions.
  - b. Single standard larger size blank panels shall be used to fill unused panel or rack spaces in lieu of numerous types. One blank 1.75in. (44.8469 mm) high blank panel shall be installed between each item of equipment.
7. Provide internal cabinet communications grounding system and connect to communications ground buss bar with a minimum #6 AWG stranded copper wire with protective covering(see PART 2, PARAGRAPH 2.4.B).
- a. Each cabinet shall be grounded to the communications grounding system.
  - b. Connect the communications system grounding wire to a cabinet provided ground terminal or with a bolt(s) screwed into one mounting hole of each equipment mounting rail (refer to PARAGRAPH 2.9 HEREIN).
8. Technical Characteristics

Overall Height	2,180 mm (85 7/8in.), maximum
Overall Depth	650 mm (25 1/2in.), maximum
Overall Width	535 mm (21 1/16in.), maximum
Front Panel Opening Width	480 mm (19in.), EIA horizontal
Hole Spacing	per EIA and Industry Standards

9. Internal Cabinet Components (MINIMUM REQUIRED)

- a. AC power outlet strip(s - DO NOT DELETE):
  - 1) Two (2) Power outlet strips shall be provided as directed by the OEM. The additional spare equipment cabinet with no installed items in the cabinet shall contain two (2) AC strips with a minimum of 10 ea. AC power outlets. Each strip shall be mounted inside and at the rear of the cabinet. It shall contain "U" grounded AC outlets for distributing AC power to the installed electronic equipment. The strip shall be self-contained in a metal enclosure and may be provided with a 2 M (6 ft.) long (maximum) connecting cord with three prong plug.
  - 2) Technical Characteristics:
    - a) Power capacity 20 Ampere (AMP), 120 VAC continuous duty.
    - b) Wire gauge: Three conductor, #12 AWG copper.
- b. Cabinet AC Power Line Surge Protector and Filter:
  - 1) Each cabinet shall be equipped with a AC Surge Protector and Line Filter. The Protector and Filter shall be housed in one single

enclosure. The Protector and Filter shall perform instantaneous regulation of the AC input voltage and isolate and filter any noise present on the AC input line. The unit shall be equipped with AC voltage and current surge protectors to prevent damage to the electronic equipment from power line induced voltage spikes, surges, lightning, etc. It shall be cabinet mounted and the cabinet AC power strip (maximum of two [2] strips) may be connected to it as long as the system design is met.

## 2) Technical Characteristics

Input Voltage range	120 VAC $\pm$ 15%
Power capacity	20 AMP, 120 VAC
Voltage output regulation	$\pm$ 3.0%
Circuit breaker	15 AMP, may be self contain
Noise filtering	Greater than -45 dB
AC outlets	Four (4) duplex grounded types, minimum
Response time	5.0 ns
Suppression	
Surge	10,000 A
Noise	
Common	-40 dB
Differential	-45 dB

## 3) Specific requirements for current and surge protection shall include:

- a) Voltage protection threshold, line to neutral, starts at no more than 220 Volts peak. The transient voltage shall not exceed 300 volts peak. The Contractor shall furnish documentation on peak clamping voltage as a function of transient AMP.
- b) Peak power dissipation minimum 35 Joules per phase, as measured for 1.0 mS at sub branch panels, 100 Joules per phase at branch panels and 300 Joules per phase at service entrance panels. The Contractor shall furnish an explanation of how the ratings were measured or empirically derived.
- c) Surge protector must not short circuit the AC power line at any time.
  - (1) The primary surge protection components must be silicon semiconductors. Secondary stages, if used, may include other types of devices.

(2) Surge protectors shall incorporate a visual device which indicates whether the surge suppression component(s) is (are) functioning.

(3) Surge protection devices shall be UL listed.

(4) Voltage and current surge protectors shall be provided on all ancillary equipment provided by the Contractor.

d) Power dissipation 12,000 Watts (W) for 1.0 mS (or 12 Joules).

e) Voltage protection threshold starts at not more than 100 VAC.

c. Uninterruptible Power Supply (UPS): Each cabinet shall be provided with an internal UPS. This item may be combined with the Surge Protector & Filter in PART 2, PARAGRAPH 2.4.I.8.b as long as the 50% expansion is met. The UPS shall provide atleast one (1) hours continuous full load //two hours if working with an emergency / safety system// uninterruptible system primary AC Power, with a 25% (at least one //to two hours//) reserve capacity, in the event of Facility Primary or Emergency AC Po-wer failure.

1) The UPS shall include, but not be limited to:

a) Protection switch	Required to automatically protect the UPS unit and associated equipment connected to it. <b>This function is required to be a part of the System's electronic supervision requirements.</b>
b) First/fast charge unit	Must provide clean predicable charge voltage / current when needed. This function is required to be a part of the System's electronic supervision requirements.
c) Over Voltage/Current protect	Must not short circuit the AC power line at any time. This function is required to be a part of the System's electronic supervision requirements.
d) Trickle charge unit	Must be cable of maintaining a suitable internal battery charge without damaging the batteries.
e) Internally mounted	Per OEM's direction.
f) Proper ventilation	Not override the cabinets' venti-lation system.
g) Power change from AC input	Shall be accomplished without interruption to the communications link or subsystem being protected. <b>This change of state shall generate visual and aural alarms in its Electrical Supervision System.</b>
h) Electrical supervision	Required - must be audile and visual locally and remoted to annunciating panel(s) via direct connection for trouble indication

C. ENVIRONMENTAL CABINET (if selected): The Contractor shall provide this enclosure in lieu of a standard equipment cabinet identified in Paragraph 2.4.B to meet system design in hostile TR locations as identified in CFM's OI&T Design Guide and locations as shown on the drawings.

1. The enclosure shall fully sustain the installed, including electronic, equipment in the same manner as the standard cabinet identified in Paragraph 2.4.B. Additionally, the enclosure shall fully support all installed equipment as if they were in a standalone air handling area regardless of the local area's air handling capabilities.
2. The enclosure shall be an OEM's fully assembled unit.
3. If more than two enclosures are required in any system location, those enclosures shall be OEM assembled for consolidating or combining two or more enclosures in a single unit to meet system space and equipment handling designs plus maintain OSHA spacing requirements.

4. Technical Characteristics

a. Environmental control	Automatic, heating and/or cooling, as required
b. Temperature conditions (rated at 1,300 W of install equipment heat generation):	
c. Internal Range	Maintains 80° to 105° of internal heat conditions, maximum
d. External Range	100° $\pm$ 25°, maximum
e. Forced air unit	Required with non disposable air filter unobstructed and uninterruptible
f. Air conditioning	As required, fully internal mounted
g. Heater	As required, fully internal mounted
h. Uninterruptible power supply	As required, fully internal mounted
i. Front door	Full length, see through, EMI resistant, and lockable
j. Rear door	Full length, non-see through, EMI resistant, and lockable
k. Conduit wiring entrance	TOP AND/OR BOTTOM, FULLY SEALED
l. Input power	2 ea. minimum 120 VAC @ 20A, maximum, independent circuit, conduit for fixed or armored cable for moveable installations
m. Dimensions:	
n. Height	1980 mm (78in.), maximum
o. Width	635 mm (25in.), maximum
p. Depth	965 mm (38in.), maximum

q. Front panel opening	480 mm (19in.), w/ EIA mounting hole spacing
------------------------	--

D. DISTRIBUTION OR SYSTEM INTERFACE CABINET: The cabinet shall be constructed of heavy 16 ga cold rolled steel, have top and side panels and hinged front and rear (front door only if wall mounted) doors.

1. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or the RE, contain integral and adjustable predrilled rack mounting rails or frame that allows front panel equipment mounting and access.
2. When all equipment, doors and panels are installed, snap-in-place chrome trim strip covers are required to be installed that will cover all front panel screw fasteners.
3. It shall be equipped the same as the equipment cabinet.
4. Technical Characteristics

a. Overall height	2,180 mm (85 7/8in.), maximum
b. Overall depth	650 mm (25 1/2in.), maximum
c. Overall width	535 mm (21 1/16in.), maximum
d. Equipment vertical mounting space	1,960 mm (77 1/8in.), maximum
e. Front panel horizontal	484 mm (19 1/16in.), maximum width

E. STAND ALONE EQUIPMENT RACK (or sometimes called Radio Relay Rack): The rack shall be constructed of heavy 16 ga cold rolled steel and have fully adjustable equipment front mounting rails that allows front panel equipment mounting and access.

1. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color to be selected by the using FMS Chief or the RE. It shall be floor or wall mounted or mounted on casters as directed by the RE.
2. Technical Characteristics

a. Overall Height	2,180 mm (85 7/8in.), maximum
b. Overall Depth	650 mm (25 1/2in.), maximum
c. Overall Width	535 mm (21 1/16in.), maximum
d. Front Panel Opening	480 mm (19in.), EIA horizontal width
e. Hole Spacing	per EIA and Industry Standards

F. WIRES AND CABLES

1. CONTROL WIRING: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways

that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.

- a. Unless otherwise specified in other Specifications Sections of the TIP specifications (re SECTIONS 27 05 11, 27 11 00, 27 13 00 & 27 15 00), control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 16 AWG.
  - b. Control wiring shall be large enough so that the voltage drop under "turn-on" conditions does not adversely affect operation of the controls.
2. COMMUNICATIONS AND SIGNAL WIRING: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated. The wires:
- a. Shall conform to the recommendations of the OEMs of the communication and signal systems; however, not less than what is shown.
  - b. Shown is for typical systems. Provide wiring as required for the systems being furnished.
  - c. Multi-conductor construction shall have the conductors color coded per TIA/TIA 569.
  - d. Shall provide minimum grade of service of BICSI Category 5E. If the Facility desires enhanced grade(s) of service, it must be fully identified and justified at the beginning of the project, during the Project's initial design phase.
3. COPPER CONDUCTOR CABLE: Is defined as solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. The copper cable is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.
- a. For special high frequency applications, the cable core shall be separated into compartments.
  - b. Cable shall be completed by the application of a:
    - 1) Suitable core wrapping material,



- 2) Corrugated copper or plastic coated aluminum shield, and
- 3) Overall extruded jacket.
- c. The contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified (ie):
  - 1) 19 gauge (6 to 400 pairs),
  - 2) 22 gauge (6 to 1,200 pairs),
  - 3) 24 gauge (6 to 2,100 pairs),
  - 4) 26 gauge (6 to 3,000 pairs).
- d. Each copper cable shall meet or exceed the following specifications for the specific type of cable:
  - 1) Each cable reel shall be sweep tested and certified by the OEM by tags affixed to each reel. The Contractor shall turn over all sweep tags to the RE or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the RE and receive approval before installation.
  - 2) Cables installed in any outside location (i.e. above ground, underground in conduit, ducts, pathways, etc.) shall be filled with a waterproofing compound between outside jacket (not immediately touching any provided armor) and inter conductors to seal punctures in the jacket and protect the conductors from moisture.
  - 3) The Contractor shall provide all Systems cables that are OEM recommended and insure the approved System expansion is met.
- e. Data Multi-Conductor (Digital): The cable shall be multi-conductor, shielded or unshielded cable with stranded conductors. The cable shall be able to handle the power and voltage used over the distance required.
  - 1) It shall meet BICSI Category 5e service at a minimum.
  - 2) Technical Characteristics:

REQUIREMENT	FUNCTION
a) Wire size	22 AWG, minimum
b) Working shield	350 V
c) Bend radius	10X the cable outside diameter
d) Impedance	100 Ohms $\pm$ 15%, BAL
e) Bandwidth	100 mHz, minimum
F) DC RESISTANCE	10.0 Ohms/100M, maximum
g) Shield coverage	
h) Overall Outside (if OEM	100%

specified)	
i) Individual Pairs (if OEM specified)	100%
j) Attenuation	
<b>k) Frequency in MHz</b>	<b>dB per 305 M (1,000ft.), maximum</b>
0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
62.0	52.0
100.0	68.0

f. Remote Control: The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors.

- 1) The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location.
- 2) The cable shall be NRTL listed and pass the FR-1 vertical flame test, at a minimum.
- 3) Each conductor shall be color-coded.
- 4) Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.
- 5) Technical Characteristics

REQUIREMENT	FUNCTION
a) Length	As required, in 1K (3,000 m.) reels minimum
b) Connectors	As required by system design
c) Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
d) Color coding	Required, EIA industry standard
f) Bend radius	10X the cable outside diameter
g) Impedance	As required
h) Shield coverage	As required by OEM specification
i) Attenuation	
<b>j) Frequency in MHz</b>	<b>dB per 305 M (1,000ft.), maximum</b>

0.7	5.2
1.0	6.5
4.0	14.0
8.0	19.0
16.0	26.0
20.0	29.0
25.0	33.0
31.0	36.0
50.0	52.0

4. FIBER OPTIC CABLE: Is not required to be plenum rated when installed in conduit. It is required to be plenum rated when installed in designated "Air Plenum" spaces / areas. Wiring that is routed in cable trays via pathways that is not rated "Air Plenum" locations, the wiring is not required to be plenum rated; only when pathways pass through "Air Plenum" spaces/areas, the wiring shall be plenum rated.

a. Single-mode

- 1) 8/125-um, 0.10 aperture 1,310 nm fiber optic cable in accordance with TIA-492CAAA,
- 2) 8/125-um, 0.10 aperture 1,550 nm fiber optic cable in accordance with TIA-492E000.

b. Multimode

- 1) 62.5/125-um, Bell System Standard, 0.275 aperture fiber optic cable in accordance with TIA-492AAAA, TIA-472D000, and ICEA S-87-640, OR
- 2) 50/125-um, American (NOT EUROPEAN) Standard, 0.275 aperture fiber optic cable that is optically enhanced in accordance with TIA-492AAAB, including any special requirements made necessary by using this specialized design (re PART 1, PARAGRAPH 1.4.E.3.h for minimum performance).

- c. Strength Members: Provide //central// //non-central//, //non-metallic// //metallic// strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

- d. Shielding or Other Metallic Covering: Provide //copper//, //copper alloy// //copper and steel laminate// //copper and stainless steel// //coated stainless steel// //bare low carbon steel// //bare aluminum or

coated aluminum// //single// //dual// tape covering or shield// in accordance with ICEA S-87-640.

- e. Fiber optic cable: Shall be specifically designed for inside or outside use with loose buffered construction. Provide fiber optic color code in accordance with TIA/EIA-598.
- f. Performance Requirements: Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.
  - 1) End to End Link Performance as listed in Annex E of ANSI/ TIA/ EIA SP-2840A.
  - 2) The cabling system must conform to the current issue of Industry Standard ANSI/TIA/EIA 568A.
  - 3) The system shall support all applications for which it is designed, including, at a minimum ATM 155 Mbps for BICSI Certified Category 5E (see PART 2, PARAGRAPH 2.4.C.4), during the lifetime of the certified system.
  - 4) Quality and installation methods used shall be equal to or better than that found in the BICSI TDM Manual.
  - 5) VA demands strict adherence to the performance specifications listed in ANSI/TIA/EIA SP-2840A, 568A and 569.
  - 6) New construction AND major renovations of telecommunications spaces and pathways shall conform to EIA/TIA 569, at a minimum.
    - a) In cases of renovations in historic or otherwise restrictive buildings; where it has been determined as impossible to follow the above stated guidelines, the exceptions must not modify the maximum distances set forth in ANSI/TIA/EIA SP-2840A, 568A and 569 and must not in any way affect the performance of the entire cabling system.
    - b) Modification to administrative issues requires written approval(s) from CFM's PE/ PM and/or RE; with concurrence from the OEM, Contractor, SMCS and Using Authority(s).

G. TEMPORARY DAS TIP PATHS: (ie overhead tracks, road / path bridges, etc.) for copper, fiberoptic, RF, coaxial and designated electrical cables that are used to maintain Facility Communications Service in force during construction and shall be installed so as to not present a pedestrian and traffic (including construction) safety hazard.

- 1. TIP temporary cable installations are not required to meet Industry Standards; but, each must be reviewed and approved, in writing, by the RE with concurrences from SMCS 0050P2H3, the Facility OI&T and Safety Officer, prior to installation. The Contractor shall:

- a. Be responsible for all work associated with each temporary TIP path installation required by system design; and, for its/their removal when determined no longer necessary,
  - b. Survey the outside TIP locations usually encountered, but are not limited to: Roads, driveways, marked paths, Hi traffic passageways, personnel walkways, etc, and provide the RE a plan for the temporary path, and
  - c. Ensure each temporary TIP path is installed so as to not present a pedestrian and vehicle safety hazard.
- H. DAS CROSS-CONNECTION SYSTEM (CCS) EQUIPMENT BREAKOUT, TERMINATION CONNECTOR (OR BULKHEAD), AND PATCH PANELS (ARE IN ADDITIONA TO THE TIP CCS REQUIREMENTS): Each DAS CCS requires the use of a single tool, has the fewest amount of parts, and the least amount of assembly or projected trouble shooting time during the life of the system.
- 1. The CCS system used at each ENT (aka DEMARC), TER & MCR, MCOR, PCR, ECR, SCC, HER, STR's, TR's. The IDF shall force cross-connect cable slack management through adherence to the OEM's installation methods, provided cable management systems, and as described herein, so that moves, adds, and changes can be administered easily and cost effectively.
  - 2. The connector panel(s) shall be made of flat smooth 3.175 mm (1/8 in.) thick solid aluminum, custom designed, fitted and installed in the cabinet. Bulkhead equipment connectors shall be mounted on the panel to enable all cabinet equipment's signal, control, and coaxial cables to be connected through the panel. Each panel shall be color matched to the cabinet installed.
  - 3. Voice (or Telephone): The DAS CSS for voice or telephone service shall be Bell/ATT Telephone Industry Standard rated 110A (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each being certified for BISCII Category 5E service.
    - a. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all DAS CCS and shall be specifically designed for BISCII Category 5E telecommunications service and the size and type of UTP cable used as described herein.
    - b. Punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the DEMARC, MCR, TER, STRs, TRs & HER's DAS Vertical Cross Connection System (VCCS) & Horizontal Cross Connection System (HCCS) ARE IN ADDITION TO RIP V&HCCS REQUIREMENTS.
    - c. Console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the RE.

d. Punch blocks shall not be used for Class II or 120 VAC power wiring.

e. Technical Characteristics

Horizontal rows	100, minimum
Terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of terminals
Wire management	Required, internal
Spares	<b>25% circuit capacity by extra rows or punch blocks</b>

4. Digital (or High Speed Data): The DAS CCS shall be a patch panel with modular female RJ45 jacks installed in rows.

a. Patch panels and RJ45 jacks shall be specifically designed for BISC Category 5E telecommunications service and the size and type of UTP or STP cable used.

b. Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.

c. Technical Characteristics

Horizontal rows	2 or 4, minimum
Jacks per row	24, minimum
Type of jacks	RJ45, female
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks
Product Reference	Ortronics Mdl. OR-B51004983 for four rows and OR-S51004912 for two rows, or equal
Wire management	Required, internal
<b>Spares</b>	<b>25% circuit expansion jacks or extra jack panel(s)</b>

5. Fiber Optic Distribution Panel (aka Light Wave Shelf) The panel shall be provided with pre-punched chassis mounting holes, contained in a metal enclosure with lockable & tinted see-thru protection cover.

a. This panel is not allowed to be used for 120 VAC power connections.

b. Technical Characteristics

Height	4 rack units (RUs), 176 mm (7.0 in.)
Width	484 mm (19 1/16in.), EIA minimum
Horizontal Rows	6 ea, minimum
Vertical Rows	12 ea, minimum
Total Connectors	72 ea, minimum

Connector Type	AT&T/Bell Standard "ST" female, or equal
Produce Reference	AT&T LST1U-072/7, or equal
Wire management	Required, internal
<b>Spares</b>	<b>25% circuit expansion jacks or extra jack panel(s)</b>

#### 6. Mounting Strips and Blocks

- a. Barrier Strips: Barrier strips are approved for AC power, data, voice, and control cable or wires. Barrier strips shall accommodate the size and type of audio spade (or fork type) lugs used with insulating and separating strips between the terminals for securing separate wires in a neat and orderly fashion. Each cable or wire end shall be provided with an audio spade lug, which is connected to an individual screw terminal on the barrier strip. The barrier strips shall be surface secured to a console, cabinet, rail, panel, etc. 120 VAC power wires shall not be connected to signal barrier strips.

#### b. Technical Characteristics

Terminal size	6-32, minimum
Terminal Count	ANY COMBINATION
Wire size	20 AWG, minimum
Voltage handling	100 V, minimum
Protective connector cover	Required for Class II and 120 VAC power connections

7. Solderless Connectors: The connectors (or fork connectors) shall be crimp-on insulated lug to fit a 6-32 minimum screw terminal. The fork connector shall be installed using a standard lug-crimping tool.
8. Punch Blocks: As a minimum, Bell/AT&T Industry Standard 110A type punch blocks are approved for data, voice, and control wiring. Punch blocks shall be specifically designed for the size and type of wire used. Punch block strips shall be secured to a console, cabinet, rail, panel, etc. Punch blocks shall not be used for Class II or 120 VAC power wiring.
9. Wire Wrap Strips: Industry Standard wire wrap strips (16.5 mm (0.065in.) wire wrap minimum) are approved for data, voice and control wiring. Wire wrap strips shall be secured to a cabinet, rail, panel, etc. Wire wrap strips shall not be used for Class II or 120 VAC power wiring.
10. Analog Audio or Control System: Product reference of a Government Approved (US State Department) type is Telewire, PUP-17 with pre-punched chassis mounting holes arranged in two horizontal rows.

- a. This panel may be used for audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors.
- b. This panel is not allowed to be used for 120 VAC power connections.
- c. Technical Characteristics

Height	Two rack units (RUs), 88 mm (3.5in.) minimum
Width	484 mm (19 1/16in.), EIA minimum
Number of connections	12 pairs, minimum
Connectors	
Audio Service	Use RCA 6.35 mm (1/4in.) Phono, XL or Barrier Strips, surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Control Signal Service	Barrier strips surface mounted with spade lugs (punch block or wire wrap type strips are acceptable alternates for barrier strips as long as system design is maintained and RE approved)
Low voltage power (class II)	Barrier strips with spade lugs and clear full length plastic cover, surfaced mounted
Fiber optic	"ST" Stainless steel, female

- I. TELECOMMUNICAITONS OUTLETS (TCO): Is the final outlet/connector for the interface between the horizontal wiring and the designated room/area TCO locations. The Contractor shall clearly and fully indicate this category for each TCO location and compare the total count to the locations identified herein as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.
1. The System shall be capable of receiving the specified telephone (or voice) and data signals acquired from the LEC, FTS contracted carrier and computer system, //, and \_\_\_\_ each RF coaxial cable(s) // //, and \_\_\_\_ each fiber optic single mode and multimode cable(s)// and shall process and distribute them to the designated TCO's described herein and as shown on the drawings.
  2. Each designated room/area shall be supplied with a TCO outlet/ connector (aka modular jack or RJ-45) for connection to the TIP Horizontal Cable Plant. All TCO outlet/connectors shall be installed in an appropriate faceplate designated by the OEM. All TCO outlet/connectors shall be complete with faceplate and attached permanently to a fixed structure, such as building walls, utility pales or modular furniture partitions.
  3. The TCO shall be modular in construction and able to accept six (6) modular connection jacks mounted in a separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled six (6) position modular faceplate.



4. The TCO Eight (8) position modular outlet/connectors (aka RJ45 jacks) shall accept six (6) position modular plugs (RJ11 or RJ11/2) while providing proper electrical connection and not damaging the jack. The OEM shall warrant all eight (8) position modular jack used in such a manner to be usable for 8 position modular plugs in the future.
5. The TCO shall be activated with one (1) minimum 25 //and \_\_\_\_\_// pair UTP cable that will sustain minimum BICSI Category 5e communications service punched down or connected to the respective TR HCCS (label each wire at each end and coil and tape unused wires in the TCO outlet box back) to contain two (2) RJ-45/11 telephone multipin jacks and two (2) RJ-45 data multipin //, and one single mode fiber optic //, and one multimode fiber optic //, and one baseband RF, video, or audio (not Telephone) // jacks that are connected to the respective HCCS. The:
  - a. Top two (2) jacks shall be designated for telephone (voice) service,
  - b. Middle two (2) designated for data service,
  - c. Bottom two (2) // and two fiber optic "ST" connectors, one designated for multimode fiber optic cable and the other for single mode fiber optic cable connection(s) // // and one analog RF coaxial "F" connector. //
6. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a stainless steel or color matched faceplate shall be provided adjacent to and attached to the activated outlet box for system expansion.
7. In order to allow normal expansion of service during the life of the TIP system, flush work area TCOs shall provide sufficient density to support up to a maximum of:
  - a. Eight (8) jacks/ connectors per single gang TCO,
  - b. Twelve (12) jacks/connectors per double gang TCO, and
  - c. Surface mount TCO's shall provide up to six (6) jacks/ connectors.
8. A non-impact termination method using a full-cycle terminating tool-having exhibiting both tactile and audible feedback to indicate proper termination shall be used. High impact tools are not acceptable and will not be approved. Terminated conductor ends shall be properly trimmed to assure a minimum clearance of 0.250 in. between the conductors of adjacent modules.
9. TCO face plates shall be clean in appearance and OEM recommended for the service it's performing. Mounting hardware shall not be visible on the faceplate. Color coded modules shall be employed and colors shall comply with the requirements of EIA/TIA 606.

10. The room/area TCO outlet/connectors shall not cause or create "resonance" on short cable runs as described in the Field Testing TSB 67 (Draft 13 section 7.8 Short Links/Channels).
11. Each TCO outlet/connector shall require (or specifically not allow more than) only one single connection to the TIP Horizontal Cable serving its location as per TIA/EIA 568/568A standard.
12. Flush mounted TCO faceplates shall accommodate modular TCO outlet/connectors and be available in one (1), two (2), four (4), six (6) and eight (8) connectors per single gang TCO.
  - a. The modular TCO outlet/connectors available shall include a minimum of four active (4) UTP eight (8) position (RJ-45), one inactive (1) optical fiber in //SC// //ST// terminations, one future (1) "F" OR one (1) "BNC" connectors for coax and video service respectively and one (1) "Spare" unused space.
  - b. All TCO's shall be made of OEM approved high impact plastic.
13. The same modular TCO outlet/connectors as found in the flush and surface mount TCOs shall be installable in utility poles and modular furniture using OEM faceplates or adapters for this purpose. Each TCO shall house at least four (4) active TCO modular RJ-45 outlet/connectors.
14. The same modular TCO outlet/connectors as found in the flush and surface telecommunications outlets shall be installable in readily available single gang and double gang stainless steel faceplates using OEM faceplates or adapters for this purpose. The eight (8) position modular UTP TCO outlet/connector and its pin assignments shall meet the requirements described in the standard TIA/EIA 568A.
15. Each TCO shall be uniquely labeled as described herein. The label shall form an integral part of the faceplate.
16. For PBPU installations, the cover plate shall be the unit's OEM approved.
17. Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.
  - a. If the TCO's are not shown on the drawings, at a minimum, one (1) TCO shall be provided on each room wall, associated with an active 120 VAC duplex outlet shall be provided.
  - b. The contractor shall provide a minimum of one spare TCO per 25% of the total system count (whichever is greater) to the RE as System Expansion/Maintenance items.
18. TCO Connection (aka Patch) Cables

- a. Telephone (aka voice): The Contractor shall provide one (1) voice connection (Patch) cable for each TCO telephone jack and HCCS Patch Panel (if provided by system design) in the System with 15% spares.
- b. The telephone (voice) connection cable shall connect the telephone instrument to one of the TCO telephone (voice) jacks. The Contractor shall not provide telephone instrument(s) or equipment.
- c. Technical Characteristics

Length	1.8M (6ft.), minimum
Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

- d. Data (aka Digital): The Contractor shall provide one (1) data connection cable for each DAS TCO data jack and CCS patch panel in the system with 15% spares.

1) The data connection cable shall connect a data instrument to the TCO data jack and perform data signal interconnection on the CCS patch panel. DAS TCOs ARE IN ADDITION TO THE TIP REQUIRED TCOs.

2) The Contractor shall not provide active data terminal(s)/ equipment.

3) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

- e. Fiber Optic: The Contractor shall provide one (1) fiberoptic connection cable for each DAS TCO fiber optic jack and CCS patch panel in the System with 15% spares.

1) The connection cable shall connect a fiber optic instrument to the DAS TCO fiber optic jack and perform voice, data or HDTV interconnection on the CCS patch panel. The Contractor shall not provide fiber optic instrument(s)/equipment.

2) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible single conductor with jacket
Connector	ST male on each end
Size	To fit single mode or multimode cable

f. RF: The Contractor shall provide one (1) RF coaxial cable connection cable for each DAS TCO RF connector and CCS patch panel in the System with 1 5% spares.

- 1) The RF coaxial connection cable shall connect a RF instrument to the DAS TCO RF jack and perform HDTV signal interconnection on the HCCS patch panel (if provided).

2) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-6/U, minimum
Connector	"F" male on each end //

//g. Baseband / Video: The Contractor shall provide one (1) coaxial connection cable for each TCO baseband / video jack and HCCS patch panel in the System with 15% spares. The coaxial video connection cable shall connect a baseband / video instrument to the TCO analog video jack and perform signal interconnection on the CCS patch panel (if provided). The Contractor shall not provide baseband / video instrument(s)/equipment.

1) Technical Characteristics:

Length	1.8M (6 ft.), minimum
Cable	Flexible RG-59/U, minimum
Connector	BNC male on each end //

//h. Baseband Audio: The Contractor shall provide one (1) audio connection cable for each TCO analog audio jack and HCCS patch panel in the System with 15% spares.

- 1) The audio connection cable shall connect an audio instrument to the TCO analog audio jack and perform signal interconnection on the HCCS panel (if provided).
- 2) The Contractor shall not provide active analog audio instrument(s)/equipment.

3) Technical Characteristics

Length	1.8M (6 ft.), minimum
Cable	Flexible 22 AWG, STP, minimum
Connector	"XL" male on each end//

J. COMMON EQUIPMENT ITEMS

1. Conduits

a. Rigid galvanized steel	Shall Conform to UL 6, ANSI C80.1.
b. Rigid aluminum	Shall Conform to UL 6A, ANSI C80.5.
c. Rigid intermediate steel	Shall Conform to UL 1242, ANSI C80.6.

(IMC)	
d. EMT	Shall Conform to UL 797, ANSI C80.3. Maximum size not to exceed 105 mm (4 inch) and shall be permitted only with cable rated 600 volts or less.
e. Flexible galvanized steel	Shall Conform to UL 1.
f. Liquid-tight flexible metal	Shall Conform to UL 360.
g. Direct burial plastic	Shall conform to UL 651 and UL 651A, and heavy wall PVC or high density polyethylene ( <b>PE</b> ).

## 2. Conduit Fittings

<b>a. Rigid steel and IMC</b>	
(1) Fittings	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
(a) Sealing	Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
(2) Standard threaded couplings, locknuts, bushings, and elbows	Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
(3) Locknuts	Bonding type with sharp edges for digging into the metal wall of an enclosure.
(4) Bushings	Metallic insulating type, consisting of an insulating insert molded or locked into the metal body of the fitting. <b>Bushings made entirely of metal or nonmetallic material are not permitted.</b>
(5) Erickson (union-type) and set screw type couplings	Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. <b>Tightening of set screws with pliers is prohibited.</b>
(6)	Must be OEM approved.
<b>b. EMT</b>	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1
(1) fittings	Only steel or malleable iron materials are acceptable.
(2) Couplings and connectors	Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for

	positive grounding.
(3)	Must be OEM approved.
<b>c. Flexible steel</b>	Conform to UL 514B. Only steel or malleable iron materials are acceptable.
(1) Clamp type,	Must be provided with insulated throat.
(2)	Must be OEM approved.
<b>d. Liquid-tight flexible metal</b>	Shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
(1)	Only steel or malleable iron materials are acceptable.
(2)	Must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
(3)	Must be OEM approved.
<b>e. Rigid aluminum</b>	Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. <b>Aluminum fittings containing more than 0.4 per-cent copper are prohibited.</b>
(1) Locknuts and bushings	As specified for rigid steel and IMC conduit.
(2) Set screw fittings	<b>Not permitted for use with aluminum conduit.</b>
(3) Indent type connectors or couplings	Are Prohibited.
(4) Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal"	Are prohibited.
(5)	Must be OEM approved.
<b>e. Direct burial plastic conduit fittings</b>	
(1)	Fittings shall meet the requirements of UL 514C and NEMA TC3.
(2)	As recommended by the conduit OEM.
<b>f. Expansion and deflection couplings:</b>	
(1) Conform	To UL 467 and UL 514B.
(2) Accommodates	19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
<b>g. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents</b>	In accordance with UL 467, and the NEC code tables for ground conductors.
<b>h. Jacket</b>	Must be flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

## 3. Conduit Supports

a. Parts and hardware	Zinc-coat or provide equivalent corrosion protection.
b. Individual Conduit Hangers	Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
c. Multiple conduit (trapeze) hangers	Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
d. Solid Masonry and Concrete Anchors	Self-drilling expansion shields, or machine bolt expansion.

## 4. Junction, and Pull Boxes

a. Conforms	To UL-50 and UL-514A.
b. Cast metal	Where required by the NEC or shown, and equipped with rustproof boxes.
c. Sheet metal boxes	Galvanized steel, except where otherwise shown.
d. Flush mounted	Wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall or ceiling. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

## 5. Telecommunications Pathways and Spaces - comply with TIA/EIA-569-A.

a. Cable trays	Shall be provided and utilized in the system to manage cable in an orderly fashion. Cable management shall be installed in racks and on walls as per OEM's recommendations. Appropriate fire barriers shall be placed around the cables in the sleeves, and unused sleeves shall be properly fire stop-ped.
b. Cable Duct	Equip with hinged covers, except where removable covers are allowed by specific authorization from the RE in writing.
c. Cable Duct Fittings	As recommended by the Cable Duct OEM.
d. Surface Metal Raceway	Shall conform to <b>UL 5</b> and be <b>"telecommunications service"</b> rated with approved length-way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
e. Surface Metal Raceway fittings	As recommended by the Raceway OEM.
f. Wireway, Metal or Approved Plastic	Shall be <b>"telecommunications service"</b> rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to another.
g. Wireway, Approved "Basket"	Shall be <b>"telecommunications service"</b> rated with approved length way partitions and cable straps to prevent wires and cables from changing from one partitioned pathway to

	another.
h. Wireway Fittings	As recommended by the Wireway OEM.

## 6. Interduct

- a. Outside plant innerduct may be plenum rated where each interduct is 3" (75 mm) and larger.
- b. Inside Plant Innerduct shall be listed and marked for installation in plenum airspaces and shall be a minimum 1.0" (25mm) inside diameter.
  - 1) Plenum innerducts shall be constructed of low smoke emission, flame retardant PVC.
  - 2) All Innerducts shall be furnished with factory installed nylon pull ropes.
  - 3) Plenum innerducts shall have a UL 94 V-O rating for flame spreading limitation.
  - 4) All innerduct reel lengths shall be provided as necessary to insure that ducts are continuous; one piece runs from ENT to MH; MH to MH; DEMARC to MCR/TER; TR to TR. No innerduct connectors will be allowed between rooms.
  - 5) Pulling accessories used for innerduct shall be compatible with materials being pulled. Accessories shall be furnished as required to complete the installation, including but not limited to, inner duct lubricants, spreaders, applicators, grips, swivels, harnesses, and line missiles (aka blown air).
  - 6) Each segment of innerduct shall extend at least 12.0" (300mm) inches beyond the end of the service conduit tie and/or cable tray. Innerduct ends shall be neatly restrained with wall mount clamps and sealed when cable is installed.

## K. WIRE LUBRECATING COMPOUND

1. Suitable for the wire insulation and conduit it is used, and shall not harden or become adhesive.
2. Shall not be used on wire for isolated type electrical power systems.
3. SHALL BE USED ONLY AT THE OEM'S DIRECTON FOR NURSE CALL, PA, FA, SECURITY MANAGEMENT AND OTHER LIKE EMERGENCY SYSTEMS.

## L. FIREPROOFING TAPE

1. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
2. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.



3. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
  4. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
  5. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.
- M. WARNING TAPE - conform to Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape // detectable // non-detectable // type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

## 2.5 WIRE MANAGEMENT SYSTEM AND EQUIPMENT

- A. Wire Management System: The system(s) shall be provided as the management center of the respective cable system: TER, MCR, TR, HE, SCR, ECC, EMCC, etc. It shall perform as a platform to house peripheral equipment in a standard relay rack(s), equipment, distribution, interface cabinet(s) and wall mounting boards, panels or rails. It shall be arranged in a manner as to provide convenient access to all installed Facilities Management Service (FMS), OI&T and other equipment.
1. All cables and connections shall be at the rear and/or top of each system interface to conduits, patch panels, punch blocks, wire wrap strips, barrier strip, etc.
  2. Each system shall be custom configured to meet the System design and user needs. The MIN required is a rack, cabinet, or wall mounted TIA/EIA 19" wide and two RUs high.
- B. Wire Management Equipment - the wire management equipment shall be the focal point of each wire management system. It shall provide an orderly interface between outside and inside wires and cables (where used), distribution and interface wires and cables, inter-connection wires and cables and associated equipment, jumper cables, and provide a uniform connection media for all system fire retardant wires and cables and other subsystems.
1. It shall be fully compatible and interface to each cable tray, duct, pathway, wireway, or conduit used in the system.
  2. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a over-head protection system and be uniformly routed down either side (or both at the same time) of the frames side protection system then laterally via a anchoring or routing shelf for termination on the rear of each respective terminating assembly.

<b>a. Vertical Cable</b>	Required, 4" X 5" duct style MIN, mounts to side or between 19" equipment racks, mounts
--------------------------	---

<b>Management</b>	in the front or rear of equipment racks or cabinets, contains cover to protect cables, has slots on each side for cable ingress and egress.
(1) Wall Brackets	Required - 19" wide and 6" deep MIN, accepts and mounts standard TIA/EIA 19" wide patch panels, mounting blocks, etc., hinged on one side to allow rear cable access.
(2) Floor Frames	Required - in very high density cable locations (ie PBX, TER, TR, MCR rooms), single or double sided metal construction, bold mountable for floor applications, compatible for 300 pair, 66, 110 or 110A blocks, maintains MIN 6" high vertical cable channels, prevents opens, crosses or shorts in cables attached to it
<b>b. Horizontal Cable Management</b>	
(1) Combination Organizers	TIA/EIA minimum Category 5E, 19" rack width, in one RU (1.75") multiples to suite system design, front and rear cable routing rings required, six MIN.
(2) Cable Bars	
(a) Flat type	Required - 19" rack width rear or front cabinet or rack mountable, contains cable tie bars and/or wire saddles.
(b) Duct type	Required - 19" rack width rear (1" X 4" MIN) or front (1 ½" X 3" MIN) cabinet or rack mountable; alternate 2" X 4" MIN rear and 3" X 3" front MIN ducts are allowed, each duct in multiple of 1.0 RU (1.75") height.
(3) Cable Hangers	<u>ALLOWED TO SUPPLEMENT CONDUIT RUNS - DO NOT USE FOR EMERGENCY/ LIFE &amp; PUBLIC SAFETY/ CRITICAL SERVICE COMMUNICATION CABLES - THESE ARE REQUIRED TO BE IN CONDUIT.</u>
(a) Wall Mountable	<u>WHEN APPROVED</u> - in open cable runs, 3" X 2.5" 2.5" MIN, wall or ceiling mountable, allows cables to be installed and re-moved from hanger, black color metal or high impact plastic construction MIN required.
(b) Bar Type	<u>WHEN APPROVED</u> - in open cable runs shall be compliment TO AC-CESS Type 66, 110 OR 110A block cable loops; screw mountable required.
(c) Rack Mountable	Required - above and or inside 19" cabinet panels where wire looms are not provided, allows quick cable attachment or removal, screw mountable.

(4) "J" Hooks & "O" Rings or "S" Clips	<p><b><u>ALLOWED ONLY FOR CONDUIT</u> - DO NOT USE FOR ANY EMERGENCY/LIFE &amp; PUBLIC SAFETY/CRITICAL SERVICE COMMUNICATION CABLES - <u>THESE ARE REQUIRED TO BE IN CONDUIT.</u></b></p> <p><b><u>WHEN APPROVED</u></b> - in open CONDUIT runs, screw mountable only, 1.5" X 2" MIN, each ITEM shall support a MIN of ONE 1.0" CONDUIT..</p>
(5) Cable Ladder	<p><b><u>WHEN APPROVED</u></b> - shall nominally be 12 in. (305 mm) wide, rung spacing of 9" (225 mm) and be certified / listed for telecommunications service.</p>
(6) Cable Support	NRTL labeled for support of minimum Category 5E cabling, designed to prevent degradation of cable performance and pin - points that could damage cable.
<b>c. Vertical or Horizontal Cable Management</b>	
(1) Cable Ties	Required - 4" MIN length, black in color, ultraviolet resistant.
(2) Cable Tie Mounting Devices	
(a) Adhesive Backed	Required - square style 0.5" X 0.5" MIN, allows two MAX cable ties to be attached in either direction, attaches directly to metal or slick surfaces, requires additional screw when mounted to wood or wall back-board.
(b) Screw Type	Required - rectangle style 0.5" X 0.75" MIN, allows one cable tie to be attached in only one direction, requires wood or dry-wall screw for wall or backboard mounting or sheet metal screw for metal mounting.
(c) Screw Anchor Type	Required - rectangle style 0.5 X 0.75" MIN with mounting hole on one end, allows one cable to be attached in only one direction, requires wood or drywall screw for wall or backboard mounting or sheet metal screw for metal mounting.
(3) Cable Clips	<p><b><u>WHEN APPROVED</u></b> - in open CONDUIT runs, nail able or screw mount-able designed with arch to fit CONDUIT diameter without damaging the CONDUIT; plastic white or black color allowed.</p>
(7) Wire Spools	<p><b><u>WHEN APPROVED</u></b> - in open cable runs, round in design with flange on outside to prevent cables from falling off spool, screw mountable via center of spool</p>
(8) Spiral Cable Wrapping	Required - when cable ties are not used to secure all cables, 0.5" OD MIN, weather proof Polyethylene construction MIN required, neatly bonds all loose cables in one bundle without damaging cables, allows cable to ingress and egress from the bundle through the wraps.

(9) Wire Clips and Clamps	Required - when cable ties are not used on short runs, adhesive backed, requires screw mounting to wall or back boards OR metal.
(10) Support Brackets	Provided with cable tie slots for fastening cable ties to Lacing Bars / Brackets.

## 2.6 ENVIRONMENTAL REQUIREMENTS:

- A. Technical submittals shall identify the environmental specifications for housing the system. These environmental specifications shall identify the requirements for initial and expanded system configurations for:
- B. Floor loading for batteries and cabinets.
- C. Minimum floor space and ceiling heights.
- D. Minimum size of doors for equipment passage.
- E. Power requirements: The bidders shall provide the specific voltage, amperage, phases, and quantities of circuits required.
- F. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
- G. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
- H. Proposed floor plan based on the expanded system configuration of the Contractor's proposed PBX (if used) for this Facility.
- I. Conduit size requirement (between equipment room and console room).

## 2.7 INSTALLATION KIT:

- A. The kit(s) shall be provided that, at a MIN, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks, wiring blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire terminal or wiring block.
- B. Unfinished or unlabeled wire connections shall not be allowed and the system will not be accepted if these types of practices are used.
- C. All unused partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and /or cable duct bundles, wire rolls, and physical installation hardware shall be turned over to the RE. THIS IS NOT AN ACCEPTABLE ALTERNATE TO THE INDIVIDUAL SPARE EQUIPMENT UNLESS the MIN spare items are provided in these counts meets the levels described herein.
- D. The MIN required installation kits are as follows:

FUNCTIONS	CHARACTERISTICS
1. System Grounding	The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC. This includes, but is not limited to:
a. Coaxial Cable Shields and Center Conductor	Only use the Building's Outside Lightning Grounding System.
b. Coaxial / System Cable Lightning Protectors	Only use the Building's Outside Lightning Grounding System.
c. Control Cable Shields	Only use the Building's Inside Signal Grounding System.
d. Data Cable Shields	Only use the Building's Inside Signal Grounding System.
e. Equipment Racks	Only use the Building's Inside Signal Grounding System.
f. Equipment Cabinets	Only use the Building's Inside Signal Grounding System.
g. Conduits	Only use the Building's Inside Signal Grounding System.
h. Cable Duct	Only use the Building's Inside Signal Grounding System.
i. Cable Trays	Only use the Building's Inside Signal Grounding System.
j. Power Panels	Only use the Building's Inside Signal Grounding System
k. Connector Panels	Only use the Building's Inside Signal Grounding System
2. COAXIAL CABLES	The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
3. WIRE AND CABLES	The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
4. CONDUIT, CABLE DUCT AND CABLE TRAY	The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.

5. EQUIPMENT INTERFACE	The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface systems and sub-systems according to the OEM requirements and this document.
6. LABELS / LABELING	The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and correctly label each sub-system according to the OEM requirements, record drawings, and this document - see Labeling Kit, Part 2, Section 2.8.
7. WIRE MANAGEMENT	The wire management kit shall include any item (i.e. cable wrap, guides, hangers, holders, forms, etc.) in sufficient quantity to provide a neat and orderly wire and cable installation between and inside all system components.
8. DOCUMENTATION	The documentation requirement of the Installation Kit shall include any item or quantity of items, computer discs, record drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this specification document and explained herein.

## 2.8 LABELING

- A. Labels: Provide labeling for equipment, new cabling and termination hardware located within the Facility in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using (thermal ink trans-fer process) (laser printer) (other \_\_\_\_\_).
1. Cable Tag Installation: Install cable tags for each TIP cable or wire located in manholes, handholes, and vaults including each splice. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of TIP cable tag identifiers shall be in accordance with TIA/EIA-606. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.
  2. Equipment Labels: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two (2) sheet-metal screws or two (2) rivets (Alternates to the nameplates will be considered during the technical submittal approval process).

3. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  4. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
  5. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
  6. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
  7. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
  8. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
- B. Ensure each OEM supplied item of equipment has appropriate NRTL (aka UL) Labels / Marks for the service the equipment is performed permanently attached / marked. EQUIPMENT INSTALLED NOT BEARING THESE MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.

## 2.9 COMMUNICATIONS SYSTEM GROUND:

- A. In addition to the requirements outlined in SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICAITONS SYSTEMS, the contractor shall provide a circulating system "Signal Ground" that is separate from other Facility grounding systems (i.e. electrical, lightning, building, etc.) as described herein.
- B. Proper communications system grounding and bonding shall be provided for each: SPDP of Presence, ENTR (DEMARC), TER, TOR, MCR, MCOR, PCR, SCC, ECR, EMCR, STR(s), HER, TRs, TCOs; and insure all internal telecommunications equipments installed in these areas are connected to it as described herein.
- C. Reference shall be made to proper codes and standards, such that all grounding systems must comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.
- D. Technical Characteristics

1.Connectors	Enclosed Circular Coated, Sealed and Plated Copper MIN #0 AWG Lug, or as specified by the
--------------	---

	RE
2. Wire	Stranded Copper # 0 AWG (minimum) with protective jacket, or as specified by the RE

## 2.10 LIGHTNING PROTECTION SYSTEM/GROUND:

- A. In addition to SECTION 26 41 00 - FACILITY LIGHTNING PROTECTION requirements, the contractor shall provide a lightning protection connection system for the communications systems / circuits totally and externally to the building. The use of internal electrical or signal grounding systems is not acceptable and will not be approved. The Contractor shall provide this system if it is not previously provided as a part of the contract.
- B. System Building Inputs, Aerial Cables and Underground Cables: These locations and equipment items shall be grounded with cooper wire run external to the building and connected to the earth ground. If the location and/or equipment item is to be installed in an area not protected by lightning rods or if the location and / or equipment item is to be elevated above existing lightning rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.

### C. Technical Characteristics

1. Connections	To the Facility's Lightning Protection System as required by the RE ( <b>if no Facility system is present - the contractor shall provide a separate Minimum #0 AWG stranded copper wire grounding cable secured and connected outside of the building to the earth as specified by the RE</b> )
2. Connectors	Enclosed Circular Coated, Sealed and Plated Copper Minimum #0 AWG Lug, or as specified by the RE
3. Signal Wire/ Cable Grounding Protectors	Provided according to the OEM's recommendations for the specific cable, circuit or system's wires and cables. Each protector shall be connected to the lightning protection system as aforementioned.

- D. System Building Inputs, Aerial Cables and Underground Cables: These locations and equipment items shall be grounded with cooper wire run external to the building and connected to the earth ground. If the location and/or equipment item is to be installed in an area not protected by lightning rods or if the location and / or equipment item is to be elevated above existing lightning rod protection, the Contractor shall immediately notify the RE in writing regarding the lightning strike hazard.

### E. Technical Characteristics



Connections	To the Facility's Lightning Protection System as required by the RE (if no Facility system is present - the contractor shall provide a separate Minimum #0 AWG stranded copper wire grounding cable secured and <b>connected outside of the building</b> to the earth as specified by the RE)
Connectors	Enclosed Circular Coated, Sealed and Plated Copper Minimum #0 AWG Lug, or as specified by the RE
Grounding Protectors	Provided according to the OEM's recommendations for the specific cable, circuit or system's wires and cables. Each protector shall be connected to the lightning protection system as aforementioned.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

A. The Contractor shall use the criteria and requirements of this PART to complete the detailed installation of the System. The Design shall include computer RF modeling and site surveys as described herein. The Contractor shall be able to show design RF signal level(s) to sub-room precision for all room(s) /area(s) within the approved defined coverage area(s). The RE shall provide the Contractor with compatible drawings from the project Architect. If the drawings are within BIM then it is the responsibility of the Contractor to modify the BIM Model for use in their wireless modeling which shall include, at a minimum, the creation of 2-D Floor Plans, Reflected Ceiling Plans (RCP) and elevations.

#### B. GENERAL SYSTEM INSTALLATION

1. After the contract's been awarded, and within the time period specified in the contract, the Contractor shall deliver the total system in a manner that fully complies with the requirements of this specification. The Contractor shall make no substitutions or changes in the System without written approval from the RE and PM.
2. The Contractor shall install all equipment and systems in a manner that complies with accepted industry standards of good practice, OEM instructions, the requirements of this specification, and in a manner which does not constitute a safety hazard. The Contractor shall insure that all installation personnel understands and complies with all the requirements of this specification.
3. The Contractor shall provide written verification to the RE at time of installation, that the type of wire/cable being provided is recommended and approved by the OEM. The Contractor is responsible for providing the proper

size and type of cable duct and/or conduit and wiring even though the actual installation may be by another subcontractor.

4. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC and NRTL standards for DAS equipment, systems, and service.
5. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
6. All passive equipment shall be connected according to the OEM's specifications to insure future correct termination, isolation, impedance match, and signal level balance at each telephone/data outlet.
7. The Contractor shall install suitable filters, traps, directional couplers, splitters, TR's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass DAS control, Lightwave (fiber optic) // , RF// , Video// , HDTV// , Security// , Emergency// , Safety// and \_\_\_\_\_ // signals in the frequency bands selected, in the direction specified, with low loss, and high isolation, and with minimal delay of specified frequencies and signals. The Contractor shall provide all equipment necessary to meet the requirements outlined herein and the System performance standards.
8. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.
9. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
10. All lines shall be terminated in a suitable manner to facilitate future expansion of the System as described (re 50% and expansion information) described in PART 2, PARAGRAPHS 2.4.A; 2.4.B.5; 2.4.B.8.c; 2.4.F.3.d.20; 2.4.F.3.e.3); 2.4.J.6 & 2.4.J.7 . There shall be a minimum of one (1) spare:
  - a. 25 pair UTP cable (current installed AWG),
  - b. 25 pair STP control cable (current installed AWG),
  - c. Six (6) pair single mode fiberoptic cable,
    - 1) 8/125-um; 0.10 Aperture; 1,300-nM; per TIA 492CAAA,
    - 2) 8/125-um; 0.10 Aperture; 1,550-nM; per TIA 492E000,
  - d. 12 pair multi-mode fiberoptic cable,
    - 1) 62.5/125-um; per TIA 4922AAA, 472D000, and ICEA S-87-640,

- 2) 50/125-um; Optically Enhanced American (not European) Standard; per TIA 492AAAB.
- e. Each cable shall be provided at each distribution point shown on the TIP drawings.
11. Terminating resistors or devices shall be used to terminate all unused branches, outlets, equipment ports of the System, and shall be devices designed for the purpose of terminating fiber optic or twisted pair // , and coaxial // // , and lightwave // cables carrying telephone and data // , and analog // signals in telephone and data // , and analog video // // , and lightwave // systems.
  12. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two matching keys (NOTE ALL CABINET LOCKS SHALL BE VENDING MACHINE TYPE LOCKS LIKE KEYED WITH INDOOR CABINETS).
  13. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two matching keys (NOTE ALL CABINET LOCKS SHALL BE VENDING MACHINE TYPE LOCKS LIKE KEYED WITH OUTDOOR CABINETS).
  14. All interconnecting twisted pair, fiberoptic // or coaxial // cables shall be terminated on equipment terminal boards, punch blocks, breakout boxes, splice blocks, and unused equipment ports/taps shall be terminated according to the OEM's instructions for telephone cable systems without adapters. The Contractor shall not leave unused or spare twisted pair wire, fiberoptic //, or coaxial // cable unterminated, unconnected, loose or unsecured
  15. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
  16. Connect the System's primary input AC power to the Facility' Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
  17. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the System OEM. Base-band cable systems shall utilize barrier terminal screw type connectors, at a minimum. Crimp type

connectors installed with a ratchet type installation tool are and acceptable alternate as long as the cable dress, pairs, shielding, grounding, and connections and labeling are provided the same as the barrier terminal strip connectors. Tape of any type, wire nuts, or solder type connections are unacceptable and will not be approved.

18. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cycolac plastic for the areas where provided.

## B. CONDUIT AND SIGNAL DUCTS

### 1. Conduit

- a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed. The minimum conduit size shall be as described herein.
- b. All telecommunications emergency, critical, life support and safety cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telecommunications cables to be installed in telecommunications approved partitioned cable tray may be granted in writing by the RE if requested). The determination as to which SECTION 27 & 28 SYSTEM ARE RATED FOR EMERGENCY SERVICE CAN BE FOUND IN PART 1 OF THIS DOCUMENT. Conduits shall be provided as described herein and in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.
- c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
- d. When "innerduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
- e. Conduit (including GFE) fill shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit

end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from communications conduit.

- f. Ensure that Critical Care Nurse Call, PA, DAS, Radio Paging, Police Two-Way Radio, Police Security Management, Emergency and Safety Systems (as identified by NEC Section 517 & 800; and UL) are completely separated and mechanically protected from all other systems by conduit and approved telecommunications partitioned cable tray or baskets.

## 2. Signal Duct, Cable Duct, or Cable Tray

- a. The Contractor shall use existing conduit, signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
- b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
- c. Approved cable tray shall be fully covered, mechanically and physically telecommunications approved partitioned for multiple electronic circuits use, and be NRTL listed and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.

C. CONNECTORS: Circuits, transmission lines, and signal extensions shall have continuity, correct connection and polarity. A uniform polarity shall be maintained between all points in the system.

### 1. Wires:

- a. Wire ends shall be neatly formed and where insulation has been cut, heat shrink tubing shall be employed to secure the insulation on each wire. Tape of any type is not acceptable.
- b. Audio spade lugs shall be installed on each wire (including spare or unused) end and connect to screw terminals of appropriate size barrier strips.
- c. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current.
- d. Punch blocks are approved for signal, not AC wires.
- e. Wire Nut or "Scotch Lock" connectors are not acceptable for signal wire installation.

- 2. Cables: Each connector shall be designed for the specific size cable being used and installed with the OEM's approved installation tool. Typical system

cable connectors include; but, are not limited to: Audio spade lug, punch block, wire wrap, etc.

3. Line or Microphone Audio: Each connector shall be installed according to the cable or connector OEM's instructions and use the OEM's approved installation tool. Install the connector's to provide and maintain the following audio signal polarity:
  - a. XLR type connectors Signal or positive conductor is pin 3; common or neutral conductor is pin 2; ground conductor is pin 1.
  - b. Two and 3 conductor 1/4" Signal or positive conductor is tip; neutral or 1/8" Phono plugs conductor is ring and ground or shield and jacks conductor is sleeve.
  - c. RCA Phono Plugs the Signal or positive conductor is tip; and Jacks neutral or shield conductor is sleeve.

4. Speaker Line Audio:

- a. Each connector shall be installed according to the cable, transformer or speaker OEM instructions and using the OEM's approved installation tool. The Contractor shall ensure each speaker is properly phased and connected in the same manner throughout the System using two conductor type wires.
- b. One of the conductors shall be color coded to aid in establishing speaker signal polarity. Each speaker line shall be permanently soldered or audio spade lug connected to each appropriate speaker or line matching transformer connection terminal. Speaker line connection to each audio amplifier shall use audio spade lugs, as described herein.

D. AC POWER: AC power wiring shall be run separately from communications cable.

E. GROUNDING (SEE PARAGRAPH 2.9 HEREIN FOR THIS REQUIREMENT)

F. EQUIPMENT ASSEMBLY

1. Cabinets: Each cabinet/enclosure shall be: floor or wall mounted with standard knockout holes for conduit connections or cable entrance; provide for ventilation of the equipment; have front and rear locking doors (except wall mounted cabinets that require only a front locking door); power outlet strip(s), and connector or patch panel(s).
  - a. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure's equipment adjustable mounting rails with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made.
    - 1) Heavy equipment shall be mounted with rack slides or rails allowing servicing from the front of the enclosure. Heavy equipment shall not depend only upon front panel mounting screws for support.

- 2) Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure.
  - 3) A color matched blank panel (spacer) of 44 mm (1.75 in.) high, shall be installed between each piece of equipment (active or passive) to insure adequate air circulation.
  - 4) The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and non-disposable air filter.
- b. Enclosures and racks shall be installed plumb and square. Each shall be permanently attached to the building structure and held firmly in place. Fifteen inches of front vertical space opening shall be provided for additional equipment.
  - c. Signal connector, patch, and bulkhead panels (i.e.: audio, data, control, analog video, etc.) shall be connected so that outputs from each source, device or system component shall enter the panel at the top row of jacks, beginning left to right as viewed from the front, which will be called "inputs". Each connection to a load, device or system component shall exit the panel at the bottom row of jacks, beginning left to right as viewed from the front, which will be called "outputs".
  - d. Equipment located indoors shall be installed in metal racks or enclosures with hinged doors to allow access for maintenance without causing interference to other nearby equipment.
  - e. Cables shall enter the equipment racks or enclosures in such a manner that allows all doors or access panels to open and close without disturbing or damaging the cables.
  - f. All distribution hardware shall be securely mounted in a manner that allows access to the connections for testing and provides sufficient room for the doors or access panels to open and close without disturbing the cables.
2. UPS: It is acceptable to power all TER, MCR, TR & STRs FMS Equipment from single battery backup system, in lieu of individual cabinet mounted UPS, as long as the system performance standards are met.
    - a. If this option is used it is acceptable to provide one AC input surge protector to isolate the battery backup system from the Facility's Emergency AC Generator Circuit as long as it is properly sized and the system performance standards are met; AND has electrical supervision provided as described herein.

G. LABELING/LABELS (SEE PARAGRAPH 2.8 HEREIN FOR THIS REQUIREMENT)

H. LIGHTNING PROTECTION SYSTEM (SEE PARAGRAPH 2.10 HEREIN FOR THIS REQUIREMENT)

### 3.2 TESTS

A. INTERIM INSPECTION: At approximately 40-50% of installation at the direction of the CFM PE, PM, SRE or RE (Additional inspection(s) may be required at the direction of the CFM PE, PM, SRE or RE):

1. This inspection shall verify the equipment and system being provided adheres to the installation and technical requirements of this document.
  - a. The interim inspection will be conducted by an OEM and factory-certified contractor representative; AND witnessed by a CFM RE Staff Member(s), Facility AND SMCS 0050P2H3 Representatives.
  - b. Each item of installed equipment shall be checked to insure appropriate NRTL (UL) listing labels and markings are in place.
  - c. This inspection shall verify cabling terminations in all telecommunications and head end rooms and at workstation locations adhere to color code for T568B // T568A // pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards.
  - d. Visually confirm Category 5e // ----- // cable marking at TCOs, CCSs locations and patch cords.
2. The entire communications circulating ground system and each TGB, the separate earth ground point and lightning protection system shall be reviewed.
3. Cable tray, conduit and path/wire-way installation practice shall be reviewed.
4. Perform fiber optical cable field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

SPEC WRITER NOTE (DO NOT DELETE): Two methods for measuring the installed single mode fiber optic cable plant are described in ANSI/EIA/TIA-526-7. Method A uses optical power measurement equipment. Method B uses an optical time domain reflector (OTDR). Method B is not recommended for installations containing branching devices and/or isolators. ANSI/EIA/TIA-526-14 does not recommend using a OTDR for testing multimode fiber optic cables. Building Industry Consulting Service International (BICSI) recommends using

5. The Contractor shall notify the RE, in writing, of the estimated date the Contractor expects to be ready for the interim inspection, at least 20 working days before the requested inspection start date.



6. Results of the interim inspection shall be provided to the CFM PE, PM, SRE and RE.
  - a. If major or multiple deficiencies are discovered, a second interim inspection may be required before permitting the Contractor to continue with the system installation until the present deficiency(s) are corrected.
  - b. The SRE or RE shall determine if an additional inspection(s) is/are required: OR if the Contractor will be allowed to proceed with the installation.
  - c. In either case, re-inspection of the deficiency(s) noted during the interim inspection(s), will be part of the proof of performance test final acceptance test.
  - d. The interim inspection shall not affect the Systems' completion date unless directed by the CFM PE, PM, SRE and RE.
  - e. The Facility Contracting Officer shall ensure all test documents become a part of the Systems' documentation.
- B. PRETESTING: Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
  1. Pretesting Procedure:
    - a. During the system pretest, the Contractor shall verify (utilizing the approved spectrum analyzer and test equipment) that the System is fully operational and meets all the system performance requirements of this standard.
    - b. The Contractor shall pretest and verify that all System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. The Contractor shall measure and record the aural carrier levels of each system DAS and data channel, at each of the following points in the system:
      - 1) Utility Provider Entrance.
      - 2) Buried Conduit Duct(s) locations (if required).
      - 3) Manhole(s) & Grab Boxes (if required).
      - 4) ENR (aka DEMARC).
      - 5) PBX (if used) Interconnections.
      - 6) MCR Interconnections.
      - 7) MCOR Interconnections.
      - 8) TER Interconnections.
      - 9) TOR Interconnections.

- 10) PCR Interconnections.
- 11) ECR Interconnections.
- 12) SCR Interconnections.
- 13) System interface(s) in locations listed herein.
- 14) System Grounding.
- 15) Waterproofing.
- 16) UPS Areas.
- 17) Other(s) as required by AHJ (SMCS 005OP2H3).

- 2. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. ACCEPTANCE TEST: After the System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 days written notice prior to the date the acceptance test is expected to begin.

- 1. The System shall be tested in the presence of a Government Representative, SMCS 005OP2H3 and an OEM certified representative. The System shall be tested utilizing the approved test equipment to certify proof of performance and Life Safety compliance.
- 2. The System shall be tested to certify proof of performance and FCC compliance. The test shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.
- 3. The acceptance test shall be performed on a "go-no-go" basis. Only those contractor minor adjustments required to show proof of performance shall be allowed.
  - a. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions.
  - b. The System shall be rated as either acceptable or unacceptable at the conclusion of the test.
  - c. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable.

4. If it is determined the system will require retesting, System Retest shall be rescheduled at the convenience of the Government and all costs borne by the Contractor at the direction of the SRE.

D. Acceptance Test Procedure

1. Physical and Mechanical Inspection

- a. The Government Representative(s) and SMCS 0050P2H3 will tour all major areas where the System is and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, Telecommunications Infrastructure Plant (TIP) Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test

- a. After the Physical and Mechanical Inspection of each DAS location listed in 3.2.D.1, terminating, mounting and interface equipment shall be checked to verify that it meets all FCC requirements outlined herein. A spectrum analyzer shall be utilized to accomplish this requirement.
- b. The DAS Cable distribution system shall be checked at each interface, junction, and distribution point to insure all meets the standards outlined herein.
- c. Each DAS location shall be functionally tested at the same time utilizing the Spectrum Analyzer.
- d. Once these tests have been completed, each installed DAS sub-system function shall be tested as a unified, functioning and fully operating system.

3. Individual Item Test: The VACO SMCS 0050P2H3 Government Representative will select individual items of DAS equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each DAS item shall meet or exceed the minimum requirements of this document

- E. Test Conclusion: (see Part 1.13.A.3 for VA "Conditions of Acceptance"): At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results

of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.

1. Please refer to PART 1, PARAGRAPH 1.13 VA ACCEPANCE OF SYSTEM MOU, CONTRACTORS WARRANTY / GUARANTEE: SUB-PARAGRAPH 1.13.A.3 for VA Conditions of System Acceptance.
2. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.

F. CONNECTING TO THE IWS / DAS SYSTEM

1. The Contractor shall manage and collect all FCC License / Listings and provide them to the RE and VAMC Chief of FMS when VA's accepts the System.
2. MANAGE EACH WSP'S CONNECTION TO THE SYSTEM: The Contractor shall represent the VAMC during negotiations with each WSP, insure all VA / GSA Land Management and Conditional Use Permits / Agreements are completed and approved by VA (VA Chief of FMS will provide appropriate forms), coordinate site preparation, assist with each WSPs' installation, and coordinate connection of each WSP to the System. Each WSP's integration to the System, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.
3. MANAGE EACH VAMNC CONNECTION(s) TO THE SYSTEM: The Contractor shall coordinate site preparation, assist with each pre approved FMS installation, and coordinate connection of each FMS radio / wireless system to the System. Each FMS integration to the System, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.
4. MANAGE ADDITIONAL SERVICE CONNECTION(S) TO THE SYSTEM: The Contractor shall represent the VAMC during negotiations with each Service, insure all VA / GSA Land Management and Conditional Use Permits / Agreements are completed and approved by VA (VA Chief of FMS will provide appropriate forms), coordinate site preparation, assist with the Service installation, and coordinate connection of each Service to the System. Each Service integration to the system, shall be turn-key and shall include BDS(s), donor antenna(s), installation materials/equipment, wire management and updated system drawings.

**3.3 TRAINING: IN ADDITION TO THE TRAINING PROVIDED IN ACCORDANCE WITH ARTICLE, INSTRUCTIONS, OF SECTION 01 00 00, GENERAL REQUIREMENTS):**

- A. Furnish the services of a factory-trained engineer or technician for a total of two (2) each four (4) hour classes to instruct designated Facility personnel.

Instruction shall include cross connection, corrective, and preventive maintenance of the System and equipment.

- B. Before the System can be accepted by the VA, this training must be accomplished. Training will be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.
- C. Training shall be provided for the particular equipment(s) or system(s) as required in each associated specification and described as follows:
  - 1. A training schedule shall be developed and submitted by the contractor and approved by the RE at least 30 days prior to the planned training.
  - 2. Provide thorough training of all staff assigned to those units receiving new DAS (other) communications equipment(s) and system(s). A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to opening of the new Facility //or cut over of the new system//.
  - 3. Provide the following minimum training times and durations:
    - a. Four (4) Weeks prior to the Facility opening for Engineering Staff (in 8-hour increments) - split evenly over 3 weeks and day and night shifts. Coordinate schedule with the RE and Facility Manager (aka Chief of FMS).
    - b. One (1) Week prior to the Facility opening for IT Staff (in 8-hour increments) - both day and night shifts. Coordinate schedule with the RE and IT Staff Supervisor or Manager.
    - c. During the Facility opening four (4) hours for supervisors and system administrators. Coordinate schedule(s) with the Facility's Chief of Staff (CoF) or other CoF designated individual(s).

- - - E N D - - -



**SECTION 28 05 00**  
**COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as

identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:

1. Description of Work for Electronic Security Systems,
2. Electronic security equipment coordination with relating Divisions,
3. Submittal Requirements for Electronic Security,
4. Miscellaneous Supporting equipment and materials for Electronic Security,
5. Electronic security installation requirements.

## 1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- D. Section 08 35 13.13 - ACCORDIAN FOLDING DOORS. Requirements for door installation.
- F. Section 08 51 13 - ALUMINUM WINDOWS. Requirements for window installation.
- G. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- H. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- K. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.



- L. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- M. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- P. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- R. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- S. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.
- T. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.
- U. Section 28 13 16 - PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- V. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
- W. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- X. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- Y. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

### 1.3 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.

- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel - component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.
- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion - Joint Photographic Experts Group.

- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.
- HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: An TIA/EIA standard for multipoint communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System - A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply

XX. UTP: Unshielded Twisted Pair

YY. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.4 QUALITY ASSURANCE**

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The

- facility shall be located within [60] <insert number> miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
  3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.5 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS**

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the

intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

#### 1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Mark the submittals, "SUBMITTED UNDER SECTION\_\_\_\_\_".
  - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 3. Submit each section separately.
- D. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 

SPEC WRITER NOTE: Include the following paragraph for projects in seismic areas of moderate-high, high and very high seismicities as listed in Table 4 of VA Handbook H-18-8, Seismic Design Requirements.
  - 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or piping so that the proposed installation can be properly reviewed.
  - 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section.

Submittals lacking the breadth or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:

1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.

- a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
  - 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
  - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
  - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
  - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
  - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
  - 1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections.



Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.

- 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
- 3) The manuals shall include:
  - a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
  - b) A control sequence describing start-up, operation, and shutdown.
  - c) Description of the function of each principal item of equipment.
  - d) Installation and maintenance instructions.
  - e) Safety precautions.
  - f) Diagrams and illustrations.
  - g) Testing methods.
  - h) Performance data.
  - i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
  - j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.

- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different

procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

- n. Calculations: Provide a section for circuit and panel calculations.
  - o. Loading Sheets: Provide a section for DGP Loading Sheets.
  - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
- 1. Section I - Drawings:
    - a. General - Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
    - b. Cover Sheet - Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.

- c. General Information Sheets - General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
- d. Floor Plans - Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
  - 1) Security devices by symbol,
  - 2) The associated device point number (derived from the loading sheets),
  - 3) Wire & cable types and counts
  - 4) Conduit sizing and routing
  - 5) Conduit riser systems
  - 6) Device and area detail call outs
- e. Architectural details - Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,
- f. Riser Diagrams - Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
- g. Block Diagrams - Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams - Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:

- 1) Panel Assembly Detail - For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
- 2) Panel Details - Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
- 3) Device Mounting Details - Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
- 4) Details of connections to power supplies and grounding
- 5) Details of surge protection device installation
- 6) Sensor detection patterns - Each system sensor shall have associated detection patterns.
- 7) Equipment Rack Detail - For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room - The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console - The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.  
Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room - Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule - Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and

Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.

- k. Door Schedule - A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:

- 1) Item Number
- 2) Door Number (Derived from A/E Drawings)
- 3) Floor Plan Sheet Number
- 4) Standard Detail Number
- 5) Door Description (Derived from Loading Sheets)
- 6) Data Gathering Panel Input Number
- 7) Door Position or Monitoring Device Type & Model Number
- 8) Lock Type, Model Number & Power Input/Draw (standby/active)
- 9) Card Reader Type & Model Number
- 10) Shunting Device Type & Model Number
- 11) Sounder Type & Model Number
- 12) Manufacturer
- 13) Misc. devices as required
  - a) Delayed Egress Type & Model Number
  - b) Intercom
  - c) Camera
  - d) Electric Transfer Hinge
  - e) Electric Pass-through device
- 14) Remarks column indicating special notes or door configurations

2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:

- a. Item Number
- b. Camera Number
- c. Naming Conventions
- d. Description of Camera Coverage
- e. Camera Location
- f. Floor Plan Sheet Number
- g. Camera Type

- h. Mounting Type
  - i. Standard Detail Reference
  - j. Power Input & Draw
  - k. Power Panel Location
  - l. Remarks Column for Camera
3. Section II - Data Gathering Panel Documentation Package
- a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
  - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
  - c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
  - d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
  - e. The DGP spreadsheet shall include an entry section for the following information:
    - 1) DGP number
    - 2) First Reader Number
    - 3) First Monitor Point Number
    - 4) First Relay Number
    - 5) DGP, input or output Location
    - 6) DGP Chain Number
    - 7) DGP Cabinet Tamper Input Number
    - 8) DGP Power Fail Input Number
    - 9) Number of Monitor Points Reserved For Expansion Boards

- 10) Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
  - 1) System Numbers for Card Readers
  - 2) System Numbers for Monitor Point Inputs
  - 3) System Numbers for Control Points (Relays)
  - 4) Next DGP or input module First Monitor Point Number
  - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
  - 1) DGP Reader Number
  - 2) System Reader Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
  - 6) Description Field
  - 7) DGP Input Location
  - 8) Date Test
  - 9) Date Passed
  - 10) Cable Type
  - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
  - 1) DGP Monitor Point Input Number
  - 2) System Monitor Point Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
  - 7) DGP or input module Input Location
  - 8) Date Test
  - 9) Date Passed
  - 10) Cable Type
  - 11) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
  - 1) DGP Control Point (Relay) Number
  - 2) System (Control Point) Number



- 3) Cable ID Number
- 4) Description Field (Room Number)
- 5) Description Field (Device: Lock Control, Local Sounder, etc.)
- 6) Description Field
- 7) DGP or OUTPUT MODULE Output Location
- 8) Date Test
- 9) Date Passed Cable Type
- 10) Camera Number (of associated alarm event preset call-ups)
- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
  - 1) Header
    - a) DGP Input and Output Worksheet
    - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
  - 2) Footer
    - a) File Name
    - b) Date Printed
    - c) Page Number
- 5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
- 6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
  - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
  - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.

- c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
- 7. Section VI - Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- G. Group II Technical Data Package
  - 1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
  - 2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
    - a. Baseline configuration
    - b. Access levels
    - c. Schedules (intrusion detection, physical access control, holidays, etc.)
    - d. Badge database
    - e. System monitoring and reporting (unit level and central control)
    - f. Naming conventions and descriptors
- H. Group III Technical Data Package
  - 1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- I. Group IV Technical Data Package
  - 1. Performance Verification Test
    - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-

delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

## 2. Training Documentation

- 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
- 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self-diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.

## 3. System Configuration and Data Entry:

- a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
  - 1) Physical Access control system components,
  - 2) All intrusion detection system components,
  - 3) Video surveillance, control and recording systems,
  - 4) Intercom systems components,
  - 5) All other security subsystems shown in the contract documents.

- b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
  - c. Refer to Part 3 for system programming requirements and planning guidelines.
- 4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
  - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
  - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
  - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components

- required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
  8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
    - a. Equipment and/or system function.
    - b. Operating characteristics.
    - c. Limiting conditions.
    - d. Performance curves.
    - e. Engineering data and test.
    - f. Complete nomenclature and number of replacement parts.
    - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
    - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
    - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
    - j. Manufacturer equipment and systems maintenance manuals are permissible.
  9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or

authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office.

Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents.

Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.

12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
  - a. Certificates received instead of labels on bulk products.
  - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
  - c. Documented qualification of installation firms.
  - d. Load and performance testing.
  - e. Inspections and certifications.
  - f. Final inspection and correction procedures.
  - g. Project schedule
13. Record Construction Documents (Record As-Built)
  - a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
  - b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable.
 

All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and



the ownership of the drawings shall be fully relinquished to the owner.

- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

K. FIPS 201 Compliance Certificates

- 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
  - a. Keypad
    - 1) Identiv uTrust TS ScramblePad
  - b. Card Readers
    - 1) HID pivCLASS Contactless Readers
  - c. Pacs
  - d. PIV Middleware
  - e. Template Matcher
  - f. Electromagnetically Opaque Sleeve
  - g. Certificate Management
    - 1) CAK Authentication System
    - 2) PIV Authentication System
    - 3) Certificate Validator
    - 4) Cryptographic Module

L. Approvals will be based on complete submission of manuals together with shop drawings.

M. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

- 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.

2. Each type of conduit and pathway coupling, bushing and termination fitting.
  3. Conduit hangers, clamps and supports.
  4. Duct sealing compound.
- N. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

#### 1.7 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ International Code Council (ICC):
- A117.1.....Standard on Accessible and Usable Buildings and Facilities
- C. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
- AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
- CP-01-00.....Control Panel Standard-Features for False Alarm Reduction
- PIR-01-00.....Passive Infrared Motion Detector Standard - Features for Enhancing False Alarm Immunity
- TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration
- D. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
- 330-09.....Electrical Performance Standards for CCTV Cameras
- 375A-76.....Electrical Performance Standards for CCTV Monitors
- E. American National Standards Institute (ANSI):
- ANSI S3.2-99.....Method for measuring the Intelligibility of Speech over Communications Systems
- F. American Society for Testing and Materials (ASTM)

- B1-07.....Standard Specification for Hard-Drawn Copper Wire
- B3-07.....Standard Specification for Soft or Annealed Copper Wire
- B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C1238-97 (R03).....Standard Guide for Installation of Walk-Through Metal Detectors
- D2301-04.....Standard Specification for Vinyl Chloride Plastic Pressure Sensitive Electrical Insulating Tape
- G. Architectural Barriers Act (ABA), 1968
- H. Department of Justice: American Disability Act (ADA)  
28 CFR Part 36-2010 ADA Standards for Accessible Design
- I. Department of Veterans Affairs:  
VHA National CAD Standard Application Guide, 2006  
VA BIM Guide, V1.0 10
- J. Federal Communications Commission (FCC):  
(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems
- K. Federal Information Processing Standards (FIPS):  
FIPS-201-1.....Personal Identity Verification (PIV) of Federal Employees and Contractors
- L. Federal Specifications (Fed. Spec.):  
A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed Installation)
- M. Government Accountability Office (GAO):  
GAO-03-8-02.....Security Responsibilities for Federally Owned and Leased Facilities
- N. Homeland Security Presidential Directive (HSPD):  
HSPD-12.....Policy for a Common Identification Standard for Federal Employees and Contractors
- O. Institute of Electrical and Electronics Engineers (IEEE):  
81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- 802.3af-08.....Power over Ethernet Standard
- 802.3at-09 .....Power over Ethernet (PoE) Plus Standard
- C2-07.....National Electrical Safety Code

- C62.41-02.....IEEE Recommended Practice on Surge Voltages in  
Low-Voltage AC Power Circuits
- C95.1-05.....Standards for Safety Levels with Respect to  
Human Exposure in Radio Frequency  
Electromagnetic Fields
- P. International Organization for Standardization (ISO):
- 7810.....Identification cards - Physical characteristics
- 7811.....Physical Characteristics for Magnetic Stripe  
Cards
- 7816-1.....Identification cards - Integrated circuit(s)  
cards with contacts - Part 1: Physical  
characteristics
- 7816-2.....Identification cards - Integrated circuit cards  
- Part 2: Cards with contacts -Dimensions and  
location of the contacts
- 7816-3.....Identification cards - Integrated circuit cards  
- Part 3: Cards with contacts - Electrical  
interface and transmission protocols
- 7816-4.....Identification cards - Integrated circuit cards  
- Part 11: Personal verification through  
biometric methods
- 7816-10.....Identification cards - Integrated circuit cards  
- Part 4: Organization, security and commands  
for interchange
- 14443.....Identification cards - Contactless integrated  
circuit cards; Contactless Proximity Cards  
Operating at 13.56 MHz in up to 5 inches  
distance
- 15693.....Identification cards -- Contactless integrated  
circuit cards - Vicinity cards; Contactless  
Vicinity Cards Operating at 13.56 MHz in up to  
50 inches distance
- 19794.....Information technology - Biometric data  
interchange formats
- Q. National Electrical Contractors Association
- 303-2005.....Installing Closed Circuit Television (CCTV)  
Systems
- R. National Electrical Manufacturers Association (NEMA):
- 250-08.....Enclosures for Electrical Equipment (1000 Volts  
Maximum)

- TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing
- FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable
- S. National Fire Protection Association (NFPA):
- 70-11..... National Electrical Code (NEC)
- 731-08.....Standards for the Installation of Electric  
Premises Security Systems
- 99-2005.....Health Care Facilities
- T. National Institute of Justice (NIJ)
- 0601.02-03.....Standards for Walk-Through Metal Detectors for  
use in Weapons Detection
- 0602.02-03.....Hand-Held Metal Detectors for Use in Concealed  
Weapon and Contraband Detection
- U. National Institute of Standards and Technology (NIST):
- IR 6887 V2.1.....Government Smart Card Interoperability  
Specification (GSC-IS)
- Special Pub 800-37.....Guide for Applying the Risk Management Framework  
to Federal Information Systems
- Special Pub 800-63.....Electronic Authentication Guideline
- Special Pub 800-73-3....Interfaces for Personal Identity Verification (4  
Parts)
- .....Pt. 1- End Point PIV Card Application Namespace,  
Data Model & Representation
- .....Pt. 2- PIV Card Application Card Command  
Interface
- .....Pt. 3- PIV Client Application Programming  
Interface
- .....Pt. 4- The PIV Transitional Interfaces & Data  
Model Specification
- Special Pub 800-76-1....Biometric Data Specification for Personal  
Identity Verification
- Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for  
Personal Identity Verification
- Special Pub 800-79-1....Guidelines for the Accreditation of Personal  
Identity Verification Card Issuers
- Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2...PIV Card Application and Middleware Interface  
Test Guidelines (SP 800-73-3 compliance)

- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A....Scheme for PIV Visual Card Topography
- V. Occupational and Safety Health Administration (OSHA):
- 29 CFR 1910.97.....Nonionizing radiation
- W. Section 508 of the Rehabilitation Act of 1973
- X. Security Industry Association (SIA):
- AG-01 .....Security CAD Symbols Standards
- Y. Underwriters Laboratories, Inc. (UL):
- 1-05.....Flexible Metal Conduit
- 5-04.....Surface Metal Raceway and Fittings
- 6-07.....Rigid Metal Conduit
- 44-05.....Thermoset-Insulated Wires and Cables
- 50-07.....Enclosures for Electrical Equipment
- 83-08.....Thermoplastic-Insulated Wires and Cables
- 294-99.....The Standard of Safety for Access Control System  
Units
- 305-08.....Standard for Panic Hardware
- 360-09.....Liquid-Tight Flexible Steel Conduit
- 444-08.....Safety Communications Cables
- 464-09.....Audible Signal Appliances
- 467-07.....Electrical Grounding and Bonding Equipment
- 486A-03.....Wire Connectors and Soldering Lugs for Use with  
Copper Conductors
- 486C-04.....Splicing Wire Connectors
- 486D-05.....Insulated Wire Connector Systems for Underground  
Use or in Damp or Wet Locations
- 486E-00.....Equipment Wiring Terminals for Use with Aluminum  
and/or Copper Conductors
- 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable
- 514A-04.....Metallic Outlet Boxes
- 514B-04.....Fittings for Cable and Conduit
- 51-05.....Schedule 40 and 80 Rigid PVC Conduit
- 609-96.....Local Burglar Alarm Units and Systems
- 634-07.....Standards for Connectors with Burglar-Alarm  
Systems
- 636-01.....Standard for Holdup Alarm Units and Systems
- 639-97.....Standard for Intrusion-Detection Units
- 651-05.....Schedule 40 and 80 Rigid PVC Conduit
- 651A-07.....Type EB and A Rigid PVC Conduit and HDPE Conduit

- 752-05.....Standard for Bullet-Resisting Equipment
- 797-07.....Electrical Metallic Tubing
- 827-08.....Central Station Alarm Services
- 1037-09.....Standard for Anti-theft Alarms and Devices
- 1635-10.....Digital Alarm Communicator System Units
- 1076-95.....Standards for Proprietary Burglar Alarm Units  
and Systems
- 1242-06.....Intermediate Metal Conduit
- 1479-03.....Fire Tests of Through-Penetration Fire Stops
- 1981-03.....Central Station Automation System
- 2058-05.....High Security Electronic Locks
- 60950.....Safety of Information Technology Equipment
- 60950-1.....Information Technology Equipment - Safety - Part  
1: General Requirements
- Z. Uniform Federal Accessibility Standards (UFAS) 1984
- AA. United States Department of Commerce:
  - Special Pub 500-101 ....Care and Handling of Computer Magnetic Storage  
Media

## 1.8 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

## 1.9 MAINTENANCE & SERVICE

- A. General Requirements
  - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security

system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

#### B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items: computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

#### C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

#### D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

#### E. System Inspections

1. These inspections shall include:
  - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
    - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
    - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices,



monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

#### F. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
  - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
  - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

#### G. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

#### H. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

#### I. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the

amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

#### J. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

#### K. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

#### 1.10 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### 1.11 DELIVERY, STORAGE, & HANDLING

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
  1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected

- against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
- 2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
- 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

B. Central Station, Workstations, and Controllers:

- 1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
- 2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
- 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
- 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

## 1.12 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

- 1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
- 2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.

3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.
- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.
- C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

#### **1.13 EQUIPMENT AND MATERIALS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  1. Components of an assembled unit need not be products of the same manufacturer.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
  4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

**1.14 ELECTRICAL POWER**

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.
- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for 8 hours of operation at actual connected load. Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.
  1. Emergency Generator
    - a. Report Printers: Unit Control Room
    - b. Video Monitors: Unit Control Room
    - c. Intercom Stations
    - d. Radio System
    - e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
    - f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.

- g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
  - h. Telephone/Radio Recording Equipment: Unit Control Room.
  - i. VASS Camera Power Supplies: Security Closets
  - j. VASS Pan/Tilt Units: Various Locations
  - k. VASS Outdoor Housing Heaters and Blowers: Various Sites
  - l. Intercom Master Control System
  - m. Fiber Optic Receivers/Transmitters
  - n. Security office Weapons Storage
  - o. Outlets that charge handheld radios
2. Uninterruptible Power Supply (UPS) on Emergency Power
- a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
    - 1) Security System Monitors and Keyboards: Control Room
    - 2) CPU: Control Equipment Room
    - 3) Communications equipment: Control Equipment Room and various sites.
    - 4) VASS Matrix Switcher: Control Equipment Room
    - 5) VASS: Control Equipment Room
    - 6) Digital Video Recorders, encoders & decoders: Control Room
    - 7) All equipment Room racked equipment.
    - 8) Network switches

#### **1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING**

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.

1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.

B. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.
4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

**1.16 COMPONENT ENCLOSURES**

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.

3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
  4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
  5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections. These labels shall not indicate the box is part of the Electronic Security System (ESS).
- B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.
1. Vertical Equipment Racks:
    - a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
    - b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
    - c. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.
  2. Console racks:
    - a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
    - b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle



sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.

C. Tamper Provisions and Tamper Switches:

1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.
2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sight to any internal component before the switch activates.
3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessible with common tools to bypass when the enclosure is in the secured mode.
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.

8. All security screws shall be Torx-Post Security Screws.
9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

#### **1.17 ELECTRONIC COMPONENTS**

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

#### **1.18 SUBSTITUTE MATERIALS & EQUIPMENT**

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.
- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
  1. Identity of the material or devices specified for which there is a proposed substitution.
  2. Description of the segment of the specification where the material or devices are referenced.
  3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
  4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein.

Depending on the manufacturers selected by the COTR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.

- D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

#### **1.19 LIKE ITEMS**

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

#### **1.20 WARRANTY**

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory

operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it's failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

#### **1.22 SINGULAR NUMBER**

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT AND MATERIALS**

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.

- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 8 hours of run time in the event of a loss of primary power to the facility.
- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

## **2.2 EQUIPMENT ITEMS**

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
  - 1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
  - 2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
  - 3. Controlling devices shall be utilized to interface the SMS with all field devices.
  - 4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
  - 5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:
    - a. Security Console Bays and Equipment Racks
    - b. Security Network Server and Workstation
    - c. CCTV Monitoring, Controlling, and Recording Equipment
    - d. PACS Monitoring and Controlling Equipment
    - e. IDS Monitoring and Controlling Equipment

- f. Security Access Detection Monitoring Equipment
  - g. EPPS Monitoring and Controlling Equipment
  - h. Main Panels for all Security Systems
  - i. Power Supply Units (PSU) for all field devices
  - j. Life safety and power monitoring equipment
  - k. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.
  - l. Police two-way radio control consoles/units.
- B. Security Console Bays - shall be EIA 310D compliant and:
- 1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.
  - 2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
  - 3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.
  - 4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
  - 5. Shall be mounted on lockable casters.
  - 6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
  - 7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.
  - 8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
  - 9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.

10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearing be identified as such.
13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the Contracting Officer.
14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)
Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front
Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System

- and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
    - a. 500 square feet for a large Access Control System and Database Management.
    - b. 300 square feet for a small Access Control System and Database Management.
    - c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.
  3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
  4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close approximately to major utility areas, or near an exposed air intake(s).
  5. Access shall meet UFAS and ADA accessibility requirements.
  6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
  7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum of four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.



8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
  9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
  10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
  11. Shall utilize a fire suppression system similar to that used by the VA's computer and telecommunications room operating areas.
  12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.
  13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in the event of electrical failure of the PACS, card reader, or locking mechanism.
  14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
  15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.
  16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
  17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.
- D. Security Control Room Ventilation
1. Shall meet or exceed all requirements laid out in VA Master Specification listed in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.

2. Controls shall be via a separate air handling system that provides an isolated supply and return system. The Security Control Room shall have a dedicated thermostat control unit and cut-off switch to be able to shut off ventilation to the control room in the event of a chemical, biological, or radiological (CBR) event or other related emergency.
3. There shall be a louver installed in the control room door to assist with ventilation of the room. The louver shall be exactly 12 x 12 inches (30 x 30 cm) and closeable.

E. Security Control Room and Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Control Room and console area:
  - a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.
  - b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.
2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

F. Remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:

1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
3. Secondary stations shall not have priority over a primary Security Control Console.

4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.

G. Wires and Cables:

1. Shall meet or exceed the manufactures recommendation for power and signals.
2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
5. Conduit fills shall not exceed 50 percent unless otherwise documented.
6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less that 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.

## 2.3 FIBER OPTIC EQUIPMENT

A. 8 Channel Fiber Optic Transceivers (Video&PTZ Control)

1. The field-located and central-located fiber optic transceivers shall utilize wave division multiplexing to transmit and receive video and

data pan-tilt-zoom control signals over two standard 62.5/125 multimode fibers.

2. The units shall be capable of operating over a range of 2 km.
3. The units shall be NTSC color compatible.
4. The units shall support data rates up to 64 Kbps.
5. The units shall be surface or rack mountable.
6. The units shall be UL listed.
7. The units shall meet or exceed the following specifications:
  - a. Video
    - 1) Input/Output: 1 volt pk-pk (75 ohms)
    - 2) Input/Output Channels: 8
    - 3) Bandwidth: 10 Hz - 6.5 MHZ per channel
    - 4) Differential Gain: <2%
    - 5) Differential Phase: <0.7°
    - 6) Tilt: <1%
    - 7) Signal to Noise Ratio: 60 dB
  - b. Data (Control)
    - 1) Data Channels: 2
    - 2) Data Format: RS-232, RS-422, 2 wire or 4 wire RS-485 with Tri-State Manchester Bi-Phase and Sensornet
    - 3) Data Rate: DC - 100 kbps (NRZ)
    - 4) Bit Error Rate: < 1 in 10<sup>9</sup> @ Maximum Optical Loss Budget
    - 5) Operating Mode: Simplex or Full-Duplex
    - 6) Wavelength: 1310/1550 nm, Multimode or Singlemode
    - 7) Optical Emitter: Laser Diode
    - 8) Number of Fibers: 1
  - c. Connectors
    - 1) Optical: ST
    - 2) Power and Data: Terminal Block with Screw Clamps
    - 3) Video: BNC (Gold Plated Center-Pin)
  - d. Electrical and Mechanical
    - 1) Power: 12 VDC @ 500 mA (stand-alone)
    - 3) Current Protection: Automatic Resettable Solid-State Current Limiters
  - e. Environmental
    - 1) MTBF: > 100,000 hours
    - 2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
    - 3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
    - 4) Relative Humidity: 0% to 95% (non-condensing)

B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:

a. Video

- 1) Input: 1 volt pk-pk (75 ohms)
- 2) Bandwidth: 5Hz - 10 MHz
- 3) Differential Gain: <5%
- 4) Tilt: <1%
- 5) Signal-Noise: 60db
- 6) Wavelength: 850nm
- 7) Number of Fibers: 1
- 8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
- 9) Connectors:
  - a) Power: Female plug with screw clamps
  - b) Video: BNC
  - c) Optical: ST
- 10) Power: 12 VDC

C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:

a. Video

- 1) Output: 1 volt pk-pk (75 ohms)
- 2) Bandwidth: 5Hz - 10 MHz
- 3) Differential Gain: <5%
- 4) Tilt: <1%
- 5) Signal-Noise: 60dB
- 6) Wavelength: 850nm
- 7) Number of Fibers: 1

- 8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
- 9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
- 10) Connectors:
- 11) Power: Female plug block with screw clamps
- 12) Video: BNC
- 13) Optical: ST
- 14) Power: 12 VAC8 Channel Fiber Optic Transcievers (Video&PTZ Control)

#### D. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.

##### a. Specifications

- 1) Card Orientation: Vertical
- 2) Construction: Aluminum
- 3) Current Consumption: 0.99 A
- 4) Humidity: 95.0 % RH
- 5) Input Power: 100-240 VAC, 60/50 Hz
- 6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
- 7) Number of Outputs: 1.0
- 8) Number of Slots 15.0
- 9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
- 10) Output Voltage: 13.5 V
- 11) Output Current 6.0 A
- 12) Power Dissipation: 28.0 W
- 13) Power Factor: 48.0
- 14) Power Supply: (built-in)
- 15) Rack Units: 3RU
- 16) Redundant Capability: Yes
- 17) Weight: 2.43 kg (5.35 lb)
- 18) Width: 483 mm (19.0 in)

## 2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESSION

#### A. Transient Voltage Surge Suppression

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have

Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
- c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
- d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
  - a. UL1449 2nd Edition, 2007, listed
  - b. UL1449 S.V.R. of 400 Volts or lower
  - c. Status Indicator Light(s)
  - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20  $\mu$ sec)
  - e. Maximum Continuous Current: 15 Amps
  - f. MCOV: 125 VAC
  - g. Service Voltage: 110-120 VAC
2. Suppressors shall be installed on the Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. UL 497B
  - b. Minimum Surge Current Capacity: 2,000 Amps per pair
  - c. Maximum Continuous Current: 5 Amps
  - d. MCOV: 33 Volts
  - e. Service Voltage: 24Volts

3. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:
  - a. Conforms with UL497B standards (where applicable)
  - b. Clamp level for 12 and 24V power: 18VDC / 38VDC
  - c. Clamp level for Data/LED: 6.8VDC
  - d. Service Voltage for Power: 12VDC/24VDC
  - e. Service Voltage for Data/LED: <5VDC
  - f. Clamp level - PoE Access Power: 72V
  - g. Clamp level - PoE Access Data: 7.9V
  - h. Service Voltage - PoE Access: 48VAC - 54VAC
  - i. Service Voltage - PoE Data: <5VDC

#### C. Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:
  - a. UL 1449 Listed
  - b. UL 1449 S.V.R. of 400 Volts or lower
  - c. Diagnostic Indicator Light(s)
  - d. Integrated ground terminating post (where case/chassis ground exists)
  - e. Minimum Surge Current Capacity of 13,000 Amps (8 x 20  $\mu$ Sec)
2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:
  - a. UL 497A Listed
  - b. Multi Stage protection design
  - c. Auto-reset current protection not to exceed 2 Amps per pair
  - d. Minimum Surge Current of 500 Amps per pair (8 x 20  $\mu$ Sec)
3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:
  - a. UL 497A Listed (where applicable)
  - b. UL 497B Listed (horns, strobes, speakers or communication circuits over 300 feet)
  - c. Multi Stage protection design
  - d. Auto-reset over-current protection not to exceed 5 Amps per pair
  - e. Minimum Surge Current of 1000 Amps per pair (8 x 20  $\mu$ Sec)

#### D. Intrusion Detection Systems

1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
  - a. UL 1449, 2nd Edition 2007, listed



- b. UL 1449 S.V.R. of 400 Volts or lower
- c. Status Indicator Lights
- d. Center screw for terminating Class II transformers
- e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20  $\mu$ Sec)
- 2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:
  - a. UL 497A Listed
  - b. Multi Stage protection design
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 130Vrms
  - e. Auto reset current protection not to exceed 150 milliAmps
- 3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
  - a. UL 497B for data communications or annunciation (powered loops)
  - b. Fail-short/fail-safe mode.
  - c. Surge Current Capacity: 9,000 Amps (8x20  $\mu$ Sec)
  - d. Clamp Voltage: 15 Vrms
  - e. Joule Rating: 76 Joules per pair (10x1000  $\mu$ Sec)
  - f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.

#### E. Video Surveillance System

- 1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:
  - a. Head-End Power
    - 1) UL 1778, cUL (Battery Back Up)
    - 2) Minimum Surge Current Capacity: 65,000 Amps (8x20 $\mu$ sec)
    - 3) Minimum of two (2) NEMA 5-15R Receptacles (one (1) AC power only, one (1) with UPS)
    - 4) All modes protected (L-N, L-G, N-G)
    - 5) EMI/RFI Filtering

6) Maximum Continuous Current: 12 Amps

b. Camera Power

1) Minimum Surge Current Capacity: 1,000 Amps (8X20μsec); 240  
Amps for IP Video/PoE cameras

2) Screw Terminal Connection

3) All protection modes L-G (all Lines)

4) MCOV <40VAC

c. Video And Data

1) Surge Current Capacity 1,000 Amps per conductor

2) "BNC" Connection (Coax)

3) Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)

4) Band Pass 0-2GHz

5) Insertion Loss <0.3dB

F. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.
5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufacturers' installation instructions.

G. 120 VAC Surge Suppression

1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)

7. Housing: ABS

## 2.5 INSTALLATION KIT

### A. General:

1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:
2. System Grounding:
  - a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
  - b. This includes, but is not limited to:
    - 1) Coaxial Cable Shields
    - 2) Control Cable Shields
    - 3) Data Cable Shields
    - 4) Equipment Racks
    - 5) Equipment Cabinets
    - 6) Conduits
    - 7) Cable Duct blocks
    - 8) Cable Trays
    - 9) Power Panels
    - 10) Grounding
    - 11) Connector Panels
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire

- wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
  6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
  7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
  8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

### **PART 3 - EXECUTION**

#### **3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.
- G. Inaccessible Equipment:

1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

### **3.2 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

### **3.3 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

### **3.4 DEMONSTRATION AND TRAINING**

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for <insert hours> hours to instruct VA personnel in operation and maintenance of units.
- E. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

### 3.5 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

### 3.6 SYSTEM PROGRAMMING

- A. General Programming Requirements
  - 1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms)]. System programming for existing or new SMS servers shall not be conducted at the project site.
- B. Level of Effort for Programming
  - 1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system

- prior to uploading new programming data. Additional programming requirements are provided as follows:
- a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.
  - b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.
2. The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
  3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

Description of Systems	Description of Tasks						
	Develop System Loading Sheets	Coordination	Initial Set-up Configuration	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)
SMS Setup & Configuration	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurations	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., check all system diagnostics (e.g., clients, panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software  Administrative account, audit log,  Keystrokes, mouse clicks, multi-screen configuration



Electronic Entry Control Systems	e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., setup of device, door groups & schedules, REX, Locks, link graphics	e.g., performing entry testing to confirm correct setup and configuration	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations
----------------------------------	---	--	--	--	---	---	---

Intru sion Dete ction Syste ms	e.g., enter door groups & schedule s, link devices - REX, lock, & graphics	e.g., confir ming device configur ations, naming conventi ons, event descript ion and narrativ es	e.g., enter data from loading sheets; configur e compon ents, link events, cameras, and graphics		e.g., , ente r door grou ps & sche dule s, link devi ces - REX, lock , & grap hics	e.g., walk test, device positi on, and maskin g	e.g., setting up monitoring and control points (e.g., motion sensors, glassbreaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,
---	---	--	--	--	--	---	---

CCTV Systems	e.g., programming call-ups recording	e.g., confirming device configurations, naming conventions	e.g., enter data from loading sheets; camera naming convention, sequence s, configure components)		e.g., programming call-ups recording	e.g., confirm area of coverage, call-up per event generated and recording rates	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Intercoms Systems	e.g., programming events & call-ups	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., programming events & call-ups	e.g., confirm operation, SMS event generation and camera call-up	e.g., setup linkages, events for activations, device troubles, land devices on graphic maps
Console Monitoring Components	N/A	per monitor	per monitor	per graphic map	N/A	per monitor	N/A
Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.							

**Table 1 Contractor Level of Effort**

### 3.7 TESTING AND ACCEPTANCE

#### A. Performance Requirements

##### 1. General:

- a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
- b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at the conclusion of each phase of testing and prior to Resident Engineer approval of the test.

2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.

- D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.

#### E. Contractor's Field Testing (CFT)

1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date

is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test details) for each device and system tested, and annotated loading sheets documenting complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

#### F. Performance Verification Test (PVT)

##### 1. Test team:

a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT

- will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
  4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.
  5. Additional Components of the PVT shall include:
    - a. System Inventory
      - 1) All Device equipment
      - 2) All Software
      - 3) All Logon and Passwords
      - 4) All Cabling System Matrices
      - 5) All Cable Testing Documents
      - 6) All System and Cabinet Keys
    - b. Inspection
      - 1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
      - 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
  6. Partial PVT - At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.
- G. Endurance Test

1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system. The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.
2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
3. Phase II (Assessment):
  - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
  - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report

and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase I be repeated.

4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.

5. Phase IV (Assessment):

1. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
2. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

H. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
  - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.



- b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
- c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

- - - E N D - - -



**SECTION 28 05 13**  
**CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- D. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- E. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SECURITY AND SAFETY. Requirements for infrastructure.
- F. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

**1.3 DEFINITIONS**

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.
- H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

J. UTP: Unshielded twisted pair.

#### **1.4 QUALITY ASSURANCE**

A. See section 28 05 00, Paragraph 1.4.

#### **1.5 SUBMITTALS**

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturer's Literature and Data: Showing each cable type and rating.
2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - a. Vertical and horizontal offsets and transitions.
  - b. Clearances for access above and to side of cable trays.
  - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
  - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
4. Wiring Diagrams. Show typical wiring schematics including the following:
  - a. Workstation outlets, jacks, and jack assemblies.
  - b. Patch cords.
  - c. Patch panels.
5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
6. Project planning documents as specified in Part 3.
7. Maintenance Data: For wire and cable to include in maintenance manuals.

## 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
  - D2301-04.....Standard Specification for Vinyl Chloride  
Plastic Pressure Sensitive Electrical Insulating  
Tape
- C. Federal Specifications (Fed. Spec.):
  - A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed  
Installation)
- D. National Fire Protection Association (NFPA):
  - 70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
  - 44-05.....Thermoset-Insulated Wires and Cables
  - 83-08.....Thermoplastic-Insulated Wires and Cables
  - 467-07.....Electrical Grounding and Bonding Equipment
  - 486A-03.....Wire Connectors and Soldering Lugs for Use with  
Copper Conductors
  - 486C-04.....Splicing Wire Connectors
  - 486D-05.....Insulated Wire Connector Systems for Underground  
Use or in Damp or Wet Locations
  - 486E-00.....Equipment Wiring Terminals for Use with Aluminum  
and/or Copper Conductors
  - 493-07.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable
  - 514B-04.....Fittings for Cable and Conduit
  - 1479-03.....Fire Tests of Through-Penetration Fire Stops//

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use [optical-fiber flashlight] [or] [optical loss test set] <Insert test>.
  - 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- B. Cable Trays:
  - 1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.
  - 2. Basket Cable Trays: 18 inches (450 mm) wide and 4 inches (100 mm) deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
- C. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

### 2.3 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
  - 3. Comply with TIA/EIA-568-B.2, [Category 5e] [Category 6].

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
  - a. Communications, General Purpose: Type CM or CMG [; or MPP, CMP, MPR, CMR, MP, or MPG].
  - b. Communications, Plenum Rated: Type CMP [; or MPP], complying with NFPA 262.
  - c. Communications, Riser Rated: Type CMR [; or MPP, CMP, or MPR], complying with UL 1666.
  - d. Communications, Limited Purpose: Type CMX[; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG].
  - e. Multipurpose: Type MP or MPG [; or MPP or MPR].
  - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
  - g. Multipurpose, Riser Rated: Type MPR [or MPP], complying with UL 1666.

#### **2.4 UTP CABLE HARDWARE**

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: [110-style for Category 5e] [110-style for Category 6] [66-style for Category 5e]. Provide blocks for the number of cables terminated on the block, plus [25] <Insert percentage> percent spare. Integral with connector bodies, including plugs and jacks where indicated.

#### **2.5 OPTICAL FIBER CABLE**

- A. Description: Multimode, [50/125] [62.5/125]-micrometer, [24] <Insert number>-fiber, [nonconductive,] tight buffer, optical fiber cable.
  1. Comply with ICEA S-83-596 for mechanical properties.
  2. Comply with TIA/EIA-568-B.3 for performance specifications.
  3. Comply with [TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A] for detailed specifications.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG [, or OFNR, OFNP].
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR [or OFNP], complying with UL 1666.

- d. General Purpose, Conductive: Type OFC or OFCG [; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP].
- e. Plenum Rated, Conductive: Type OFCP [ or OFNP], complying with NFPA 262.
- f. Riser Rated, Conductive: Type OFCR [; or OFNR, OFCP, or OFNP], complying with UL 1666.
- 5. Conductive cable shall be [steel] [aluminum] armored type.
- 6. Maximum Attenuation: [3.50] <Insert number> dB/km at 850 nm; [1.5] <Insert number> dB/km at 1300 nm.
- 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

**B. Jacket:**

- 1. Jacket Color: [Aqua for 50/125-micrometer cable] [Orange for 62.5/125-micrometer cable].
- 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
- 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

**2.6 OPTICAL FIBER CABLE HARDWARE**

- A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  - 1. Quick-connect, simplex and duplex, [Type SC] [Type ST] [Type LC] [Type MT-RJ] connectors. Insertion loss shall be not more than 0.75 dB.
  - 2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

**2.7 COAXIAL CABLE**

- A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-11/U: NFPA 70, Type CATV.
  - 1. No. [14] <Insert size> AWG, solid, copper-covered steel conductor.
  - 2. Gas-injected, foam-PE insulation.
  - 3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
  - 4. Jacketed with sunlight-resistant, black PVC or PE.



5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.
- C. RG59/U: NFPA 70, Type CATVR.
1. No. [20] <Insert size> AWG, solid, silver-plated, copper-covered steel conductor.
  2. Gas-injected, foam-PE insulation.
  3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
  4. Color-coded PVC jacket.
- D. RG-6/U: NFPA 70, Type CATV or CM.
1. No. [16] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
  3. Jacketed with black PVC or PE.
  4. Suitable for indoor installations.
- E. RG59/U: NFPA 70, Type CATV.
1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
  3. PVC jacket.
- F. RG59/U (Plenum Rated): NFPA 70, Type CMP.
1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
  2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
  3. Copolymer jacket.
- G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV[, or CATVP or CATVR].
  2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
  3. CATV Riser Rated: Type CATVR[; or CATVP, CATVR, or CATV], complying with UL 1666.
  4. CATV Limited Rating: Type CATVX.

## 2.8 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.9 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Polypropylene insulation.
  3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  4. PVC jacket.
  5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Plastic insulation.
  3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
  4. Plastic jacket.
  5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with NFPA 262.

## 2.10 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM[ or CMG].
1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. PVC insulation.
  3. Unshielded.
  4. PVC jacket.
  5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Fluorinated ethylene propylene insulation.
  3. Unshielded.
  4. Fluorinated ethylene propylene jacket.
  5. Flame Resistance: NFPA 262, Flame Test.

**2.11 LOW-VOLTAGE CONTROL CABLE**

- A. Paired Lock Cable: NFPA 70, Type CMG.
  - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
  - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
  - 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. PVC insulation.
  - 3. Unshielded.
  - 4. PVC jacket.
  - 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
  - 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. Fluorinated ethylene propylene insulation.
  - 3. Unshielded.
  - 4. Plastic jacket.
  - 5. Flame Resistance: NFPA 262, Flame Test.

**2.12 CONTROL-CIRCUIT CONDUCTORS**

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, [Type THHN-THWN, in raceway] [power-limited cable, concealed in building finishes] [power-limited tray cable, in cable tray] complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

**2.13 FIRE ALARM WIRE AND CABLE**

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, [not less than] [No. 18 AWG] [<Insert wire size> AWG] [size as recommended by system manufacturer].
  - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
  - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor[ with outer jacket] with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

**2.14 IDENTIFICATION PRODUCTS**

- A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

**2.15 SOURCE QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

**2.16 WIRE LUBRICATING COMPOUND**

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

- B. Shall not be used on wire for isolated type electrical power systems.

## **2.17 FIREPROOFING TAPE**

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

9. Pulling Cable:
  - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
  - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
  - c. Use ropes made of nonmetallic material for pulling feeders.
  - d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer/COTR.
  - e. Pull in multiple cables together in a single conduit.
- C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
  1. Splices and terminations shall be mechanically and electrically secure.
  2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
- D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
- E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
- G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
- I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
- J. UTP Cable Installation:
  1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- K. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

L. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1525 mm)] <Insert dimension> apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

M. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [72 inches (1830 mm)] <Insert size> long shall be neatly coiled not less than [12 inches (300 mm)] <Insert size> in diameter below each feed point.

N. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

O. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### **3.2 FIRE ALARM WIRING INSTALLATION**

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
  1. Install plenum cable in environmental air spaces, including plenum ceilings.
  2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
  1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
  2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is[ not] permitted.
  3. Signaling Line Circuits: Power-limited fire alarm cables [may] [shall not] be installed in the same cable or raceway as signaling line circuits.



- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### **3.3 CONTROL CIRCUIT CONDUCTORS**

- A. Minimum Conductor Sizes:
  - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
  - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### **3.4 CONNECTIONS**

- A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.
- C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.

- D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

### **3.5 FIRESTOPPING**

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### **3.6 GROUNDING**

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

### **3.7 IDENTIFICATION**

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- 4. Optical Fiber Cable Tests:
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - b. Link End-to-End Attenuation Tests:
    - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
    - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- 5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."
- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 EXISTING WIRING

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

- - - E N D - - -



**SECTION 28 05 28.33**  
**CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing certification of the conduit, fittings, and boxes to form a complete, coordinated, raceway system(s). Conduits and when approved separate UL Certified and Listed partitioned telecommunications raceways are required for a fully functional Electronic Safety and Security (ESS) system. Raceways are required for all electronic safety and security cabling unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 06 10 00 - ROUGH CARPENTRY. Requirements for mounting board for communication closets.
- C. Section 07 84 00 - FIRESTOPPING. Requirements for sealing around penetrations to maintain the integrity of fire rated construction.
- D. Section 07 60 00 - FLASHING AND SHEET METAL. Requirements for fabrications for the deflection of water away from the building envelope at penetrations.
- E. Section 07 92 00 - JOINT SEALANTS. Requirements for sealing around conduit penetrations through the building envelope to prevent moisture migration into the building.
- F. Section 09 91 00 - PAINTING. Requirements for identification and painting of conduit and other devices.
- G. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general electrical requirements, general arrangement of the contract documents, coordination, quality assurance, project conditions, equipment and materials, and items that is common to more than one section of Division 28.
- H. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYTEMS. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- I. Section 27 08 00 - COMMISIONING OF COMMUNICATIONS SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.

### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

### 1.4 QUALITY ASSURANCE

- A. Refer to Paragraph 1.4 Quality Assurance, in Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

### 1.5 SUBMITTALS

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Furnish the following:
- B. Shop Drawings:
  - 1. Size and location of main feeders;
  - 2. Size and location of panels and pull boxes
  - 3. Layout of required conduit penetrations through structural elements.
  - 4. The specific item proposed and its area of application shall be identified on the catalog cuts.
- C. Certification: Prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.
- D. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion.
- E. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- F. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Custom enclosures and cabinets.
- G. Coordination Drawings: Conduit routing 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. Structural members in the paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- H. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- I. Source quality-control test reports.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
- TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and  
Tubing
- FB1-07.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable
- C. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1-05.....Flexible Metal Conduit
- 5-04.....Surface Metal Raceway and Fittings
- 6-07.....Rigid Metal Conduit
- 50-07.....Enclosures for Electrical Equipment

360-09.....	Liquid-Tight Flexible Steel Conduit
467-07.....	Grounding and Bonding Equipment
514A-04.....	Metallic Outlet Boxes
514B-04.....	Fittings for Cable and Conduit
514C-02.....	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-05.....	Schedule 40 and 80 Rigid PVC Conduit
651A-07.....	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07.....	Electrical Metallic Tubing
1242-06.....	Intermediate Metal Conduit

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Conduit Size: In accordance with the NEC, but not less than 20 mm (3/4 inch) unless otherwise shown.

### **2.2.CONDUIT**

- A. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
- C. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242, ANSI C80.6.
- D. Electrical metallic tubing (EMT): Shall Conform to UL 797, ANSI C80.3.  
Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 volts or less.
- E. Flexible galvanized steel conduit: Shall Conform to UL 1.
- F. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
- G. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).

### **2.3.WIREWAYS AND RACEWAYS**

- A. Surface metal raceway: Shall Conform to UL 5.

### **2.4.CONDUIT FITTINGS**

- A. Rigid steel and IMC conduit fittings:
  1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  2. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  3. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  4. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting.



Bushings made entirely of metal or nonmetallic material are not permitted.

5. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
6. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

C. Electrical metallic tubing fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 50 mm (2 inches) and smaller. Use set screw type couplings with four set screws each for conduit sizes over 50 mm (2 inches). Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
4. Indent type connectors or couplings are prohibited.
5. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.

D. Flexible steel conduit fittings:

1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
2. Clamp type, with insulated throat.

E. Liquid-tight flexible metal conduit fittings:

1. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
2. Only steel or malleable iron materials are acceptable.
3. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

F. Direct burial plastic conduit fittings:

1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
2. As recommended by the conduit manufacturer.

G. Surface metal raceway fittings: As recommended by the raceway manufacturer.

H. Expansion and deflection couplings:

1. Conform to UL 467 and UL 514B.
2. Accommodate, 19 mm (0.75 inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
3. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
4. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

## 2.5 CONDUIT SUPPORTS

- A. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
- B. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
- C. Multiple conduit (trapeze) hangers: Not less than 38 mm by 38 mm (1-1/2 by 1-1/2 inch), 12 gage steel, cold formed, lipped channels; with not less than 9 mm (3/8 inch) diameter steel hanger rods.
- D. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.

## 2.6 OUTLET, JUNCTION, AND PULL BOXES

- A. UL-50 and UL-514A.
- B. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, semi-adjustable, rectangular.
- E. Sheet metal boxes: Galvanized steel, except where otherwise shown.
- F. Flush mounted wall or ceiling boxes shall be installed with raised covers so that front face of raised cover is flush with the wall. Surface mounted wall or ceiling boxes shall be installed with surface style flat or raised covers.

## 2.7 CABINETS

- A. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
- B. Hinged door in front cover with flush latch and concealed hinge.
- C. Key latch to match panelboards.
- D. Metal barriers to separate wiring of different systems and voltage.
- E. Accessory feet where required for freestanding equipment.

**2.8 WIREWAYS**

- A. Equip with hinged covers, except where removable covers are shown.

**2.9 WARNING TAPE (NOT USED)****2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING (NOT USED)****2.11 SLEEVES FOR RACEWAYS**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 84 00 "FIRESTOPPING."

**2.12 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

**2.13 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

**PART 3 - EXECUTION****3.1 PENETRATIONS**

- A. Cutting or Holes:
  - 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer/COTR prior to drilling through structural sections.

2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer/COTR as required by limited working space.
- B. Fire Stop: Where conduits, wireways, and other electronic safety and security raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.
- C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight as specified in Section 07 92 00, "JOINT SEALANTS".

### **3.2 INSTALLATION, GENERAL**

- A. Install conduit as follows:
  1. In complete runs before pulling in cables or wires.
  2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
  3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
  5. Mechanically continuous.
  6. Independently support conduit at 2.4 m (8 foot) on center. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts).
  7. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
  8. Close ends of empty conduit with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
  9. Conduit installations under fume and vent hoods are prohibited.
  10. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

11. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, "FLASHING AND SHEET METAL".
12. Do not use aluminum conduits in wet locations.
13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
3. Bending of conduits with a pipe tee or vise is prohibited.

C. Layout and Homeruns:

1. Install conduit with wiring, including homeruns, as shown.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer/COTR.

D. Fire Alarm:

1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer may be used in lieu of painted conduit) in accordance with the requirements of Section 28 31 00, "FIRE DETECTION AND ALARM".

### 3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only when the following occurs:
  - a. Where shown on the structural drawings.
  - b. As approved by the Resident Engineer/COTR prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inch) thick is prohibited.
  - a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.

- c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
- 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
  - 1. Conduit for conductors above 600 volts:
    - a. Rigid steel or rigid aluminum.
    - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
  - 2. Conduit for conductors 600 volts and below:
    - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  - 3. Align and run conduit parallel or perpendicular to the building lines.
  - 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (6 feet) of flexible metal conduit extending from a junction box to the fixture.
  - 5. Tightening set screws with pliers is prohibited.

### **3.4 EXPOSED WORK INSTALLATION**

- A. Unless otherwise indicated on the drawings, exposed conduit is only permitted in mechanical and electrical rooms.
- B. Conduit for Conductors 600 volts and below:
  - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- C. Align and run conduit parallel or perpendicular to the building lines.
- D. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- E. Support horizontal or vertical runs at not over 2400 mm (eight foot) intervals.
- F. Surface metal raceways: Use only where shown.
- G. Painting:
  - 1. Paint exposed conduit as specified in Section 09 91 00, "PAINTING".
  - 2. Paint all conduits containing cables rated over 600 volts safety orange. Refer to Section 09 91 00, "PAINTING" for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (two inch) high black numerals and letters, showing the cable voltage

rating. Provide legends where conduits pass through walls and floors and at maximum 6000 mm (20 foot) intervals in between.

### **3.5 EXPANSION JOINTS**

- A. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inches) with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 125 mm (5 inch) vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 375 mm (15 inches) and larger conduits are acceptable.
- C. Install expansion and deflection couplings where shown.
- D. Seismic Areas: In seismic areas, provide conduits 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 375 mm (15 inches) of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.

### **3.6 CONDUIT SUPPORTS, INSTALLATION**

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits. Maximum distance between supports is 2.5 m (8 foot) on center.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U-bolts or other approved fasteners.
- D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
  - 2. Existing Construction:
    - a. Steel expansion anchors not less than 6 mm (1/4 inch) bolt size and not less than 28 mm (1-1/8 inch) embedment.
    - b. Power set fasteners not less than 6 mm (1/4 inch) diameter with depth of penetration not less than 75 mm (3 inches).

- c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
- F. Hollow Masonry: Toggle bolts are permitted.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### **3.7 BOX INSTALLATION**

- A. Boxes for Concealed Conduits:
  - 1. Flush mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
- C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- D. Outlet boxes in the same wall mounted back-to-back are prohibited. A minimum 600 mm (24 inch), center-to-center lateral spacing shall be maintained between boxes).
- E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 100 mm (4 inches) square by 55 mm (2-1/8 inches) deep, with device covers for the wall material and thickness involved.
- F. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".
- G. On all Branch Circuit junction box covers, identify the circuits with black marker.



### 3.8 ELECTRONIC SAFETY AND SECURITY CONDUIT

- A. Install the electronic safety and security raceway system as shown on drawings.
- B. Minimum conduit size of 19 mm (3/4 inch), but not less than the size shown on the drawings.
- C. All conduit ends shall be equipped with insulated bushings.
- D. All 100 mm (four inch) conduits within buildings shall include pull boxes after every two 90 degree bends. Size boxes per the NEC.
- E. Vertical conduits/sleeves through closets floors shall terminate not less than 75 mm (3 inches) below the floor and not less than 75 mm (3 inches) below the ceiling of the floor below.
- F. Terminate conduit runs to/from a backboard in a closet or interstitial space at the top or bottom of the backboard. Conduits shall enter communication closets next to the wall and be flush with the backboard.
- G. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- H. All empty conduits located in communications closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- I. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards. Minimum radius of communication conduit bends shall be as follows (special long radius):

Sizes of Conduit Trade Size	Radius of Conduit Bends mm, Inches
3/4	150 (6)
1	230 (9)
1-1/4	350 (14)
1-1/2	430 (17)
2	525 (21)
2-1/2	635 (25)
3	775 (31)
3-1/2	900 (36)
4	1125 (45)

- J. Furnish and install 19 mm (3/4 inch) thick fire retardant plywood specified in on the wall of communication closets where shown on

drawings . Mount the plywood with the bottom edge 300 mm (one foot) above the finished floor.

- K. Furnish and pull wire in all empty conduits. (Sleeves through floor are exceptions).

### **3.9 COMMISSIONING**

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system.

- - - E N D - - -

**SECTION 28 08 00****COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. The requirements of this Section apply to all sections of Division 28.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

**1.2 RELATED WORK**

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

**1.3 SUMMARY**

- A. This Section includes requirements for commissioning the Facility electronic safety and security systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

**1.4 DEFINITIONS**

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

**1.5 COMMISSIONED SYSTEMS**

- A. Commissioning of a system or systems specified in Division 28 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 28, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

**1.6 SUBMITTALS**

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

**PART 2 - PRODUCTS (NOT USED)****PART 3 - EXECUTION****3.1 CONSTRUCTION INSPECTIONS**

- A. Commissioning of Electronic Safety and Security systems will require inspection of individual elements of the electronic safety and security systems throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 19 00 and the Commissioning plan to schedule electronic safety and security systems inspections as required to support the Commissioning Process.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the

type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

### **3.3 CONTRACTORS TESTS**

- A. Contractor tests as required by other sections of Division 28 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

### **3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

### **3.5 TRAINING OF VA PERSONNEL**

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01

91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for additional Contractor training requirements.

----- END -----

**SECTION 28 13 00**  
**PHYSICAL ACCESS CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.
- B. This Section includes a Physical Access Control System consisting of a system server, operating system and application software, and field-installed Controllers connected by a high-speed electronic data transmission network. The PACS shall have the following:
  - 1. Physical Access Control:
    - a. Regulating access through doors
    - b. Anti-passback
    - c. Visitor assignment
    - d. Surge and tamper protection
    - e. Secondary alarm annunciator
    - f. Credential cards and readers
    - g. Biometric identity verification equipment
    - h. Push-button switches
    - i. RS-232 ASCII interface
    - j. Credential creation and credential holder database and management
    - k. Monitoring of field-installed devices
    - l. Interface with systems.
    - m. Reporting
  - 2. Security:
    - a. Real-time guard tour.
    - b. Time and attendance.
    - c. Key tracking.
    - d. Video and camera control.
    - e. Time and attendance
- C. System Architecture:
  - 1. Criticality, operational requirements, and/or limiting points of failure may dictate the development of an enterprise and regional server architecture as opposed to system capacity. Provide server and workstation configurations with all necessary connectors, interfaces and accessories as shown.

- D. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- E. Physical Access Control System (PACS) shall consist of:
  - 1. Head-End equipment server,
  - 2. One or more networked PC-based workstations,
  - 3. Physical Access Control System and Database Management Software,
  - 4. Credential validation software/hardware,
  - 5. Field installed controllers,
  - 6. PIV Middleware,
  - 7. Card readers,
  - 8. Biometric identification devices,
  - 9. PIV cards,
  - 10. Supportive information system,
  - 11. Door locks and sensors,
  - 12. Power supplies,
  - 13. Interfaces with:
    - a. Video Surveillance and Assessment System,
    - b. Gate, turnstile, and traffic arm controls,
    - c. Automatic door operators,
    - d. Intrusion Detection System,
    - e. Intercommunication System
    - f. Fire Protection System,
    - g. HVAC,
    - h. Building Management System,
- F. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.
- G. Information system supporting PACS, Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems) and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).
- H. PACS system shall support:
  - 1. Multiple credential authentication modes,
  - 2. Bidirectional communication with the reader,
  - 3. Incident response policy implementation capability; system shall have capability to automatically change access privileges for



certain user groups to high security areas in case of incident/emergency.

4. Visitor management,
- I. All security relevant decisions shall be made on "secure side of the door". Secure side processing shall include;
  1. Challenge/response management,
  2. PKI path discovery and validation,
  3. Credential identifier processing,
  4. Authorization decisions.
- J. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.
- K. System Software: Based on existing central-station, workstation operating system, server operating system, and application software.
- L. Software and controllers shall be capable of matching full 56 bit FASC-N plus minimum of 32 bits of public key certificate data.
- M. Software shall have the following capabilities:
  1. Multiuser multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.
  2. Support authentication and enrolment;
    - a. PIV verification,
    - b. Expiration date check,
    - c. Biometric check,
    - d. Digital photo display/check,
    - e. Validate digital signatures of data objects (Objects are signed by the Trusted Authority)
    - f. Private key challenge (CAK & PAK to verify private key public key pairs exist and card is not a clone)
  3. Support CRL validation via OCSP or SCVP on a scheduled basis and automatically deny access to any revoked credential in the system.
  4. Graphical user interface to show pull-down menus and a menu tree format that complies with interface guidelines of Microsoft Windows operating system.
  5. System license shall be for the entire system and shall include capability for future additions that are within the indicated system size limits specified in this Section.

6. System shall have open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with existing operating system.
7. Operator login and access shall be utilized via integrated smart card reader and password protection.

N. Systems Networks:

1. A standalone system network shall interconnect all components of the system. This network shall include communications between a central station and any peer or subordinate workstations, enrollment stations, local annunciation stations, portal control stations or redundant central stations.

O. Security Management System Server Redundancy:

1. The SMS shall support multiple levels of fault tolerance and SMS redundancy listed and described below:
  - a. Existing features

P. Number of points:

1. PACS shall support multiple autonomous regional servers that can connect to a master command and controller server.
2. Unlimited number of access control readers, unlimited number of inputs or outputs, unlimited number of client workstations, unlimited number of cardholders.
3. Total system solution to enable enterprise-wide, networked, multi-user access to all system resources via a wide range of options for connectivity with the customer's existing LAN and WAN.

Q. Console Network:

1. Console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.

R. Network(s) connecting PCs and Controllers shall comply with NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems) and consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet 10 BASE-T, star topology network based on TCP/IP.

2. Direct-connected, RS-232 cable from the COM port of the Central Station to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

## 1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- E. Section 08 35 13.13 - ACCORDIAN FOLDING DOORS. Requirements for door installation.
- F. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- G. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- J. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- K. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- L. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- O. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.
- P. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- Q. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS. Requirements for grounding of equipment.
- R. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- S. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. For requirements for commissioning, systems readiness checklists, and training.
- T. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- U. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
- V. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- W. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.

- X. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS).  
Requirements for emergency and interior communications.
- Y. Section 28 31 00 - FIRE DETECTION AND ALARM. Requirements for  
integration with fire detection and alarm system.

### 1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.
- B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- D. Product Qualifications:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
  - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- E. Contractor Qualifications:
  - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference

sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

- a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
- b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.4 SUBMITTALS**

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.

- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:
  - 1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a complete list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Clearly define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  - 3. A detailed riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.

- c. Include the number, size, identification, and maximum lengths of interconnecting wires.
  - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
- a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
  - b. Provide full detail of all system components wiring from point-to-point.
  - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
  - d. Show device locations that correspond to the floor plans.
  - e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
- a. Device ID.
  - b. Device Location (e.g. site, building, floor, room number, location, and description).
  - c. Mounting type (e.g. flush, wall, surface, etc.).
  - d. Power supply or circuit breaker and power panel number.
  - e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).
6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
- 1. 35 percent
  - 2. 65 percent

- 3. 90 percent
  - 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
  - G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
  - H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion.
  - I. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
    - 1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - DESIGN SUBMITTAL PROCEDURES, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
    - 2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
    - 3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
    - 4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly



- marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
  6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
    - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
      - 1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and or maintenance of the component or system.
      - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
    - b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
    - c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
    - d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.

- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
  - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
  - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
  - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
  - 1) General system or equipment description.
  - 2) Design factors and assumptions.
  - 3) Copies of applicable Shop Drawings and Product Data.
  - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance, repair instructions, sources of required maintenance materials and related services, and a manual index.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and

telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.

- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
- k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
- l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical

sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.

- n. Calculations: Provide a section for circuit and panel calculations.
  - o. Loading Sheets: Provide a section for DGP Loading Sheets.
  - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.
- J. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:
- 1. Section I - Drawings:
    - a. General - Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.

- b. Cover Sheet - Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
- c. General Information Sheets - General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
- d. Floor Plans - Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
  - 1) security devices by symbol,
  - 2) the associated device point number (derived from the loading sheets),
  - 3) wire & cable types and counts
  - 4) conduit sizing and routing
  - 5) conduit riser systems
  - 6) device and area detail call outs
- e. Architectural details - Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).
- f. Riser Diagrams - Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).
- g. Block Diagrams - Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams - Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram

shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.

i. Security Details:

- 1) Panel Assembly Detail - For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
- 2) Panel Details - Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
- 3) Device Mounting Details - Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
- 4) Details of connections to power supplies and grounding
- 5) Details of surge protection device installation
- 6) Sensor detection patterns - Each system sensor shall have associated detection patterns.
- 7) Equipment Rack Detail - For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room - The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console - The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.  
Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room - Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and

associated equipment and device placements both vertical and horizontally.

- j. Electrical Panel Schedule - Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule - A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
  - 1) Item Number
  - 2) Door Number (Derived from A/E Drawings)
  - 3) Floor Plan Sheet Number
  - 4) Standard Detail Number
  - 5) Door Description (Derived from Loading Sheets)
  - 6) Data Gathering Panel Input Number
  - 7) Door Position or Monitoring Device Type & Model Number
  - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
  - 9) Card Reader Type & Model Number
  - 10) Shunting Device Type & Model Number
  - 11) Sounder Type & Model Number
  - 12) Manufacturer
  - 13) Misc. devices as required
    - a) Delayed Egress Type & Model Number
    - b) Intercom
    - c) Camera
    - d) Electric Transfer Hinge
    - e) Electric Pass-through device
  - 14) Remarks column indicating special notes or door configurations
- 2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package

submittal. At a minimum, the camera schedule shall include the following information:

- a. Item Number
- b. Camera Number
- c. Naming Conventions
- d. Description of Camera Coverage
- e. Camera Location
- f. Floor Plan Sheet Number
- g. Camera Type
- h. Mounting Type
- i. Standard Detail Reference
- j. Power Input & Draw
- k. Power Panel Location
- l. Remarks Column for Camera

3. Section II - Data Gathering Panel Documentation Package

- a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
- b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
- c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.



- d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
- e. The DGP spreadsheet shall include an entry section for the following information:
  - 1) DGP number
  - 2) First Reader Number
  - 3) First Monitor Point Number
  - 4) First Relay Number
  - 5) DGP, input or output Location
  - 6) DGP Chain Number
  - 7) DGP Cabinet Tamper Input Number
  - 8) DGP Power Fail Input Number
  - 9) Number of Monitor Points Reserved For Expansion Boards
  - 10) Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
  - 1) System Numbers for Card Readers
  - 2) System Numbers for Monitor Point Inputs
  - 3) System Numbers for Control Points (Relays)
  - 4) Next DGP or input module First Monitor Point Number
  - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
  - 1) DGP Reader Number
  - 2) System Reader Number
  - 3) Cable ID Number
  - 4) Description Field (Room Number)
  - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
  - 6) Description Field
  - 7) DGP Input Location
  - 8) Date Test
  - 9) Date Passed
  - 10) Cable Type
  - 11) Camera Numbers (of cameras viewing the reader location)

- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
    - 1) DGP Monitor Point Input Number
    - 2) System Monitor Point Number
    - 3) Cable ID Number
    - 4) Description Field (Room Number)
    - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
    - 6) DGP or input module Input Location
    - 7) Date Test
    - 8) Date Passed
    - 9) Cable Type
    - 10) Camera Numbers (of associated alarm event preset call-ups)
  - i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
    - 1) DGP Control Point (Relay) Number
    - 2) System (Control Point) Number
    - 3) Cable ID Number
    - 4) Description Field (Room Number)
    - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
    - 6) Description Field
    - 7) DGP or OUTPUT MODULE Output Location
    - 8) Date Test
    - 9) Date Passed Cable Type
    - 10) Camera Number (of associated alarm event preset call-ups)
  - j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
    - 1) Header
      - a) DGP Input and Output Worksheet
      - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
    - 2) Footer
      - a) File Name
      - b) Date Printed
      - c) Page Number
4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as

- practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
  6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
    - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
    - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
    - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
  7. Section VI - Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- K. Group II Technical Data Package
1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its

- performance. The Contractor shall not correct any deficiency without written permission from the COTR.
2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
    - a. Baseline configuration
    - b. Access levels
    - c. Schedules (intrusion detection, physical access control, holidays, etc.)
    - d. Badge database
    - e. System monitoring and reporting (unit level and central control)
    - f. Naming conventions and descriptors
- L. Group III Technical Data Package
1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- M. Group IV Technical Data Package
1. Performance Verification Test
    - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.
  2. Training Documentation
    - a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations,

turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.

b. New Unit Control Room:

- 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
- 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
- 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
- 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
- 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's

manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.

3. System Configuration and Data Entry:

- a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
  - 1) Physical Access control system components,
  - 2) All intrusion detection system components,
  - 3) Video surveillance, control and recording systems,
  - 4) Intercom systems components,
  - 5) All other security subsystems shown in the contract documents.
- b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
- c. Refer to Part 3 for system programming requirements and planning guidelines.

- 4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent

information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

N. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
  - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration

procedures; manufacturer's repair list indicating sources of supply; and interface definition.

3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
  - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
  - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.



8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
- a. Equipment and/or system function.
  - b. Operating characteristics.
  - c. Limiting conditions.
  - d. Performance curves.
  - e. Engineering data and test.
  - f. Complete nomenclature and number of replacement parts.
  - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
  - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
  - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
  - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master

- Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
  11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
  12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous

records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:

- a. Certificates received instead of labels on bulk products.
- b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
- c. Documented qualification of installation firms.
- d. Load and performance testing.
- e. Inspections and certifications.
- f. Final inspection and correction procedures.
- g. Project schedule

13. Record Construction Documents (Record As-Built)

- a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
- b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.

- c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

O. FIPS 201 Compliance Certificates

- 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
  - a. Fingerprint Capture Station
  - b. Card Readers
  - c. Facial Image Capturing Camera
  - d. PIV Middleware
  - e. Template Matcher
  - f. Electromagnetically Opaque Sleeve
  - g. Certificate Management
    - 1) CAK Authentication System
    - 2) PIV Authentication System
    - 3) Certificate Validator
    - 4) Cryptographic Module

P. Approvals will be based on complete submission of manuals together with shop drawings.

Q. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion.

## 1.5 APPLICABLE PUBLICATIONS

A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to

the extent referenced. The publications are referenced in the text by the basic designation only.

- B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
  - AC-03.....Access Control: Access Control Guideline Dye Sublimation Printing Practices for PVC Access Control Cards
  - TVAC-01.....CCTV to Access Control Standard - Message Set for System Integration
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
  - A117.1.....Standard on Accessible and Usable Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
  - 28 CFR Part 36.....ADA Standards for Accessible Design 2010
- E. Department of Veterans Affairs (VA):
  - PACS-R:           Physical Access Control System (PACS) Requirements
  - VA Handbook 0730       Security and Law Enforcement
- F. Government Accountability Office (GAO):
  - GAO-03-8-02 Security Responsibilities for Federally Owned and Leased Facilities
- G. National Electrical Contractors Association
  - 303-2005.....Installing Closed Circuit Television (CCTV) Systems
- H. National Electrical Manufacturers Association (NEMA):
  - 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- I. National Fire Protection Association (NFPA):
  - 70-11..... National Electrical Code
- J. Underwriters Laboratories, Inc. (UL):
  - 294-99.....The Standard of Safety for Access Control System Units
  - 305-08.....Standard for Panic Hardware
  - 639-97.....Standard for Intrusion-Detection Units
  - 752-05.....Standard for Bullet-Resisting Equipment
  - 827-08.....Central Station Alarm Services
  - 1076-95.....Standards for Proprietary Burglar Alarm Units and Systems

1981-03.....Central Station Automation System  
 2058-05.....High Security Electronic Locks

K. Homeland Security Presidential Directive (HSPD):  
 HSPD-12.....Policy for a Common Identification Standard for  
                     Federal Employees and Contractors

L. Federal Communications Commission (FCC):  
 (47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

M. Federal Information Processing Standards (FIPS):  
 FIPS-201-1.....Personal Identity Verification (PIV) of Federal  
                     Employees and Contractors

N. National Institute of Standards and Technology (NIST):  
 IR 6887 V2.1.....Government Smart Card Interoperability  
                     Specification (GSC-IS)

Special Pub 800-63.....Electronic Authentication Guideline  
 Special Pub 800-96.....PIV Card Reader Interoperability Guidelines  
 Special Pub 800-73-3....Interfaces for Personal Identity Verification  
                     (4 Parts)

.....Pt. 1- End Point PIV Card Application  
                     Namespace, Data Model & Representation

.....Pt. 2- PIV Card Application Card Command  
                     Interface

.....Pt. 3- PIV Client Application Programming  
                     Interface

.....Pt. 4- The PIV Transitional Interfaces & Data  
                     Model Specification

Special Pub 800-76-1....Biometric Data Specification for Personal  
                     Identity Verification

Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes for  
                     Personal Identity Verification

Special Pub 800-79-1....Guidelines for the Accreditation of Personal  
                     Identity Verification Card Issuers

Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines  
 Special Pub 800-85A-2...PIV Card Application and Middleware Interface  
                     Test Guidelines (SP 800-73-3 compliance)

Special Pub 800-96.....PIV Card Reader Interoperability Guidelines  
 Special Pub 800-37.....Guide for Applying the Risk Management  
                     Framework to Federal Information Systems  
 Special Pub 800-96.....PIV Card Reader Interoperability Guidelines

- Special Pub 800-96.....PIV Card Reader Interoperability Guidelines
- Special Pub 800-104A....Scheme for PIV Visual Card Topography
- Special Pub 800-116.....Recommendation for the Use of PIV Credentials  
in Physical Access Control Systems (PACS)
- O. Institute of Electrical and Electronics Engineers (IEEE):
- C62.41.....IEEE Recommended Practice on Surge Voltages in  
Low-Voltage AC Power Circuits
- P. International Organization for Standardization (ISO):
- 7810.....Identification cards - Physical characteristics
- 7811.....Physical Characteristics for Magnetic Stripe  
Cards
- 7816-1.....Identification cards - Integrated circuit(s)  
cards with contacts - Part 1: Physical  
characteristics
- 7816-2.....Identification cards - Integrated circuit cards  
- Part 2: Cards with contacts -Dimensions and  
location of the contacts
- 7816-3.....Identification cards - Integrated circuit cards  
- Part 3: Cards with contacts - Electrical  
interface and transmission protocols
- 7816-4.....Identification cards - Integrated circuit cards  
- Part 11: Personal verification through  
biometric methods
- 7816-10.....Identification cards - Integrated circuit cards  
- Part 4: Organization, security and commands  
for interchange
- 14443.....Identification cards - Contactless integrated  
circuit cards; Contactless Proximity Cards  
Operating at 13.56 MHz in up to 5 inches  
distance
- 15693.....Identification cards -- Contactless integrated  
circuit cards - Vicinity cards; Contactless  
Vicinity Cards Operating at 13.56 MHz in up to  
50 inches distance
- 19794.....Information technology - Biometric data  
interchange formats
- Q. Uniform Federal Accessibility Standards (UFAS) 1984
- R. ADA Standards for Accessible Design 2010

S. Section 508 of the Rehabilitation Act of 1973

## 1.6 DEFINITIONS

- A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
- B. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.
- C. Access Control: A function or a system that restricts access to authorized persons only.
- D. API Application Programming Interface
- E. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels: [M-04-04]
  - 1. Level 1: LITTLE OR NO confidence
  - 2. Level 2: SOME confidence
  - 3. Level 3: HIGH confidence
  - 4. Level 4: VERY HIGH confidence
- F. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.
- G. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.
- H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).
- I. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.
- J. Biometric: An authenticator produced from measurable qualities of a living person.



- K. CAC EP - CAC End Point with end point PIV applet
- L. CAC NG - CAC Next Generation with transitional PIV applet
- M. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. [SP800-73] NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.
- N. CCTV: Closed-circuit television.
- O. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.
- P. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- Q. CPU: Central processing unit.
- R. Credential: Data assigned to an entity and used to identify that entity.
- S. File Server: A PC in a network that stores the programs and data files shared by users.
- T. FIPS Federal Information Processing Standards
- U. FRAC - First Responder Authentication Credential
- V. HSPD Homeland Security Presidential Directive
- W. I/O: Input/Output.
- X. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- Y. IEC International Electrotechnical Commission
- Z. ISO International Organization for Standardization
- AA. KB Kilobyte
- BB. kbit/s Kilobits / second
- CC. LAN: Local area network.
- DD. LED: Light-emitting diode.
- EE. Legacy CAC - Contact only Common Access Card with v1 and v2 applets

FF. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.

GG. NIST: National Institute of Standards and Technology

HH. PACS: Physical Access Control System

II. PC/SC: Personal Computer / Smart Card

JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.

KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).

LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.

MM. PIV: Personal Identification Verification

NN. PIV-I - PIV Interoperable credential

OO. PPS: Protocol and Parameters Selection

PP. RF: Radio frequency.

QQ. ROM: Read-only memory. ROM data are maintained through losses of power.

RR. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

SS. RS-485: An TIA/EIA standard for multipoint communications.

TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. TPDU: Transport Protocol Data Unit

VV. TWIC - Transportation Worker Identification Credential

WW. UPS: Uninterruptible power supply.

XX. Vcc: Voltage at the Common Collector

YY. WAN: Wide area network.

ZZ. WAV: The digital audio format used in Microsoft Windows.

AAA. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

#### **1.7 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

#### **1.8 MAINTENANCE & SERVICE**

- A. General Requirements
  - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.
- B. Description of Work
  - 1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

#### C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

#### D. Schedule of Work

1. The work shall be performed during regular working ours, Monday through Friday, excluding federal holidays. These inspections shall include:
  - a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
    - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
    - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

#### E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.

- a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
- b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

#### F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

#### G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

#### H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

#### I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications

made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

**1.9 PERFORMANCE REQUIREMENTS**

- A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.
- B. All processing of authentication information must occur on the "safe side" of a door
- C. Physical Access Control System shall provide access to following Security Areas:
  1. Controlled
  2. Limited
  3. Exclusion
- D. PACS shall provide:
  1. One authentication factor for access to Controlled security areas
  2. Two authentication factors for access to Limited security areas
  3. Three authentication factors for access to Exclusion security areas
- E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.

- F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:
1. Name chaining;
  2. Signature chaining;
  3. Certificate validity;
  4. Key usage, basic constraints, and certificate policies certificate extensions;
  5. Full CRLs; and
  6. CRLs segmented on names.
- H. Number of Locations: Support unlimited number of separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
1. Each Location shall have its own database and history in the Central Station. Locations may be combined to share a common database.
- I. Data Capacity:
1. 130 different card-reader formats.
  2. 999 comments.
  3. 16 graphic file types for importing maps.
- J. Location Capacity:
1. 24 reader-controlled doors.
  2. 50,000 total access credentials.
  3. 2048 supervised alarm inputs.
  4. 2048 programmable outputs.
  5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
- K. System Network Requirements:
1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
  2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
  3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.

- L. Central Station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central Station shall control system networks to interconnect all system components, including workstations and field-installed Controllers.
- M. Field equipment shall include Controllers, sensors, and controls. Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.
- N. System Response to Alarms: Field device network shall provide a system end-to-end response time of [1] second(s) or less for every device connected to the system. Alarms shall be annunciated at the Central Station within 1 second of the alarm occurring at a Controller or device controlled by a local Controller, and within 100 ms if the alarm occurs at the Central Station. Alarm and status changes shall be displayed within 100 ms after receipt of data by the Central Station. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console.
- O. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- P. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.



- Q. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- R. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.
- S. References to industry and trade association standards and codes are minimum installation requirement standards.
- T. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

#### **1.10 EQUIPMENT AND MATERIALS**

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
  - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.

2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

#### **1.11 WARRANTY OF CONSTRUCTION.**

- A. Warrant PACS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

#### **1.12 GENERAL REQUIREMENTS**

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- B. General requirements applicable to this section include:
  1. General Arrangement Of Contract Documents,
  2. Delivery, Handling and Storage,
  3. Project Conditions,
  4. Electrical Power,
  5. Lightning, Power Surge Suppression, and Grounding,
  6. Electronic Components,
  7. Substitute Materials and Equipment, and
  8. Like Items.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.
- B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
- C. PACS equipment shall meet or exceed all requirements listed below.
- D. A PACS shall be comprised of, but not limited to, the following components:

1. Physical Access Control System
2. Application Software
3. System Database
4. Surge and Tamper Protection
5. Standard Workstation Hardware
6. Communications Workstation
7. Controllers (Data Gathering Panel)
8. Secondary Alarm Annunciator
9. Keypads
10. Card Readers
11. Credential Cards
12. Biometric Identity Verification Equipment
13. Enrolment Center (To be provided in accordance with the VA PIV enrollment and issuance system.)
14. System Sensors and Related Equipment
15. Push Button Switches
16. Interfaces
17. Door and Gate Hardware interface
18. RS-232 ASCII Interface
19. Floor Select Elevator Control
20. After-Hours HVAC Control
21. Real Time Guard Tour
22. Video and Camera Control
23. Cables
24. Transformers

## **2.2 SECURITY MANAGEMENT SYSTEM (SMS)**

- A. Shall allow the configuration of an enrollment and badging, alarm monitoring, administrative, asset management, digital video management, intrusion detection, visitor enrollment, remote access level management, and integrated client workstations or any combination of all or some.
- B. Shall be expandable to support an unlimited number of individual module or integrated client workstations. All access control field hardware, including Data Gathering Panels(DGP), shall be connected to all physical access control system workstation on the network.
- C. Shall have the ability to compose, file, maintain, update, and print reports for either individuals or the system as follows.

1. Individual reports that consist of an employee's name, office location, phone number or direct extension, and normal hours of operation. The report shall provide a detail listing of the employee's daily events in relation to accessing points within a facility.
  2. System reports shall be able to produce information on a daily/weekly/monthly basis for all events, alarms, and any other activity associated with a system user.
- D. All reports shall be in a date/time format and all information shall be clearly presented. Shall be designed to allow it to work with any industry standard network protocol and topology listed below:
1. Transmission Control Protocol (TCP)/IP
  2. Novell Netware (IPX/SPX)
  3. Banyan VINES
  4. IBM LAN Server (NetBEUI)
  5. Microsoft LAN Manager (NetBEUI)
  6. Network File System (NFS) Networks
  7. Remote Access Service (RAS) via ISDN, x.25, and standard phone lines.
- E. Shall provide full interface and control of the PACS to include the following subsystems within the PACS:
1. Public Key Infrastructure
  2. Card Management
  3. Identity and Access Management
  4. Personal Identity Verification
- F. Shall have the following features or compatibilities:
1. The ability to be operated locally or remotely via a LAN, WAN, internet, or intranet.
  2. Event and Alarm Monitoring
  3. Database Partitioning
  4. Ability to fully integrate with all other security subsystems
  5. Enhanced Monitoring Station with Split Screen Views
  6. Alternate and Extended Shunt by Door
  7. Escort Management
  8. Enhanced IT-based Password Protection
  10. N-man Rule and Occupancy Restrictions
  11. Open Journal Data Format for Enhanced Reporting
  12. Automated Personnel Import

13. ODBC Support
14. Windows 2000 Professional, Windows Server 2003, Windows XP Professionals for Servers, Windows 7
15. Field-Level Audit Trail
16. Cardholder Access Events

### **2.3 APPLICATION SOFTWARE**

- A. System Software: Based on 32, Microsoft Windows central-station and workstation operating system and application software. Software shall have the following features:
  1. Multiuser multitasking to allow independent activities and monitoring to occur simultaneously at different workstations.
  2. Graphical user interface to show pull-down menus and a menu tree format.
  3. Capability for future additions within the indicated system size limits.
  4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.
  5. Password-protected operator and smart card login and access.
- B. Peer Computer Control Software: Shall detect a failure of a central computer, and shall cause the other central computer to assume control of all system functions without interruption of operation. Drivers shall be provided in both central computers to support this mode of operation.
- C. Application Software: Interface between the alarm annunciation and entry-control Controllers, to monitor sensors, operate displays, report alarms, generate reports, and help train system operators. Software shall have the following functions:
  1. Resides at the Central Station, workstations, and Controllers as required to perform specified functions.
  2. Operate and manage peripheral devices.
  3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.
  4. Import custom icons into graphics views to represent alarms and I/O devices.

5. Globally link I/O so that any I/O can link to any other I/O within the same Location, without requiring interaction with the host PC. This operation shall be at the Controller.
6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the Controller.
7. Messages from PC to Controllers and Controllers to Controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.
8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-Controller communications methods by changing the polling frequency and the amount of time the system waits for a response.
9. Automatic and encrypted backups for database and history backups shall be automatically stored at the central control PC and encrypted with a nine-character alphanumeric password, which must be used to restore or read data contained in backup.
10. Operator audit trail for recording and reporting all changes made to database and system software.

D. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.
2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as an autonomous intelligent processing unit. Controllers shall make decisions about physical access control, alarm monitoring, linking functions, and door locking schedules for its operation, independent of other system components. Controllers shall be part of a fully distributed processing control network. The portion of the database associated with a Controller and consisting of parameters, constraints, and the latest value or

status of points connected to that Controller, shall be maintained in the Controller.

2. Functions: The following functions shall be fully implemented and operational within each Controller:

- a. Monitoring inputs.
- b. Controlling outputs.
- c. Automatically reporting alarms to the Central Station.
- d. Reporting of sensor and output status to Central Station on request.
- e. Maintaining real time, automatically updated by the Central Station at least once a day.
- f. Communicating with the Central Station.
- g. Executing Controller resident programs.
- h. Diagnosing.
- i. Downloading and uploading data to and from the Central Station.

3. Controller Operations at a Location:

- a. Location: Up to 64 Controllers connected to RS-485 communications loop. Globally operating I/O linking and anti-passback functions between Controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the Central Station or workstations are off line.
- b. In the event of communications failure between the Central Station and a Location, there shall be no degradation in operations at the Controllers at that Location. The Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.
- c. Buffered events shall be handled in a first-in-first-out mode of operation.

4. Individual Controller Operation:

- a. Controllers shall transmit alarms, status changes, and other data to the Central Station when communications circuits are operable. If communications are not available, Controllers shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the Central Station, shall be stored for later transmission to the Central Station. Storage

capacity for the latest 1024 events shall be provided at each Controller.

- b. Card-reader ports of a Controller shall be custom configurable for at least [120] <Insert number> different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different Controllers or within the same Controller.
  - c. Controllers shall provide a response to card-readers or keypad entries in less than 0.25 seconds, regardless of system size.
  - d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to its proper working state. This shall happen without any operator intervention.
  - e. Initial Startup: When Controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each Controller.
  - f. Failure Mode: On failure for any reason, Controllers shall perform an orderly shutdown and force Controller outputs to a predetermined failure mode state, consistent with the failure modes shown and the associated control device.
  - g. Startup After Power Failure: After power is restored, startup software shall initiate self-test diagnostic routines, after which Controllers shall resume normal operation.
  - h. Startup After Controller Failure: On failure, if the database and application software are no longer resident, Controllers shall not restart, but shall remain in the failure mode until repaired. If database and application programs are resident, Controllers shall immediately resume operation. If not, software shall be restored automatically from the Central Station.
5. Communications Monitoring:
- a. System shall monitor and report status of RS-485 communications loop TCP/IP communication status of each Location.
  - b. Communication status window shall display which Controllers are currently communicating, a total count of missed polls since midnight, and which Controller last missed a poll.
  - c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM memory for each Controller.



6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the Central Station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:

1. Central-station or workstation communications shall use the following:
  - a. Direct connection using serial ports of the PC.
  - b. TCP/IP LAN network interface cards.
  - c. Dial-up modems for connections to Locations.
2. Serial Port Configuration: Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only"; or as an ASCII output port.
3. Multiport Communications Board: Use if more than two serial ports are needed.
  - a. Expandable and modular design. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32 or 64 serial ports.
  - b. Connect the first board to an internal PCI bus adapter card.
4. Direct serial, TCP/IP, and dial-up communications shall be alike in the monitoring or control of system, except for the connection that must first be made to a dial-up Location.
5. TCP/IP network interface card shall have an option to set the poll frequency and message response time-out settings.
6. PC-to-Controller and Controller-to-Controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications shall be verified and buffered and retransmitted if not acknowledged.

G. Direct Serial or TCP/IP PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-Controller communications link.
2. Loss of communications to any Controller shall result in an alarm at all PCs running the communications software.

3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the Controller.

H. Dial-up Modem PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-Controller communications link during dial-up modem connect times.
2. Communication software shall be programmable to routinely poll each of the remote dial-up modem Locations, collecting event logs and verifying phone lines at time intervals that are operator selectable for each Location.
3. System shall be programmable for dialing and connecting to all dial-up modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 60 minutes.
4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.
5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.
6. The Controller connected to a dial-up modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the Controller shall automatically initiate a call to the Central Station and upload all transactions.
7. Alarms shall be reported immediately.
8. Dial-up modems shall be provided by manufacturer of the system. Modems used at the Controller shall be powered by the Controller. Power to the modem shall include battery backup if the Controller is so equipped.

I. Controller-to-Controller Communications:

1. Controller-to-Controller Communications: RS-485, 4-wire, point-to-point, regenerative (repeater) communications network methodology.
2. RS-485 communications signal shall be regenerated at each Controller.

J. Database Downloads:

1. All data transmissions from PCs to a Location, and between Controllers at a Location, shall include a complete database

checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.

2. If a Controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the Controller to their normal working state and shall take place with no operator intervention.

K. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.
2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.
3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.
4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.
5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.
6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:
  - a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.
  - b. Maps to provide real-time display animation and allow for control of points assigned to them.
  - c. System to allow inputs, outputs, and override groups to be placed on different maps.
  - d. Software to allow changing the order or priority in which maps will be displayed.
7. Override Groups Containing I/Os:
  - a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.

- b. Icon shall change automatically to show the live summary status of points in that group.
  - c. Override group icon shall provide a method to manually control or set to time zone points in the group.
  - d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.
- 8. Schedule Overrides of I/Os and Override Groups:
  - a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.
  - b. Each schedule shall be composed of a minimum of two dates with separate times for each date.
  - c. The first time and date shall be assigned the override state that the point shall advance to, when the time and date become current.
  - d. The second time and date shall be assigned the state that the point shall return to, when the time and date become current.
- 9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.
- L. Operator Access Control:
  - 1. Control operator access to system controls through three password-protected operator levels. System operators and managers with appropriate password clearances shall be able to change operator levels for operators.
  - 2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.
  - 3. A minimum of 32 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.
  - 4. The password shall not be displayed or printed.
  - 5. Each password shall be definable and assignable for the following:

- a. Commands usable.
- b. Access to system software.
- c. Access to application software.
- d. Individual zones that are to be accessed.
- e. Access to database.

M. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.
2. Command inputs shall be acknowledged and processing shall start in not less than 1 second(s).
3. Tasks that are executed by operator's commands shall include the following:
  - a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.
  - b. Place Zone in Access: Used to remotely disable intrusion alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.
  - c. Place Zone in Secure: Used to remotely activate intrusion alarm circuits emanating from a specific zone.
  - d. System Test: Allows the operator to initiate a system-wide operational test.
  - e. Zone Test: Allows the operator to initiate an operational test for a specific zone.
  - f. Print reports.
  - g. Change Operator: Used for changing operators.
  - h. Security Lighting Controls: Allows the operator to remotely turn on/off security lights.
  - i. Display Graphics: Used to display any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.
  - j. Run system tests.
  - k. Generate and format reports.
  - l. Request help with the system operation.
    - 1) Include in main menus.

- 2) Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.
  - 3) Provide navigation to specific topic from within the first help window.
  - 4) Help shall be accessible outside the applications program.
- m. Entry-Control Commands:
- 1) Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.
  - 2) Arm or disarm each monitored input up to four times a day through time-zone programming.
  - 3) Enable or disable readers or keypads up to twice a day through time-zone programming.
  - 4) Enable or disable cards or codes up to four times per day per entry point through access-level programming.
4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:
- a. Command entered is incorrect or incomplete.
  - b. Operator is restricted from using that command.
  - c. Command addresses a point that is disabled or out of service.
  - d. Command addresses a point that does not exist.
  - e. Command is outside the system's capacity.
- N. Alarms:
1. System Setup:
    - a. Assign manual and automatic responses to incoming point status change or alarms.
    - b. Automatically respond to input with a link to other inputs, outputs, operator-response plans, unique sound with use of WAV files, and maps or images that graphically represent the point location.
    - c. 60-character message field for each alarm.
    - d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to zone.

- e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.
  - f. Allow 25 secondary messages with a field of 4 lines of 60 characters each.
  - g. Store the most recent 1000 alarms for recall by the operator using the report generator.
2. Software Tamper:
- a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.
  - b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond their authorization level.
  - c. Maintain a transcript file of the last 5000 commands entered at the each Central Station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.
  - d. Allow only acknowledgment of software tamper alarms.
3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.
4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.
5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.
6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.
7. Alarm Automation Interface: High-level interface to Central Station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in same manner as burglar alarms, using an RS-232 ASCII interface.

8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.
9. Camera Control: Provides operator ability to select and control cameras from graphic maps.
- O. Alarm Monitoring: Monitor sensors, Controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.
  1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.
  2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.
  3. Maps shall automatically display the alarm condition for each input assigned to that map, if that option is selected for that input location.
  4. Alarms initiate a status of "pending" and require the following two handling steps by operators:
    - a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."
    - b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.
  5. Each workstation shall display the total pending alarms and total unresolved alarms.
  6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.
  7. Alarms shall transmit to Central Station in real time, except for allowing connection time for dial-up locations.
  8. Alarms shall be displayed and managed from a minimum of four different windows.
    - a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.
    - b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.



- c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.
  - d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.
9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.
  10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.
  11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.
  12. Identical alarms from same alarm point shall be acknowledged at same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.
  13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and Controllers.
  14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.
- P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.
1. Color Code:
    - a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.
    - b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.
    - c. YELLOW: Advises operator that a zone is in access.
    - d. GREEN: Indicates that a zone is secure and that power is on.
  2. Graphics:
    - a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.
    - b. Allow I/O to be placed on graphic maps by the drag-and-drop method.

- c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on graphic map.
  - d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic map associated with inputs or outputs.
  - e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.
- Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.
- 1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.
- R. Report Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest priority activity. Report generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.
- 1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of period; and the default printer.
  - 2. Printing on Requests: An operator may request a printout of any report.
  - 3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm (such as door alarm, intrusion alarm, tamper alarm, etc.), the type of sensor, the location, the time, and the action taken.
  - 4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.
  - 5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.

6. Automatic History Reports: Named, saved, and scheduled for automatic generation.
7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.
8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.
9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.
10. Who Is In (Muster) Report:
  - a. Emergency Muster Report: One click operation on toolbar launches report.
  - b. Cardholder Report. Contain a count of persons that are "In" at a selected Location and a count with detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.
11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that they are available on-site at all times.
12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events or alarms only.
13. History Reports: Custom reports that allows the operator to select any date, time, event type, device, output, input, operator, Location, name, or cardholder to be included or excluded from the report.
  - a. Initially store history on the hard disk of the host PC.
  - b. Permit viewing of the history on workstations or print history to any system printer.
  - c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.
  - d. Each report shall depict the date, time, event type, event description, device, or I/O name, cardholder group assignment, and cardholder name or code number.
  - e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.

- f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.
- 14. Reports shall have the following four options:
  - a. View on screen.
  - b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to system.
  - c. "Save to File" with full path statement.
  - d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.
- 15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:
  - a. Active, inactive, or future activate or deactivate.
  - b. Code number, name, or imprinted card number.
  - c. Group, Location, access levels.
  - d. Start and stop code range.
  - e. Codes that have not been used since a selectable number of days.
  - f. In, out, or either status.
  - g. Codes with trace designation.
- 16. The reports of system database shall allow options so that every data field may be printed.
- 17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.
- S. Anti-Passback:
  - 1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.
  - 2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.

3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.
  4. Timed Anti-Passback: A Controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.
  5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at Controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.
  6. The anti-passback schemes shall be definable for each individual door.
  7. The Master Access Level shall override anti-passback.
  8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential holder population anti-passback status to a neutral status.
- T. Visitor Assignment:
1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only access levels that have been designated as approved for visitors.
  2. Provide an automated log of visitor name, time and doors accessed, and whom visitor contacted.
  3. Allow a visitor designation to be assigned to a credential holder.
  4. PACS shall be able to restrict the access levels that may be assigned to credentials that are issued to visitors.
  5. Allow operator to recall visitors' credential holder file, once a visitor is enrolled in the system.
  6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.
  7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

- V. Training Software: Enables operators to practice system operation including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.
- W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.
1. The enrollment station shall not have alarm response or acknowledgment functions.
  2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.
  3. The program shall provide means to disable the enrollment station when it is unattended to prevent unauthorized use.
  4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.
  5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:
    - a. MASK: Determines a specific format that data must comply with.
    - b. REQUIRED: Operator is required to enter data into field before saving.
    - c. UNIQUE: Data entered must be unique.
    - d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.
    - e. NAME ID: Data entered will be considered a unique ID for the cardholder.
  6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined

- user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.
7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.
  8. Batch card printing.
  9. Default card data can be programmed to speed data entry for sites where most card data are similar.
  10. Enhanced ACSII File Import Utility: Allows the importing of cardholder data and images.
- X. System Redundancy & High Availability: The system shall provide multiple levels of communications redundancy and failover for all PACS hosted controllers, digital video recorders, and client workstations. The PACS shall be capable of automatically re-routing communications to alternate computers across the system without operator intervention.
2. PACS system configuration with multiple regional application/database servers shall provide at a minimum the following redundancy and failover capability:
    - a) The PACS shall support the same level of communications redundancy and failover for network-attached devices per regional application/database server, allowable to span across regional application/database servers in the event of a regional application/database server failure.
    - b) In case of a regional application/database server failure, client workstations shall be able to failover to their designated backup regional application/database server to allow continuous system operations.
    - c) In case of a regional application/database server failure, upon server restoration, the ISMS shall automatically update and synchronize the regional application/database server.
    - d) Client workstations which transition to a backup regional application/database server, shall be able to be redirected back to their default regional application/database server, once the regional application/database server functions have been restored.

#### **2.4 SURGE AND TAMPER PROTECTION**

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power,

communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
  2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.
- B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

## **2.5 PACS SERVER HARDWARE**

- A. SMS Server Computer: Standard unmodified PC of modular design. The CPU word size shall be 64 bytes or larger; the CPU operating speed shall be at least 3.4 GHz.
1. Processor family: Intel® Xeon® E5640 (4 core, 2.66 GHz, 12MB L3, 80W).
  2. Number of processors: 2
  3. Memory: 12 GB RAM , expandable to a minimum of 192 GB without additional chassis or power supplies. Memory protection Mirrored Memory, Online Spare, Advanced ECC, Memory Lock Step Mode.
  4. Input/Output: 2 expansions slots, Network Controller (2) 1GbE NC382i Multifunction 4 Ports.
  5. Power Supply: Dual - minimum capacity of 460 W hot plug.
  6. Real-Time Clock:
    - a. Accuracy: Plus or minus 1 minute per month.
    - b. Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
    - c. Clock shall function for 1 year without power.
    - d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.



7. Serial Ports: Provide two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
8. Parallel Port: An enhanced parallel port.
9. The server shall have a 1 GB NIC or greater network card, rated at 100/1000 MB/sec.
10. The server shall have dual 100 GB hard disk drives at 7200 RPM.
11. The server shall have a CD / DVD combo drive.
12. The server operating system shall be either:
  - a. Windows 2003 Server, 32 bit native mode, with Service Pack 2 or later with default services enabled.
  - b. Windows XP Professional Service Pack 2 or later and default services enabled.
  - c. Windows 2008.
13. The Web Server shall be IIS 7.0 or better.
14. The Database shall be SQL Server 2005 (Express, Standard, Data Center, or Enterprise).
15. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.
16. Color Monitor: 17" or larger SVGA (1024 x 768) monitor with true color support. The server shall have a dedicated 256 MB SVGA accelerated video card with at least 64 MB onboard RAM.
17. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI X3.154.
18. Mouse: Standard, compatible with the installed software.
19. Special function keyboard attachments or special function keys to facilitate data input of the following operator tasks:
  - a. Help.
  - b. Alarm Acknowledge.
  - c. Place Zone in Access.
  - d. Place Zone in Secure.
  - e. System Test.
  - f. Print Reports.
  - g. Change Operator.
20. CD-ROM Drive:
  - a. Nominal storage capacity of 650 MB.
  - b. Data Transfer Rate: 1.2 Mbps.
  - c. Average Access Time: 150 ms.

- d. Cache Memory: 256 KB.
  - e. Data Throughput: 1 MB/second, minimum.
- 22. Report Printer:
  - a. Connected to the Central Station and designated workstations.
  - b. Laser printer with minimum resolution of 1200 dpi.
  - c. RAM: 2 MB, minimum.
  - d. Printing Speed: Minimum 12 pages per minute.
  - e. Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.
  - f. Interface: Bidirectional parallel and universal serial bus.
- B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real-time. If central computer fails, redundant computer shall assume control immediately and automatically.
- C. PACS controllers clustering shall support the following features:
  - 1. Assignment of Master and alternate master controllers for cluster communication to the SMS server
  - 2. Primary and backup communication paths to the SMS server
  - 3. Encrypted communications
  - 4. Up to 16 controllers per cluster
  - 5. Logical event linking between controllers in a cluster independent of SMS server communication
  - 6. Asynchronous communication via TCP/IP (Polled devices shall not be acceptable)
- D. UPS: Self-contained; complying with requirements in Division 26 Section "Static Uninterruptible Power Supply."
  - 1. Size: Provide a minimum of 4 hours of operation of the central-station equipment, including 2 hours of alarm printer operation.

## 2.6 STANDARD WORKSTATION HARDWARE

- A. Workstation shall consist of a standard unmodified PC, with accessories and peripherals that configure the workstation for a specific duty.
- B. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 MHz.

1. Memory: 256 MB of usable installed memory, expandable to a minimum of 1024 MB without additional chassis or power supplies.
2. Power Supply: Minimum capacity of 250 W.
3. Real-Time Clock:
  - a. Accuracy: Plus or minus 1 minute per month.
  - b. Time Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.
  - c. Provide automatic time correction once every 24 hours by synchronizing clock with the Central Station.
4. Serial Ports: Provide two RS-232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.
5. Parallel Port: An enhanced parallel port.
6. LAN Adapter Card: 10/100 Mbps PCI bus, internal network interface card.
7. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.
8. Color Monitor: Not less than 17 inches (430 mm), with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.
9. Keyboard: With a minimum of 64 characters, standard ASCII character set based on ANSI X3.154.
10. Mouse: Standard, compatible with the installed software.
11. Disk storage shall include the following, each with appropriate controller:
  - a. Minimum 10 GB hard disk, maximum average access time of 10 ms.
12. CD-ROM Drive:
  - a. Nominal storage capacity of 650 MB.
  - b. Data Transfer Rate: 1.2 Mbps.
  - c. Average Access Time: 150 ms.
  - d. Cache Memory: 256 KB.
  - e. Data Throughput: 1 MB/second, minimum.
13. Printer:
  - a. Connected to the Central Station and designated workstations.
  - b. Laser printer with minimum resolution of 600 dpi.
  - c. RAM: 2 MB, minimum.
  - d. Printing Speed: Minimum 12 pages per minute.

- e. Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.
- 14. Interface: Bidirectional parallel, and universal serial bus.
- 15. LAN Adapter Card: 10/100 Mbps internal network interface card.
- C. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and automatically.
- D. UPS: Self-contained, complying with requirements in Division 26 Section "Static Uninterruptible Power Supply."
  - 1. Size: Provide a minimum of 6 hours of operation of the central-station equipment, including 2 hours of alarm printer operation.
  - 2. Batteries: Sealed, valve regulated, recombinant, lead calcium.
  - 3. Accessories:
    - a. Transient voltage suppression.
    - b. Input-harmonics reduction.
    - c. Rectifier/charger.
    - d. Battery disconnect device.
    - k. Remote battery monitoring.

## **2.7 COMMUNICATIONS WORKSTATION (NOT USED)**

## **2.8 CONTROLLERS**

- A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the Central Station or workstation for controlling its operation.
- B. Subject to compliance with requirements in this Article, manufacturers may use multipurpose Controllers.
- C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.
- D. Alarm Annunciation Controller:
  - 1. The Controller shall automatically restore communication within 10 seconds after an interruption with the field device network[ with dc line supervision on each of its alarm inputs].

- a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.
- b. Alarm-Line Supervision:
  - 1) Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.
  - 2) Transmit alarm-line-supervision alarm to the Central Station during the next interrogation cycle after the abnormal current condition.
- c. Outputs: Managed by Central Station software.
- 2. Auxiliary Equipment Power: A GFI service outlet inside the Controller enclosure.
- E. Entry-Control Controller:
  - 1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators, and exit push-buttons.
    - a. Operate as a stand-alone portal Controller using the downloaded database during periods of communication loss between the Controller and the field-device network.
    - b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:
      - 1) On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.
      - 2) Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control.
    - c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal

by the presentation of credentials or other identifying information.

2. Inputs:

- a. Data from entry-control devices; use this input to change modes between access and secure.
- b. Database downloads and updates from the Central Station that include enrollment and privilege information.

3. Outputs:

- a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.
  - b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion alarm annunciation from sensors stimulated by authorized entries.
  - c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the Central Station.
  - d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.
4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.
5. Data Line Problems: For periods of loss of communications with Central Station, or when data transmission is degraded and generating continuous checksum errors, the Controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.
- a. Store up to 1000 transactions during periods of communication loss between the Controller and access-control devices for subsequent upload to the Central Station on restoration of communication.

## **2.9 PIV MIDDLEWARE**

- A. PIV Middleware shall provide three-factor authentication, including biometric matching using a fingerprint capture device capable of single fingerprint capture. Unit shall enable digital certificates can to be verified by security personnel using the issuer's certificate authority, SCVP, OCSP responder/repeater, or the TSA hot list for TWIC cardholders. All cards shall be validated using FIPS-201 challenge-

response protocol in order to identify forged or cloned cards. PIV Middleware solution shall validate all PIV, TWIC, NG CAC, and FRAC cards. TWIC card FASC-Ns shall also be verified against a live or cached TSA hot list.

B. PIV Middleware shall have ability to:

1. Verify cardholder identity and validates FIPS 201-compliant PIV-II, next-generation (NG) CAC, TWIC, or FRAC credentials in real-time
2. Perform three-factor authentication of cardholder using PIN, biometrics, and certificate (or serial numbers) detecting forged or cloned cards
3. Enroll FASC-N, photo, and pertinent cardholder information into PACS software
4. Automatically suspend a cardholder's badge if his or her PIV, TWIC, or CAC card certificate serial number is on the Certificate Revocation List (CRL)
5. Upload a cardholder transaction audit trail to central database or exports it to a .csv file for centralized transaction management
6. Be compatible with biometric mobile terminal for off-site verification and enrollment
7. Re-validate imported cardholder certificates on a periodic basis via the Internet
8. Operate with commercial, off-the-shelf (COTS) FIPS 201 PIV-II and ANSI INCITS 378-compliant fingerprint capture devices
9. Revalidate imported cardholder certificates at regular intervals, ensuring that the credentials used in PACS system are backed by a valid set of digital certificates. Digital certificates are verified against local OCSP repeater/validation authority using the issuer's validation authority, or Microsoft Crypto Application Programming Interface (API) on Windows XP SP3 or Vista.
10. Certificate Manager shall fully support SCVP and OCSP for fast, online validation.
11. Provide verification of TWIC credentials against a live TSA hot list.
12. Support uploading local transactions to a central database for consolidated activity reporting. This application shall support a variety of ODBC- or ADO-compliant databases, including Oracle, SQL Server 2005, Informix, DB2, and Firebird.

13. Provide user with ability to produce canned transaction log queries as well as creating queries directly from the SQL database.

C. PIV Middleware PC requirements:

1. PIV Middleware software shall operate on Intel-based PC with minimum 1.8 GHz CPU, 1 GB RAM, 40 GB hard disk, and Microsoft Windows XP SP2 with Microsoft .NET Framework 2.0
2. Unit shall fingerprint capture devices and smart card reader.

D. PIV Middleware shall be FIPS 201 approved product.

## 2.10 CARD READERS

A. Power: Card reader shall be powered from its associated Controller, including its standby power source.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.
2. Indoors, uncontrolled environment.
3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: LED or other type of visual indicator display shall provide visual[ and audible] status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.

F. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.

G. Shall be individually home run to the main panel.

H. Shall be installed in a manner that they comply with:

1. The Uniform Federal Accessibility Standards (UFAS)
2. The Americans with Disabilities Act (ADA)
3. The ADA Standards for Accessible Design



- I. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, card and/or biometrics, card and/or pin and/or biometrics, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201, and is ISO 14443 A or B, ISO/IEC 7816 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.
- J. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.
- K. Shall contain read head electronics, and a sender to encode digital door control signals.
- L. LED's shall be utilized to indicate card reader status and access status.
- M. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked), which will go in effect during loss of communication with the main control panel.
- N. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide tactile audible feedback.
- O. Shall have a minimum of two programmable inputs and two programmable outputs.
- P. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:
  - 1. Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Communications protocol shall be compatible with the local processor.
- Q. Shall include a Light Emitting Diode (LED) or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus five (5) degrees or less off a vertical plane perpendicular to the plane of the

face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

1. Shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.
2. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
3. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
4. Shall provide a means for users to indicate a duress situation by entering a special code.

R. PIV Contact Card Reader

1. Application Protocol Data Unit (APDU) Support: At a minimum, the contact interface shall support all card commands for contact based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
2. Buffer Size: The reader must contain a buffer large enough to receive the maximum size frame permitted by International Organization for Standardization International Electrotechnical Commission (ISO/IEC) 7816-3:1997, Section 9.4.
3. Programming Voltage: PIV Readers shall not generate a Programming Voltage.
4. Support for Operating Class: PIV Readers shall support cards with Class A Vccs as defined in ISO/IEC 7816-3:1997 and ISO/IEC 7816-3:1997/Amd 1:2002.
5. Retrieval Time: Retrieval time<sup>1</sup> for 12.5 kilobytes (KB) of data through the contact interface of the reader shall not exceed 2.0 seconds.
6. Transmission Protocol: The PIV Reader shall support both the character-based T=0 protocol and block-based T=1 protocol as defined in ISO/IEC 7816-3:1997.
7. Support for PPS Procedure: The reader shall support Protocol and Parameters Selection (PPS) procedure by having the ability to read

character TA1 of the Answer to Reset (ATR) sent by the card as defined in ISO/IEC 7816-3:1997.

S. Contactless Smart Cards and Readers

1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
2. The readers shall have "flash" download capability to accommodate card format changes.
3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
4. The card reader shall be contactless and meet or exceed the following technical characteristics:
  - a. Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 - 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 - 232 bits. All Wiegand formats or the upgradeability from Low to Medium Levels can be field configured with the use of a command card.
  - b. FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.
  - c. Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1" to 2" (2.5 - 5 cm).
  - d. APDU Support: At a minimum, the contactless interface shall support all card commands for contactless based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
  - e. Buffer Size: The reader shall contain a buffer large enough to receive the maximum size frame permitted by ISO/IEC 7816-3, Section 9.4.
  - f. ISO 14443 Support: The PIV Reader shall support parts (1 through 4) of ISO/IEC 14443 as amended in the References of this publication.
  - g. Type A and B Communication Signal Interfaces: The contactless interface of the reader shall support both the Type A and Type B communication signal interfaces as defined in ISO/IEC 14443-2:2001.

- h. Type A and B Initialization and Anti-Collision The contactless interface of the reader shall support both Type A and Type B initialization and anti-collision methods as defined in ISO/IEC 14443-3:2001.
- i. Type A and B Transmission Protocols: The contactless interface of the reader shall support both Type A and Type B transmission protocols as defined in ISO/IEC 14443-4:2001.
- j. Retrieval Time: Retrieval time for 4 KB of data through the contactless interface of the reader shall not exceed 2.0 seconds.
- k. Transmission Speeds: The contactless interface of the reader shall support bit rates of fc/128 (~106 kbits/s), fc/64(~212 kbits/s), and configurable to allow activation/deactivation.
- l. Readability Range: The reader shall not be able to read PIV card more than 10cm(4inch) from the reader

## **2.11 KEYPADS**

- A. Designed for use with unique combinations of alphanumeric and other symbols as an Identifier. Keys of keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in random scrambled order. Communications protocol shall be compatible with Controller.
  - 1. Keypad display or enclosure shall limit viewing angles of the keypad as follows:
    - a. Maximum Horizontal Viewing Angle: 5 degrees or less off in either direction of a vertical plane perpendicular to the plane of the face of the keypad display.
    - b. Maximum Vertical Viewing Angle: 15 degrees or less off in either direction of a horizontal plane perpendicular to the plane of the face of the keypad display.
  - 2. Duress Codes: Provide duress situation indication by entering a special code.

## **2.12 CREDENTIAL CARDS**

- A. Personal Identity Verification (PIV) credential cards shall comply to Federal Information Processing Standards Publication (FIPS) 201.
- B. Visual Card Topography shall be compliant with NIST 800-104.
- C. PIV logical credentials shall contain multiple data elements for the purpose of verifying the cardholder's identity at graduated assurance levels. These mandatory data elements shall collectively comprise the data model for PIV logical credentials, and include the following:

1. CHUID

2. PIN

- D. The credential card (PIV) shall be an ISO 14443 type smart card with contactless interface that operates at 13.56 MHZ.

### **2.13 SYSTEM SENSORS AND RELATED EQUIPMENT**

- A. The PACS (Physical Access Control System) and related Equipment provided by the Contractor shall meet or exceed the following performer specifications:

- B. Request to Exit Detectors:

1. Passive Infrared Request to Exit Motion Detector (REX PIR) (1) The Contractor shall provide a surface mounted motion detector to signal the physical access control system request to exit input. The motion detector shall be a passive infrared sensor designed for wall or ceiling mounting 2134 to 4572 mm (7 to 15 ft) height. The detector shall provide two (2) form "C" (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads. The detectors relays shall be user adjustable with a latch time from 1-60 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion. The detection pattern shall be adjustable plus or minus fourteen ( $\pm 14$ ) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50 watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.

- E. Crash Bar:

1. Emergency Exit with Alarm (Panic):
  - a. Entry control portals shall include panic bar emergency exit hardware as designed.
  - b. Panic bar emergency exit hardware shall provide an alarm shunt signal to the PACS and SMS.

- c. The panic bar shall include a conspicuous warning sign with one (1) inch (2.5 cm) high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.
  - d. Operation of the panic bar hardware shall generate an intrusion alarm that reports to both the SMS and Intrusion Detection System. The use of a micro switch installed within the panic bar shall be utilized for this.
  - e. The panic bar shall utilize a fully mechanical connection only and shall not depend upon electric power for operation.
  - f. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.I.9 for key-bypass specifications.
  - g. Normal Exit:
    - 1) Entry control portals shall include panic bar non-emergency exit hardware as designed.
    - 2) Panic bar non-emergency exit hardware shall be monitored by and report to the SMS.
    - 3) Operation of the panic bar hardware shall not generate a locally audible or an intrusion alarm within the IDS.
    - 4) When exiting, the panic bar shall depend upon a mechanical connection only. The exterior, non-secure side of the door shall be provided with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the SMS.
    - 5) The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.I.9 for key-bypass specifications. The strikes/bolts shall include a micro switch to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system in the event the door is left open or accessed without the identification credentials.
- F. Key Bypass:
- 1. Shall be utilized for all doors that have a mortise or rim mounted door hardware.

2. Each door shall be individually keyed with one master key per secured area.
3. Cylinders shall be six (6)-pin and made of brass or equivalent. Keys for the cylinders shall be constructed of solid material and produced and cut by the same distributor. Keys shall not be purchased, cut, and supplied by multiple dealers.
4. All keys shall have a serial number cut into the key. No two serial numbers shall be the same.
5. All keys and cylinders shall be stored in a secure area that is monitored by the Intrusion Detection System.

G. Automatic Door Opener and Closer:

1. Shall be low energy operators.
2. Door closing force shall be adjustable to ensure adequate closing control.
3. Shall have an adjustable back-check feature to cushion the door opening speed if opened violently.
4. Motor assist shall be adjustable from 0 to 30 seconds in five (5) second increments. Motor assist shall restart the time cycle with each new activation of the initiating device.
5. Unit shall have a three-position selector mode switch that shall permit unit to be switched "ON" to monitor for function activation, switched to "H/O" for indefinite hold open function or switched to "OFF," which shall deactivate all control functions but will allow standard door operation by means of the internal mechanical closer.
6. Door control shall be adjustable to provide compliance with the requirements of the Americans with Disabilities Act (ADA) and ANSI standards A117.1.
7. All automatic door openers and closers shall:
  - a. Meet UL standards.
  - b. Be fire rated.
  - c. Have push and go function to activate power operator or power assist function.
  - d. Have push button controls for setting door close and door open positions.
  - e. Have open obstruction detection and close obstruction detection built into the unit.

- f. Have door closer assembly with adjustable spring size, back-check valve, sweep valve, latch valve, speed control valve and pressure adjustment valve to control door closing.
- g. Have motor start-up delay, vestibule interface delay; electric lock delay and door hold open delay up to 30 seconds. All operators shall close door under full spring power when power is removed.
- h. Are to be hard wired with power input of 120 VAC, 60Hz and connected to a dedicated circuit breaker located on a power panel reserved for security equipment.

H. Door Status Indicators:

- 1. Shall monitor and report door status to the SMS.
- 2. Door Position Sensor:
  - a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
  - b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
  - c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
  - d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
  - e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

**2.14 PUSH BUTTON SWITCHES**

- A. Push-Button Switches: Momentary-contact back-lighted push buttons, with stainless-steel switch enclosures.
  - 1. Electrical Ratings:
    - a. Minimum continuous current rating of 10 A at 120 V ac or 5 A at 240-V ac.
    - b. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.



2. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.
3. Enclosures shall additionally be suitable for installation in the following locations:
  - a. Indoors, controlled environment.
4. Power: Push-button switches shall be powered from their associated Controller, using dc control.

## **2.15 PORTAL CONTROL DEVICES**

- A. Shall be used to assist the PACS.
- B. Such devices shall:
  1. Provide a means of monitoring the doors status.
  2. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
  3. Provide a means of override to the PACS via a keypad or key bypass.
  4. Assist door operations utilizing automatic openers and closures.
  5. Provide a secondary means of access to a space via a keypad.
- C. Shall be connected to and monitored by the main PACS panel.
- D. Shall be installed in a manner that they comply with:
  1. The Uniform Federal Accessibility Standards (UFAS)
  2. The Americans with Disabilities Act (ADA)
  3. The ADA Standards for Accessible Design
- E. Shall provide a secondary means of physical access control within a secure area.
- F. Push-Button Switches:
  1. Shall be momentary contact, back lighted push buttons, and stainless steel switch enclosures for each push button as shown. Buttons are to be utilized for secondary means of releasing a locking mechanism.
    - a. In an area where a push button is being utilized for remote access of the locking device then no more than two (2) buttons shall operate one door from within one secure space. Buttons will not be wired in series with one other.
    - b. In an area where locally stationed guards control entry to multiple secure points via remote switches. An interface board shall be designed and constructed for only the amount of buttons it shall house. These buttons shall be flush mounted and clearly labeled for ease of use. All buttons shall be connected to the PACS and SMS system for monitoring purposes.

- c. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

G. Entry Control Devices:

1. Shall be hardwired to the PACS main control panel and operated by either a card reader or a biometric device via a relay on the main control panel.
2. Shall be fail-safe in the event of power failure to the PACS system.
3. Shall operate at 24 VCD, with the exception of turnstiles and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two doors simultaneously without error to the system or overload the power supply unit.
4. Shall have a diode or metal-oxide varistor (MOV) to protect the controller and power supply from reverse current surges or back-check.
5. Electric Strikes/Bolts: Shall be:
  - a. Made of heavy-duty construction and tamper resistant design.
  - b. Tested to over one million cycles.
  - c. Rated for a minimum of 1000 lbs. holding strength.
  - d. Utilize an actuating solenoid for the strike/bolt. The solenoid shall move from fully open to fully closed position and back in not more than 500 milliseconds and be rated for continuous duty.
  - e. Utilize a signal switch that will indicate to the system if the strike/bolt is not engaged or is unlocked when it should be secured.
  - f. Flush mounted within the door frame.
6. Electric Mortise Locks: Shall be installed within the door and an electric transfer hinge shall be utilized to allow the wires to be transferred from the door frame to the lock. If utilized with a double door then the lock shall be installed inside the active leaf. Electric Mortise Locks shall:
  - a. These locks shall be provided and installed by the Division 8 "DOOR HARDWARE" Contractor.
  - b. Have integrated Request to Exit switch for doors receiving physical access control devices.
  - b. Provide integration of the Electric Mortise Locks with the PACS for:
    - 1) Lock Power

2) Request to Exit switch.

7. Electromagnetic Locks:

- a. These locks shall be without mechanical linkage utilizing no moving parts, and securing the door to its frame solely on electromagnetic force.
- b. Shall be comprised of two pieces, the mag-lock and the door plate. The electromagnetic locks shall be surface mounted to the door frame and the door plate shall be surface mounted to the door.
- c. Ensure a diode is installed in line with the DC voltage supplying power to the unit in order to prevent back-check on the system when the electromagnetic lock is powered.
- d. Shall utilize a magnetic bonding sensor (MBS) to monitor the door status and report that status to the SMS.
- e. Electromagnetic locks shall meet the following minimum technical characteristics:

Operating Voltage		24 VDC
Current Draw		.5A
Holding Force	Swing Doors	675 kg (1500 lbs)
	Sliding Doors	225 kg (500 lbs)

8. Turnstiles:

- a. Shall operate at 110 VAC, 60 Hz or 220 VAC, 50 Hz supplied from a dedicated circuit breaker on a security power panel. This device does not require a back-up power source.
- b. Shall be utilized as a means of monitoring and controlling access in a lobby.
- c. Shall meet the following minimum requirements:
  - 1) Be UFAS compliant.
  - 2) Provide either an audible or visual confirmation that access has been granted to a cleared individual.
  - 3) Provide an audible alarm in the event a non-cleared individual is attempting to gain access.
  - 4) Interface with the SMS and utilize a card reader for accessing and exiting a facility, and provide a recorded event of personnel accessing these points.
  - 5) Have a built-in step-down transformer to provide power to a card reader unit.

- 6) Have built-in signal wiring chassis to allow for plug and play capabilities with the PACS.
- 7) Have the ability to detect tailgating within one quarter on an inch to prevent unauthorized access to a facility.

## 2.16 SECONDARY ALARM ANNUNCIATOR

- A. Secondary Alarm Annunciation Site: A workstation with limited I/O capacity, consisting of a secondary alarm annunciation workstation to allow the operator to duplicate functions of the main operator interface, and to show system status changes.

## 2.17 INTERFACES

- A. CCTV System Interface
  1. An RS232 [Ethernet] interface associated driver, and controller shall be provided for connection of the SMS Central Computer to the CCTV Alarm interface and switcher. The interface shall provide alarm data to the CCTV Alarm interface for automatic camera call-up. If required the Security Contractor shall be responsible for programming the command strings into the SMS Server.
- B. Intercom System Interface
  1. The CCTV call-up from intercom stations shall be through the intercom unit via RS232 [Ethernet] communications interface to the SMS system, then through the matrix switcher.
    - a. Application Software
      - 1) Provides the interface between the Alarm Annunciation System and Operator; all sensors, local processors and data links, drive displays, report alarms, and report generation.
      - 2) Software is categorized as System Software and Application Software. System Software must consist of software to support set-up, operation, hard drive back-ups and maintenance processor. Application Software must consist of software to provide the completion of Physical Access Control System.
- C. Power Supplies:
  1. Shall be UL rated and able to adequately power (enter number) entry control devices on a continuous base without failure.
  2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ (enter amperage)A
-------------	---------------------------------

OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to <__> Ah
OUTPUT CURRENT	[10] amp max. [@ 13.8] VDC [5] amp max. [@ 27.6] VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)
BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

## 2.18 FLOOR SELECT ELEVATOR CONTROL (NOT USED)

## 2.19 AFTER-HOURS HVAC CONTROL

- A. After-Hours HVAC Control: Provide for any credential read to activate or control individual HVAC zones based on access level. This control module shall control and record the after-hours use of the heating and cooling system in zones or tenant space.
1. This control shall give the administrator the ability to determine how much extra energy consumption each tenant is responsible for. This information can be used in billing tenants for the extra after-hour usage.
  2. At the specified time every day, the HVAC shall automatically go into its after-hours mode. It shall then revert into its normal business hours mode by a tenant using an access code or card at a designated keypad or reader.
  3. Once enabled, the tenant's HVAC zone shall be under thermostat control for a preset amount of time. When the preset amount of time elapses, the HVAC for that zone shall revert back to after-hours mode unless a tenant uses his/her code or card again. This shall continue until the unit automatically returns to its normal business hours operation.
- B. Control module activates the HVAC system after a valid access by any of three methods; however, the HVAC control shall always allow for manual override from the PC.
1. By time expiration after access of an adjustable period from 1 second to 546 minutes (9.1 hours).
  2. By use of the card or code again at the same or different reader or keypad.

3. By system returning to its normal business hours operation.
- C. After-hours HVAC control shall operate with all other features running simultaneously and use the central-station PC that controls access for the building but shall not rely on the host PC for any HVAC control decisions.

## **2.20 REAL TIME GUARD TOUR (NOT USED)**

## **2.21 VIDEO AND CAMERA CONTROL**

- A. Control station or designated workstation displays live video from a CCTV source.
  1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
  2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.
  3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.
- B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.
- C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

## **2.22 WIRES AND CABLES**

- A. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- C. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  1. NFPA 70, Type CMP.
  2. Flame Resistance: NFPA 262 Flame Test.

- F. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
  - 1. NFPA 70, Type CMP.
  - 2. Flame Resistance: NFPA 262 Flame Test.
- G. Multiconductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
  - 1. NFPA 70, Type CMG.
  - 2. Flame Resistance: UL 1581 Vertical Tray.
  - 3. For TIA/EIA-RS-232 applications.
- I. Paired Readers and Wiegand Keypads Cable: Paired, 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  - 1. NFPA 70, Type CM.
  - 2. Flame Resistance: UL 1581 Vertical Tray.
- K. Plenum-Type, Multiconductor, Readers and Keypads Cable: 6 conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
  - 1. NFPA 70, Type CMP.
  - 2. Flame Resistance: NFPA 262 Flame Test.
- M. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
  - 1. NFPA 70, Type CMP.
  - 2. Flame Resistance: NFPA 262 Flame Test.
- Q. Plenum-Type, Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
  - 1. NFPA 70, Type CMP.

- 2. Flame Resistance: NFPA 262 Flame Test.
- S. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
  - 1. NFPA 70, Type CMP.
  - 2. Flame Resistance: NFPA 262 Flame Test.
- U. LAN (Ethernet) Cabling: Comply with Division 28 Section "Conductors and Cables for Electronic Safety and Security."

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

### **3.2 CURRENT SITE CONDITIONS**

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

### **3.3 EXAMINATION**

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations,



installation tolerances, hazards to cable installation, and other conditions affecting installation.

- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 PREPARATION**

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
  - 1. Record setup data for control station and workstations.
  - 2. For each Location, record setup of Controller features and access requirements.
  - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
  - 4. Set up groups, linking, and list inputs and outputs for each Controller.
  - 5. Assign action message names and compose messages.
  - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
  - 7. Prepare and install alarm graphic maps.
  - 8. Develop user-defined fields.
  - 9. Develop screen layout formats.
  - 10. Propose setups for guard tours and key control.
  - 11. Discuss badge layout options; design badges.
  - 12. Complete system diagnostics and operation verification.
  - 13. Prepare a specific plan for system testing, startup, and demonstration.
  - 14. Develop acceptance test concept and, on approval, develop specifics of the test.
  - 15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.

- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

### **3.5 CABLING**

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."
- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
- F. Install cables without damaging conductors, shield, or jacket.
- G. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- H. Install end-of-line resistors at the field device location and not at the Controller or panel location.

### **3.6 CABLE APPLICATION**

- A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).
- E. Card Readers and Keypads:
  - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
  - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).

3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed 250 feet (75 m).
- G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of 25 feet (8 m).

### 3.7 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
  1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
  2. Bus: Mount on wall of main equipment room with standoff insulators.
  3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

### 3.8 INSTALLATION

- A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated

with all associated security subsystems, whether the system is a stand alone or a network.

E. For integration purposes, the PACS shall be integrated where appropriate with the following associated security subsystems:

1. CCTV:

- a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings. As well as all emergency exits utilizing a fixed color camera.
- b. Be able to monitor, control and record cameras on a 24 hours basis.
- c. Be programmed automatically call up a camera when an access point is but into an alarm state.
- d. For additional PACS system requirements as they relate to the CCTV, refer to Section 28 23 00, VIDEO SURVEILLANCE.

2. IDS:

- a. Be able monitor door control sensors.
- b. Be able to monitor and control the IDS on a 24 hours basis.
- c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the operator via an audible alarm.
- d. For additional PACS system requirements as they relate to the IDS, refer to Section 28 16 11, INTRUSION DETECTION SYSTEM.

3. Security Access Detection:

- a. Be able to monitor all objects that have been screened with an x-ray machine and be able to monitor all data acquired by the bomb detection unit.
- b. For additional PACS system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.

4. EPPS:

- a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
- b. For additional PACS requirements as they relate to the EPPS, refer to Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM.

F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.

- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.
- H. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment:
1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
  3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.

4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
  5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- M. Control Panels:
1. Connect power and signal lines to the controller.
  2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.
- N. SMS:
1. Coordinate with the VA agency's IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only authorized VA personnel have access to the system.
  2. Program and set-up the SMS to ensure it is in fully operation.
- O. Card Readers:
1. Connect all signal inputs and outputs as shown and specified.
  2. Terminate input signals as required.
  3. Program and address the reader as per the design package.

4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

P. Biometrics:

1. Connect all signal input and output cables along with all power cables.
2. Program and ensure the device is in operating order.

Q. Portal Control Devices:

1. Install all signal input and output cables as well as all power cables.
2. Devices shall be surface or flush mounted as per the design package.
3. Program all devices and ensure they are working.

R. Door Status Indicators:

1. Install all signal input and output cables as well as all power cables.
2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door, or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

S. Entry Control Devices:

1. Install all signal input and power cables.
2. Strikes and bolts shall be mounted within the door frame.
3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.

T. System Start-Up:

1. The Contractor shall not apply power to the PACS until the following items have been completed:
  - a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
  - b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

- c. System wiring has been tested and verified as correctly connected as indicated.
- d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
- e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
- 2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
- 3. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

U. Supplemental Contractor Quality Control:

- 1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.
- 2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
- 3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
- 4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

### **3.9 SYSTEM SOFTWARE**

- A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

### **3.10 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.



C. Perform the following field tests and inspections and prepare test reports:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

### **3.11 PROTECTION**

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

### **3.12 COMMISSIONING**

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to related sections for contractor responsibilities for system commissioning.

**3.13 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications.
- C. Develop separate training modules for the following:
  - 1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.
  - 2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
  - 3. Security personnel.
  - 4. Hardware maintenance personnel.
  - 5. Corporate management.
- D. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.

-----END-----

**SECTION 28 13 16**  
**PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operation Physical Access Control Database Management System, hereinafter referred to as the PACMS.
- B. This Section includes a Physical Security Access System Database Management consisting of database management software. Requirements for hardware supporting database management are described in Section 28 13 00 PHYSICAL ACCESS CONTROL, Part 2.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- C. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- D. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS. Requirements for grounding and bonding.
- E. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- G. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system.
- I. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- J. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- K. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

**1.3 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the Access Control System and Database Management as shown. The Contractor shall also provide certification as required.

- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. The manufacturers of all hardware and software components employed in the SMS shall be established vendors to the access control/security monitoring industry for no less than five (5) years and shall have successfully implemented at least 5 systems of similar size and complexity.
- E. Contractor / Integrator Qualifications
  - 1. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems and have a proven track record with similar systems of the same size, scope, and complexity.
  - 2. The security system integrator shall supply information attesting to the fact that their firm is an authorized product integrator certified with the SMS. A minimum of one technician shall be a installer certified by the SMS manufacturer.
  - 3. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained and certified personnel capable of maintaining the system and providing reasonable service time.
  - 4. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.
  - 5. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for these systems.
- F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four

hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.4 SUBMITTALS**

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 02 41 00, DEMOLITION.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220mm x 1220mm); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
  - 1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).

- e. Identify all pull box and conduit locations, sizes, and fill capacities.
  - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
    - a. Indicate the sequence of operation.
    - b. Relationship of integrated components on one diagram.
    - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
    - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
  4. A system drawing for each applicable security system shall:
    - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
    - b. Provide full detail of all system components wiring from point-to-point.
    - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
    - d. Show device locations that correspond to the floor plans.
    - e. All general and drawing specific notes shall be included with the system drawings.
  5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
    - a. Device ID.
    - b. Device Location (e.g. site, building, floor, room number, location, and description).
    - c. Mounting type (e.g. flush, wall, surface, etc.).
    - d. Power supply or circuit breaker and power panel number.
    - e. In addition, for the CCTV Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
  6. Detail and elevation drawings for all devices that define how they were installed and mounted.

- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
  - 1. 35 percent
  - 2. 65 percent
  - 3. 90 percent
  - 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS.

#### 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/ Security Industry Association (SIA):
  - AC-03.....Access Control: Access Control Guideline  
Dye Sublimation Printing Practices for  
PVC Access Control Cards
  - TVAC-01.....CCTV to Access Control Standard - Message  
Set for System Integration
- C. American National Standards Institute (ANSI)/ International Code Council (ICC):
  - A117.1.....Standard on Accessible and Usable  
Buildings and Facilities
- D. Department of Justice American Disability Act (ADA)
  - 28 CFR Part 36.....2010 ADA Standards for Accessible Design
- E. Federal Communications Commission (FCC):

- (47 CFR 15) Part 15.....Limitations on the Use of Wireless  
Equipment/Systems
- F. Government Accountability Office (GAO):  
GAO-03-8-02Security.....Responsibilities for Federally Owned and  
Leased Facilities
- G. National Electrical Contractors Association  
303-2005.....Installing Closed Circuit Television  
(CCTV) Systems
- H. National Electrical Manufacturers Association (NEMA):  
250-08.....Enclosures for Electrical Equipment (1000  
Volts Maximum)
- I. National Fire Protection Association (NFPA):  
70-11..... National Electrical Code
- J. Underwriters Laboratories, Inc. (UL):  
294-99.....The Standard of Safety for Access Control  
System Units  
305-08.....Standard for Panic Hardware  
639-97.....Standard for Intrusion-Detection Units  
752-05.....Standard for Bullet-Resisting Equipment  
827-08.....Central Station Alarm Services  
1076-95.....Standards for Proprietary Burglar Alarm  
Units and Systems  
1981-03.....Central Station Automation System  
2058-05.....High Security Electronic Locks
- K. Homeland Security Presidential Directive (HSPD):  
HSPD-12.....Policy for a Common Identification  
Standard for Federal Employees and  
Contractors
- L. Federal Information Processing Standards (FIPS):  
FIPS-201-1.....Personal Identity Verification (PIV) of  
Federal Employees and Contractors
- M. National Institute of Standards and Technology (NIST):  
IR 6887 V2.1.....Government Smart Card Interoperability  
Specification (GSC-IS)  
Special Pub 800-37.....Guide for Applying the Risk Management  
Framework to Federal Information Systems  
Special Pub 800-63.....Electronic Authentication Guideline



- Special Pub 800-73-3....Interfaces for Personal Identity  
Verification (4 Parts)  
.....Pt. 1- End Point PIV Card Application  
Namespace, Data Model & Representation  
.....Pt. 2- PIV Card Application Card Command  
Interface  
.....Pt. 3- PIV Client Application Programming  
Interface  
.....Pt. 4- The PIV Transitional Interfaces &  
Data Model Specification
- Special Pub 800-76-1....Biometric Data Specification for Personal  
Identity Verification
- Special Pub 800-78-2....Cryptographic Algorithms and Key Sizes  
for Personal Identity Verification
- Special Pub 800-79-1....Guidelines for the Accreditation of  
Personal Identity Verification Card  
Issuers
- Special Pub 800-85B-1...DRAFTPIV Data Model Test Guidelines
- Special Pub 800-85A-2...PIV Card Application and Middleware  
Interface Test Guidelines (SP 800-73-3  
compliance)
- Special Pub 800-96.....PIV Card Reader Interoperability  
Guidelines
- Special Pub 800-104A....Scheme for PIV Visual Card Topography
- Special Pub 800-116.....Recommendation for the Use of PIV  
Credentials in Physical Access Control  
Systems (PACS)
- N. International Organization for Standardization (ISO):
- 7810.....Identification cards - Physical  
characteristics
- 7811.....Physical Characteristics for Magnetic  
Stripe Cards
- 7816-1.....Identification cards - Integrated  
circuit(s) cards with contacts - Part 1:  
Physical characteristics
- 7816-2.....Identification cards - Integrated circuit  
cards - Part 2: Cards with contacts -  
Dimensions and location of the contacts

- 7816-3.....Identification cards - Integrated circuit cards - Part 3: Cards with contacts - Electrical interface and transmission protocols
- 7816-4.....Identification cards - Integrated circuit cards - Part 11: Personal verification through biometric methods
- 7816-10.....Identification cards - Integrated circuit cards - Part 4: Organization, security and commands for interchange
- 14443.....Identification cards - Contactless integrated circuit cards; Contactless Proximity Cards Operating at 13.56 MHz in up to 5 inches distance
- 15693.....Identification cards -- Contactless integrated circuit cards - Vicinity cards; Contactless Vicinity Cards Operating at 13.56 MHz in up to 50 inches distance
- 19794.....Information technology - Biometric data interchange formats

O. Uniform Federal Accessibility Standards (UFAS) 1984

P. Section 508 of the Rehabilitation Act of 1973

#### **1.6 WARRANTY OF CONSTRUCTION.**

- A. Warrant PACMS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21 and Section 280500.
- B. Demonstration and training shall be performed prior to system acceptance.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DATABASE**

- A. Database and database management software shall be HSPD-12 and FIPS compliant. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.
- B. Database Operations:

1. System data management shall be in a hierarchical menu tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.
  2. Navigational Aids:
    - a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.
    - b. Point and click feature to facilitate data manipulation.
    - c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.
    - d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.
  3. All data entry shall be automatically checked for duplicate and illegal data and shall verify that data are in a valid format.
  4. Provide a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose the item was entered for, reasons for changes that were made, and the like.
- C. File Management:
1. Provide database backup and restoration system, allowing selection of storage media, including hard discs, optical media, flash drives, and designated network resources.
  2. Provide manual and automatic mode of backup operations. The number of automatic sequential backups before the oldest backup becomes overwritten; FIFO mode shall be operator selectable.
  3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.
- D. Database Segmentation:
1. The System shall employ advanced database segmentation functionality. Each segment shall be allowed to have its own unique set of cardholders, hardware, and system parameters including access control field hardware, timezones, access levels, etc., which shall allow System Administrators to expand upon current hardware constraints. As such, only

credentials that are assigned access levels to card readers in a segment need to be downloaded to the Data Gathering Panels in that segment.

2. Cardholders shall be allowed to belong to one segment, many segments, or all segments.
3. The database segmentation functionality shall also provide a capability to object records in the system, where segment System Administrators and Operators can only view, add, modify, delete, and manipulate cardholders, system parameters and access control field hardware that belong to their respective segments.
4. System Administrators and System Operators shall be assigned the segments they are allowed to view and control. System Administrators and System Operators may be assigned to more than one segment and a segment may be assigned to more than one System Administrator and System Operator. A one-to-many relationship shall exist for System Administrators and System Operators with respect to segments. The SYSTEM shall support a minimum of 65,000 segments.

#### E. Bi-Directional Data Exchange

1. The System shall support a real time, bi directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the SYSTEM in real time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways, but shall always be in ASCII text format.
2. The System shall also support a one step download and distribution process of cardholder and security information from the external database to the SYSTEM database, all the way down to the Intelligent Field Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the SYSTEM database server and the ISC is broken. If

the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.

F. Database connectivity:

1. The SMS database shall support open direct database connectivity for importing cardholder and card ID data from external systems and/or database applications. The PACS SMS shall facilitate interfacing by providing the following capabilities:
  - a. Real time and batch processing of data via ODBC, JDBC or OLE DB over a network connection.
  - b. Insert, update, and delete record information.
  - c. Automatic download of data to control panels (data gathering panels) based on database changes.
  - d. Provide audit trail in the operator history/archive database for all database changes initiated by the interface.

G. Operator Passwords:

1. Software shall support up to 32,000 individual system operators, each with a unique password.
2. Operator Password: One to eight alphanumeric characters.
3. Allow passwords to be case sensitive.
4. Allow use of Single sign-off (SSO) password.
5. Passwords shall not be displayed when entered.
6. Provide each password with a unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:
  - a. Allow for at least 32,000 operator password profiles.
  - b. Predetermine the highest-level password profile for access to all functions and areas of program.
  - c. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.
  - d. Restrict which doors an operator can assign access to.
7. Operators shall use a user name and password to log on to system.
  - a. This user name and password is used to access database areas and programs as determined by the associated profile.

8. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.
- H. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN) .
1. Access authorization shall verify the card or card-and-PIN validation, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.
  2. Use data-entry windows to view, edit, and issue access levels. Access authorization entry management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.
  3. Allow assignment of multiple cards/codes to a cardholder.
  4. Allow assignment of at least four access levels for each Location to a cardholder. Each access level may contain any combination of doors.
  5. Each door may be assigned four time zones.
  6. Access codes may be up to 11 digits in length.
  7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.
  8. Visitor Access: Issue a visitor badge, without assigning that person a card or code, for data tracking or photo ID purposes.
  9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visual annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.
  10. Allow option for each cardholder to be given either an unlimited number of uses or a number from 1 to 9998 that regulates the number of times the card can be used before it is automatically deactivated.
  11. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate dates to be preprogrammed.
- I. Security Access Integration:

1. Photo ID badging and photo verification shall use same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.
  2. The SMS shall provide a means for manually importing and exporting selected data in XML format. This mechanism shall support the import and export of any and all classes or types of data in the system. Specific data validation and logging requirements shall be met.
  3. The system shall also support importing from CSV files.
  4. The SMS shall provide an automated import mechanism (preferably XML-based). This mechanism shall support the import of most classes or types of data into the system. Specific data validation and logging requirements shall be met.
  5. The SMS shall provide a Data Mapping feature that provides field mapping information using the XSLT file based on the input data or an external XSLT file.
  6. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.
  7. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.
- J. Key control and tracking shall be an integrated function of cardholder data.
1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.
  2. Reports shall be designed to list everyone that has possession of a specified key.
- K. Operator Comments:
1. With the press of one appropriate button on toolbar, the user shall be permitted to make operator comments into history at anytime.
  2. Automatic prompting of operator comment shall occur before the resolution of each alarm.

3. Operator comments shall be recorded by time, date, and operator number.
4. Comments shall be sorted and viewed through reports and history.
5. The operator may enter comments in two ways; either or both may be used:
  - a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.
  - b. Predefined and stored in database for retrieval on request.
6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.

L. Group:

1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.
2. System software shall have the capacity to assign 1 of 32,000 group names to an access authorization.
3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.
4. Allow sorting of history reports and code list printouts by group name.

M. Time Zones:

1. Each zone consists of a start and stop time for 7 days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.
2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.
3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.
4. System shall have the capacity for 2048 time zones for each Location.



N. Holidays:

1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time zone schedule for that 24-hour period.
2. System shall have the capacity for 32,000 holidays.
3. Three separate holiday schedules may be applied to a time zone.
4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in system and will not be purged.
5. Holidays not designated to occur each year shall be automatically purged from database after the date expires.

O. Access Levels:

1. System shall allow for the creation at least 32,000 access levels.
2. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.
3. System shall be able to create multiple door and time zone combinations under same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same Controller.

P. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.
2. System shall accommodate a title for each field; field length shall be 20 characters.
3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.
4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.

5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.
6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.
7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include search for a character string.
8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

Q. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.
2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.
3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.
4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the Central Station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.
5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

R. Database and File Replication:

1. The Security Management System shall be capable of supporting database and file replication using [Microsoft SQL Server Replication Services and Microsoft File Replication Services] <insert database and file replication services> for providing distributed database replication across multiple PACS application servers allowing for system expansion and delivering N tiers of server redundancy.
2. Database and file replication shall not require any proprietary database or file replication software.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. System installation shall be in accordance with manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. All software shall be installed per the design package and the manufacturer's installation specifications.

**3.2 TESTING AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Perform testing and system certification as outlined in section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- C. The software shall be entered into the SMS computer systems and debugged. The Contractor shall be responsible for documenting and entering the initial database into the system. The Contractor shall provide the necessary blank forms with instructions to fill in all the required data information that will make up the database. The database shall then be reviewed by the Contractor and entered into the system. Prior to full operation, a complete demonstration of the computer real time functions shall be performed. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.
- D. Upon satisfactory on line operation of the system software, the entire installation including all subsystems shall be inspected. The Contractor shall perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response.
- E. Tests shall demonstrate the response time and display format of each different type of input sensor and output control device. Response time shall be measured with the system functioning at

full capacity. Computer operation shall be tested with the complete data file.

- F. The Contractor shall provide a competent trainer who has extensive experience on the installed systems and in delivering training to provide the instruction. As an alternative, the Contractor may propose the use of factory training personnel and coordinate the number of personnel to be trained.

### **3.3 MAINTENANCE**

- A. The Contractor shall offer a Support Agreement (SSA) in order for Technical Support Specialists to reactively troubleshoot system problems.
- B. As part of the agreement, 5x9 telephone support (Standard and Enhanced SSA) will be provided to the Contractor by Certified Technicians. An option of 7x24 Standby telephone support (Enhanced SSA) shall be offered.
- C. As part of the agreement, Flashable and Non-Flashable (Chips) firmware and documentation shall be provided.
- D. As part of the agreement, access to Security Management System (SMS) software patches and software release updates shall be provided.
- E. The Support Agreement shall cover the current version of the SMS software release one full version back, and associated controller hardware.

-----END----

**SECTION 28 13 53**  
**SECURITY ACCESS DETECTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide and install a complete Detection and Screening System, hereinafter referred to as the Security Access Detection as specified in this section.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- C. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- D. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.
- E. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- F. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS. Requirements for grounding of equipment.
- G. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- I. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- J. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- K. Section 28 16 00 - INTRUSION DETECTION SYSTEM. Requirements for alarm systems.
- L. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- M. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

**1.3 QUALITY ASSURANCE**

- A. Refer to 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY, Part 1

**1.4 SUBMITTALS**

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00,

DEMOLITION, and Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (in.) (1220 x 1220 millimeters) (mm); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
  - 1. Index Sheet that shall:
    - a. Clearly define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a complete list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
    - a. Include a title block as defined above.
    - b. Clearly define the drawings scale in both standard and metric measurements.
    - c. Provide device identification and location.
    - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements.
    - e. Identify all pull box and conduit locations, sizes, and fill capacities.
    - f. Address all general and drawing specific notes for a particular drawing sheet.
  - 3. A detailed riser drawing for each applicable security subsystem shall:

- a. Indicate the sequence of operation.
  - b. Relationship of integrated components on one (1) diagram.
  - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
  - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
- a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
  - b. Provide full detail of all system components wiring from point-to-point.
  - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
  - d. Show device locations that correspond to the floor plans.
  - e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
- a. Device ID.
  - b. Device Location (e.g. site, building, floor, room number, location, and description).
  - c. Mounting type (e.g. flush, wall, surface, etc.).
  - d. Power supply or circuit breaker and power panel number.
  - e. In addition, provide the Security Access Detection detector or screening device ID, type (e.g. walk-through screener, X-ray, explosive detector, etc.), type of technology used by system for detection and model number.
6. Provide detail and elevation drawings for all devices that define how they were installed and mounted.
- E. The pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews

shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:

1. 35 percent
2. 65 percent
3. 90 percent
4. 100 percent

- F. The Contractor shall provide manufacturer security system product cut-sheets that clearly and completely indicate the description and function of each component of the security systems they are associated with. Also, indicate all termination points of devices and interconnections required for operation of the system, and between modules and devices.
- G. The Contractor shall submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include detailed procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- H. The Contractor shall submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing for all security system devices, power sources, control panels, and monitoring equipment.
- I. The Contractor shall provide complete maintenance and operating manuals from the manufacturer that support as-builts and system design, to include all technical product sheets and overall system schematics. Two (2) weeks prior to the final inspection, four (4) copies of the maintenance and operating manuals also need to be submitted to the RE.
- J. Certifications: Two (2) weeks prior to final inspection, submit four (4) copies of the following to the RE:
  1. Complete maintenance and operating manuals from the manufacturer that support as-built and systems design, to include all technical data sheets and overall system schematics.
  2. Certification by the Contractor that the materials submitted is in accordance with the drawings and specifications.
  3. Certification by the Contractor that a complete security system installation has been installed, tested and adjusted.
- K. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion.



## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM)  
C1238-97 (R03).....Standard Guide for Installation of Walk-Through  
Metal Detectors
- C. Department of Justice American Disability Act (ADA)  
28 CFR Part 36-94.....ADA Standards for Accessible Design
- D. Department of Veterans Affairs  
VHA National CAD Standard Application Guide, 2006  
VA BIM Guide, V1.0 10
- E. Federal Communications Commission (FCC):  
(47 CFR 15) Part 15.....Limitations on the Use of Wireless  
Equipment/Systems
- F. Government Accountability Office (GAO):  
GAO-03-8-02.....Security Responsibilities for Federally Owned  
and Leased Facilities
- G. Institute of Electrical and Electronics Engineers (IEEE):  
C95.1-05.....Standards for Safety Levels with Respect to  
Human Exposure in Radio Frequency  
Electromagnetic Fields
- H. National Fire Protection Association (NFPA):  
70-11..... Article 780-National Electrical Code
- I. National Institute of Justice (NIJ)  
0601.02-03.....Standards for Walk-Through Metal Detectors for  
use in Weapons Detection  
0602.02-03.....Hand-Held Metal Detectors for Use in Concealed  
Weapon and Contraband Detection
- J. National Electrical Manufacturers Association (NEMA)  
250-08.....Enclosures for Electrical Equipment (1000 Volts  
Maximum)
- K. Occupational and Safety Health Administration (OSHA):  
29 CFR 1910.97.....Nonionizing radiation
- L. Security Industry Association (SIA):  
AG-01.....Security CAD Symbols Standards
- M. Underwriters Laboratories, Inc. (UL):

187-98.....Standard for X-ray Equipment

464-03.....Audible Signal Appliances

N. United States Department of Commerce:

Special Pub 500-101 ....Care and Handling of Computer Magnetic Storage  
Media

O. Uniform Federal Accessibility Standards (UFAS), 1984

P. Architectural Barriers Act (ABA), 1968

## **1.6 COORDINATION**

A. Coordinate arrangement, mounting, and support of security access  
detection equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

## **1.7 WARRANTY OF CONSTRUCTION.**

A. Warrant Security Access Detection work subject to the Article "Warranty of Construction" of FARclause 52.246-21.

B. Demonstration and training shall be performed prior to system acceptance.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

A. All equipment shall operate on a 120 volts alternating current (VAC); 60 Hz alternating current (AC) power system unless documented otherwise in subsequent sections listed within this spec. All equipment shall have a battery back-up source of power that will provide 12 hours

- (hrs.) of run time in the event of a loss of primary power to Security Access Detection systems until a backup generator comes on-line.
- B. Walk-through metal detectors and X-ray machines shall meet the National Institute of Justice (NIJ) Standards and Safety requirements.
  - C. The Security Access Detection shall be designed, installed, and programmed in a manner that will allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.
  - E. All Security Access Detection equipment and materials provided shall be new, first grade, standard, current products of the manufacturer and shall be suitable for the systems being installed and the intent of the design.
  - F. All Security Access Detection equipment and materials shall be stored, adequately protected and carefully handled to prevent damage before and during installation and according to manufacture's instructions.
  - G. All Security Access Detection equipment provided with a factory finish shall be maintained free of dust, dirt and foreign matter. Dents, marred finishes and other damage shall be repaired to its original condition or shall be replaced, at no additional cost to the Owner.
  - H. The Contractor shall provide the RE with written verification, that the type of wire/cable being provided is recommended and approved by the OEM. Cabling shall meet the interconnecting wiring requirements of NFPA 70 (NEC). The Contractor is responsible for providing the correct protection cable duct and/or conduit and wiring.
  - I. The Contractor is responsible for interfacing Security Access Detection with other security subsystems. The Contractor shall utilize interfacing methods that are approved by the OEM and RE. At a minimum, an acceptable interfacing method requires not only a physical and mechanical connection; but also a matching of signal, voltage, and processing levels with regard to signal quality and impedance. The interface point must adhere to all standards described herein.
  - J. The characteristics listed in this section will serve as a guide in selection of equipment and materials for the Security Access Detection. If updated or more suitable versions are available then the RE will approve the acceptance of prior to an installation.
  - K. If any obsolete, incompatible, or damaged equipment is offered by the Contractor at the time of installation, then the equipment will be returned and replaced with equipment at no cost to the government.

## **2.2 EQUIPMENT ITEMS**

### **A. General**

1. All specifications listed within this section are the minimum requirements to be met to ensure a working Security Access Detection is in place.
2. Detection Sensor subsystems shall consist of sensors capable of:
  - a. Locating and identifying prohibited, threatening, contraband materials and items the system is designed to detect and protect against being brought into a facility.
  - b. Sensors shall be adjustable to maximize capabilities based on environmental and security requirement changes.
3. Annunciation: Shall contain one (1) or more indicator lamps, alphanumeric displays that provide status information about a circuit or condition of the operating units. Walk-Through or conveyer pass through units must provide a uniform two-digit error code to identify different types of system failures.
4. Audible Signal Device: Shall consist of audible sound for alarms, supervisory, and trouble signals and shall be distinctive.
5. Assessment: Shall consist of electronic devices required to visually and audibly verify the validity and functionality of Security Access Detection. Assessment also includes providing indication of tampering, fail-safe, low battery, and power losses.
6. Alarm Reporting: Shall consist of electronic devices to annunciate Security Access Detection information to at least two (2) separate locations. The alarms shall maintain the capability to respond with local and remote visible and audible signals upon activation of detection sensors. The alarms should have the capability of a silent mode only alerting personnel using the system.
7. Power Supply: Security Access Detection shall be capable of continuous operation and include a battery backup module capable of 12 hrs. of backup use. All non-portable systems shall operate on 100-240 VAC. Hand-Held Security Access Detection (Metal and Explosive Detectors) shall have the capability to operate on rechargeable batteries.

### **2.3. WALK-THROUGH METAL DETECTORS: (NOT USED)**

### **2.4. HAND-HELD METAL DETECTORS: (NOT USED)**

## **2.5 X-RAY DETECTORS: (NOT USED)**

## **2.6 EXPLOSIVES DETECTORS:**

# **PART 3 - EXECUTION**

## **3.1 GENERAL**

- A. System installation shall be in accordance with appropriate NEC, UL, NFPA, Related Work VA specifications, and appropriate installation manual for each type of Security Access Detection.
- B. The Security Access Detection system will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.
- C. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- D. All Security Access Detection requiring VAC connection will be installed with surge protection and Uninterrupted Power Supply (UPS).
- F. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

## **3.2 WIRING**

- B. Wiring Method: Install cables concealed in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation and supervise pretesting, testing, and adjusting of video surveillance equipment.
- B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
- C. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
- D. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
- E. Remove and replace malfunctioning items and retest as specified above.
- F. Record test results for each piece of equipment.
- G. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

### 3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:
  - 1. Check cable connections.
  - 2. Check proper operation of detectors.
  - 3. Recommend changes to walk through detectors, X-ray machines, and associated equipment to improve Owner' utilization of security access detection system.
  - 4. Provide a written report of adjustments and recommendations.
- B. Adjustment/Alignment/Synchronization: Contractor shall prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, programming, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

### 3.5 CLEANING

- A. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.

### 3.6 INTEGRATION

- A. For integration purposes, the Security Access Detection system shall be integrated with the Physical Access Control System and Database Management via CAT-V cables and where appropriate with CCTV and EPPS. The CCTV Security System will:
  - 1. Provide full coverage of all lobby entrance screening areas utilizing a fixed color camera.
  - 2. Record activity on a 24 hours basis.
  - 3. The CCTV system should have facial recognition software to assist in identifying individuals for current and future purposes.
  - 4. For additional CCTV system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.
- B. Integration with CCTV and EPPS security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- C. For programming purposes, refer to the manufacturers requirements for correct system operations. Ensure computer hardware being utilized for system integration meets or exceeds the minimum system requirements as well as systems software requirements.

### 3.7 EXISTING CONDITIONS

- A. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- B. Existing Equipment
  - 1. The Contractor shall connect to and utilize existing equipment, and control signal transmission lines, and devices as outlined in the design package. Equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  - 2. The Contractor shall perform a field survey, including testing and inspection of all existing equipment, power outlets, and signal

lines intended to be used by the Security Access Detection, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.

3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
5. The Contracting Officer shall provide a full list of all equipment that is to be removed or replaced by the Contractor. The Contractor shall dispose of all equipment that has been removed or replaced. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.

### **3.8 SYSTEM START-UP AND TESTING**

#### **A. System Start-Up**

1. The Contractor shall not apply power to any installed Security Access Detection until the following items have been completed:
  - a. Security Access Detection equipment items have been set up in accordance with manufacturer's instructions.
  - b. A visual inspection of the Security Access Detection system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
  - c. System wiring has been tested and verified as correctly connected as indicated.
  - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
  - e. Power supplies to be connected to the Security Access Detection system have been verified as the correct voltage, phasing, and frequency as indicated by the manufacturer.



2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
- B. Supplemental Contractor Quality Control: The following requirements supplement the Contractor quality control requirements specified elsewhere in the contract:
1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of any installed Security Access Detection; and are approved by the Contracting Officer.
  2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
  3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
  4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.
- C. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

### 3.9 COMMISSIONING

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system.

-----END-----



**SECTION 28 16 00**  
**INTRUSION DETECTION SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide and install a complete Intrusion Detection System, hereinafter referred to as IDS, as specified in this section.
- B. This Section includes the following:
  - 1. Intrusion detection with hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.
  - 2. Responsibility for integrating electronic and electrical systems and equipment is specified in the following Sections, with Work specified in this Section:
    - a. Division 08 Section "DOOR HARDWARE".
    - d. Division 28 Section "PHYSICAL ACCESS CONTROL".
    - f. Division 28 Section "VIDEO SURVEILLANCE".
- C. Related Sections include the following:
  - 1. Division 28 Section "VIDEO SURVEILLANCE" for closed-circuit television cameras that are used as devices for video motion detection.
  - 2. Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY" for cabling between central-station control units and field-mounted devices and controllers.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- E. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.  
 Requirements for connection of high voltage.
- G. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- H. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- I. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

- J. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.  
Requirements for grounding of equipment.
- K. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- L. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY.  
Requirements for commissioning - systems readiness checklists, and training.
- M. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- N. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.  
Requirements for control and operation of all security systems.
- O. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- P. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS).  
Requirements for emergency and interior communications.

### **1.3 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the IDS as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.

### **1.4 DEFINITIONS**

- A. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- B. I/O: Input/Output.
- C. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- D. LED: Light-emitting diode.
- E. NEC: National Electric Code

- F. NEMA: National Electrical Manufacturers Association
- G. NFPA: National Fire Protection Association
- H. NRTL: Nationally Recognized Testing Laboratory.
- I. SMS: Security Management System - A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- J. PIR: Passive infrared.
- K. RF: Radio frequency.
- L. Standard Intruder: A person who weighs 45 kg (100 lb.) or less and whose height is 1525 mm (60 in) or less; dressed in a long-sleeved shirt, slacks, and shoes.
- M. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.
- N. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- O. UPS: Uninterruptible Power Supply
- P. UTP: Unshielded Twisted Pair

## **1.5 SUBMITTALS**

- A. Refer to Section 28 05 00, Part 1

## **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Security Industry Association (SIA):
  - PIR-01-00.....Passive Infrared Motion Detector Standard -  
Features for Enhancing False Alarm Immunity
  - CP-01-00.....Control Panel Standard-Features for False Alarm  
Reduction
- C. Department of Justice American Disability Act (ADA)
  - 28 CFR Part 36.....2010 ADA Standards for Accessible Design
- D. Federal Communications Commission (FCC):
  - (47 CFR 15) Part 15.....Limitations on the Use of Wireless  
Equipment/Systems
- E. National Electrical Manufactures Association (NEMA):

250-08.....Enclosures for Electrical Equipment (1000 Volts  
Maximum)

F. National Fire Protection Association (NFPA):

70-11.....National Electrical Code

731-08.....Standards for the Installation of Electric  
Premises Security Systems

G. Underwriters Laboratories, Inc. (UL):

464-09.....Audible Signal Appliances

609-96.....Local Burglar Alarm Units and Systems

634-07.....Standards for Connectors with Burglar-Alarm  
Systems

639-07.....Standards for Intrusion Detection Units

1037-09.....Standard for Anti-theft Alarms and Devices

1635-10.....Digital Alarm Communicator System Units

H. Uniform Federal Accessibility Standards (UFAS), 19841.

## 1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of intrusion detection  
system equipment:

1. To allow maximum possible headroom unless specific mounting heights  
that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum  
interference to other installations.
3. To allow right of way for piping and conduit installed at required  
slope.
4. So connecting raceways, cables, wireways, cable trays, and busways  
will be clear of obstructions and of the working and access space of  
other equipment.

B. Coordinate installation of required supporting devices and set sleeves  
in cast-in-place concrete, masonry walls, and other structural  
components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety  
and security items that are behind finished surfaces or otherwise  
concealed.

## 1.8 EQUIPMENT AND MATERIALS

A. General

1. All equipment associated within the IDS shall be rated for  
continuous operation. Environmental conditions (i.e. temperature,  
humidity, wind, and seismic activity) shall be taken under

consideration at each facility and site location prior to installation of the equipment.

2. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of 96 hours of run time in the event of a loss of primary power to the facility.
3. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
5. All equipment and materials for the system will be compatible to ensure functional operation in accordance with requirements.

#### **1.9 WARRANTY OF CONSTRUCTION.**

- A. Warrant IDS work subject to the Article "Warranty of Construction" of FAR 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

### **PART 2 - PRODUCTS**

#### **2.1 FUNCTIONAL DESCRIPTION OF SYSTEM**

- A. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
  1. Alarm Signal: Display at central-station control unit and actuate audible and visual alarm devices.
  2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or controller failure.
  3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or controller.

- B. System Control: Central-station control unit shall directly monitor intrusion detection units and connecting wiring.
- C. System Control: Central-station control unit shall directly monitor intrusion detection devices and connecting wiring in a multiplexed distributed control system or as part of a network.
- D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.
- E. Operator Commands:
  - 1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
  - 2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
  - 3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
  - 4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
  - 5. Protected Zone Test: Initiate operational test of a specific protected zone.
  - 6. System Test: Initiate system-wide operational test.
  - 7. Print Reports.
- F. Timed Control at Central-Station Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.
- G. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:
  - 1. Switch selected lights.
  - 2. Shift elevator control to a different mode.
  - 3. Open a signal path between certain intercommunication stations.
  - 4. Shift sound system to "listening mode" and open a signal path to certain system speakers.
  - 5. Switch signal to selected monitor from closed-circuit television camera in vicinity of sensor signaling an alarm.
- H. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When central-station control unit receives a



signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

- I. Response Time: 2 seconds between actuation of any alarm and its indication at central-station control unit.
- J. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from central-station control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at central-station control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.
- K. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.
- L. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

## **2.2 SYSTEM COMPONENT REQUIREMENTS**

- A. Compatibility: Detection devices and their communication features, connecting wiring, and central-station control unit shall be selected and configured with accessories for full compatibility with the following equipment:
  - 1. Data Gathering Panel, Output Module, Input Module, 28 13 00 PHYSICAL ACCESS CONTROL SYSTEM.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS.
  2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements in Division 26 Section TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS as recommended by manufacturer for type of line being protected.
- C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V RMS injected into power supply lines at 10 to 10,000 MHz.
- D. Tamper Protection: Tamper switches on detection devices, controllers, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Central-station control-unit alarm display shall identify tamper alarms and indicate locations.
- E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to central-station control unit.
- F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to central-station control unit as an alarm signal.
- G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to central-station control unit.
- H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at central-station control unit for calibration, sensitivity, and alarm condition.

### **2.3 ENCLOSURES**

- A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.
- B. Interior Electronics: NEMA 250, Type 12.

## 2.5 EQUIPMENT ITEMS

### A. General:

1. All requirements listed below are the minimum specifications that need to be met in order to comply with the IDS.
2. All IDS sensors shall conform to UL 639, Intrusion Detection Standard.
3. Ensure that IDS is fully integrated with other security subsystems as required to include, but not limited to, the CCTV, PACS, EPPS, and Physical Access Control System and Database Management. The IDS provided shall not limit the expansion and growth capability to a single manufacturer and shall allow modular expansion with minimal equipment modifications.

### B. IDS Components: The IDS shall consist of, but not be limited to, the following components:

1. Control Panel
3. Interior Detection Devices (Sensors)
4. Power Supply
5. Enclosures

## 2.6 CONTROL PANEL

- A. The Control panel shall be the main point of programming, monitoring, accessing, securing, and troubleshooting the IDS. Refer to American National Standards Institute (ANSI) CP-01 Control Panel Standard-Features for False Alarm Reduction.
- B. The Control Panel shall provide a means of reporting alarms to an Physical Access Control System and Database Management via a computer interface or direct connection to an alarm control monitoring panel.
- C. The Control panel shall utilize a Multifunctional Keypad, Input and Output Modules for expansion of alarm zones, interfacing with additional security subsystems, programming, monitoring and controlling the IDS.
- D. The Control panel shall meet or exceed the following minimum functional requirements for programming outputs, system response, and user interface:
  1. Programming Outputs:
    - a. 2 Amps alarm power at 12 VDC
    - b. 1.4 Amps auxiliary power at 12 VDC
    - c. Four alarm output patterns
    - d. Programmable bell test

- e. Programmable bell shut-off timer
- 2. System Response:
  - a. Selectable point response time
  - b. Cross point capability
  - c. Alarm verification
  - d. Watch mode
  - e. Scheduled events arm, disarm, bypass and un-bypass points, control relays, and control authority levels
- 3. User Interface:
  - a. Supervises up to eight command points (e.g. Up to 16 unsupervised keypads can be used)
  - b. Provides custom keypad text
  - c. Addresses full function command menu including custom functions
  - d. Allows user authority by defined area and 16-character name
  - e. Provides for 14 custom authority control levels allowing user's authority to change, add, delete pass codes, disarm, bypass points, and start system tests.
- 4. The Control panel shall meet or exceed the following technical characteristics:

Input Voltage via 110 VAC or 220 VAC Step-down Transformer	16 or 18 VAC
Operating Voltage	12 VDC
Output Voltage	12 VDC @ 2 A max
Direct Hardwire Zones	7
Partitions	8
Multifunctional Keypads	16 (2 per partition)
Communications Port	RJ-11

- E. A multifunctional keypad shall be utilized as a user interface for arming, disarming, monitoring, troubleshooting, and programming the alarm control panel.
- F. Keypads shall have the following features:
  - 1. Multiple function keypads suitable for remote mounting, no greater than 1333 m (4000 ft), shall be provided from the control panel and have a light emitting diode (LED) readout of alarm and trouble conditions by zone.
  - 2. An alphanumeric English language display, with keypad programmability, and EE-PROM memory, shall also be provided.

3. Trouble alarm indicators shall be distinguishable from intrusion alarms.
4. A minimum of four (4) zones selectable as entry and exit with programmable time delay.
5. Complete system test activated capability at the keypad.
6. Capability for opening and closing reports to a remote monitoring location.
7. Adjustable entry and exit delay times.
8. Capability for a minimum of two (2) multiple function keypads.
9. Capability to shunt or bypass selected interior zones while arming perimeter protection and remaining interior zones.
10. Capability for a minimum of seven assignable pass-codes that are keypad programmable from a suppressed master code.
11. The control panel shall have a communications port that will allow for communications with a computer for programming, monitoring, and troubleshooting purposes. The communications port will be, at a minimum, and RJ-11 or better.
12. The control panel will have a systems success probability of 95% or better, and shall include the following success considerations:
  - a. False Alarm: Shall not exceed one (1) false alarm per 30 days per sensor zone.
  - b. Nuisance Alarm: Shall not exceed a rate of one (1) alarm per seven (7) days per zone within the first 60 days after installation and acceptance. Sensor adjustments will be made and then shall not exceed one (1) alarm per 30 days.
13. The Control Panel will be able to detect either a line fault or power loss for all supervised data cables.
  - a. Line Fault Detection: Communication links of the IDS shall have an active mode for line fault detection. Fault isolation at the systems level shall have the same geographic resolutions as provided for intrusion detection. The line fault alarm shall be clearly distinguishable from other alarms.
  - b. Power Loss Detection: Provide the capability to detect when critical components experience temporary or permanent loss of power and annunciate to clearly identify the component experiencing power loss.

## 2.7 KEYPADS

A. Keypads shall meet or exceed the following technical characteristics:

Connections	4-wire flying lead for data and power
Operating Temperature	0°C to +50°C (+32°F to +122°F)
Display Window	8-point LED
Indicators: Illuminated keys	Armed Status-LED
	Point Status-LED
	Command Mode-LED
	Power-LED
Voltage	Nominal 12 VDC

## 2.8 INPUT MODULE

A. An input module shall be utilized to connect additional detection devices to the control panel. This module will meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Zone Inputs	Style A (Class B) Supervised
Operating Temperature	0 to 40 degrees C (32 to 140 degrees F)

## 2.9 OUTPUT MODULE

A. An output module shall be utilized to interface the control panel with other security subsystems. The output module shall meet or exceed the following technical characteristics:

Operating Voltage	8.5 to 14.5 VDC Nominal
Output Relays	"Form C" Dry Relay Contracts
Relay Contact Rating	4A @ 24 VDC
	4A @ 24 VAC
	1A @ 70 VAC
Operating Temperature	0 to 40 degrees C F (32 to 140 degrees)

## 2.10 EXTERIOR DETECTION DEVICES (SENSORS) (NOT USED)

## 2.11 INTERIOR DETECTION DEVICES (SENSORS)

A. The IDS shall consist of interior, exterior, and other detection devices that are capable of:

1. Locating intrusions at individually protected asset areas or at an individual portal;

2. Locating intrusions within a specific area of coverage;
  3. Locating failures or tampering of individual sensors or components.
- B. Provide and adjust for devices so that coverage is maximized in the space or area it is installed in. For large rooms where multiple devices are required, ensure device coverage is overlapping.
- C. Detection sensitivity shall be set up to ensure maximum coverage of the secure area is obtained while at the same time limiting excessive false alarms due to the environment and impact of small animals. All detection devices shall be anti-masking with exception of video motion detection.
- D. Dual sensor technology shall be used when possible. Sensor technology shall not be of the same type that is easily defeated by a single method. This will reduce the amount of false alarms.
- E. Interior Environmental Conditions: Systems shall be able to operate in environmentally protected interior areas and shall meet operational performance requirements for the following ambient conditions:
1. If components are installed in unheated areas they shall be able to operate in temperatures as low as -17 C (0 F);
  2. Interior Sensor Environmental Characteristics:

Temperatures	0 to 50 C (32F to 120 F)
Pressure	Sea Level to 4573m (15,000 ft.) above sea level
Humidity	5% - 95%
Fungus	Components of non-fungus nutrient materials
Acoustical Noise	Suitable for high noise environments above 100db

K. Passive Infrared Motion Sensors (PIR)

1. These sensors shall detect an intruder presence by monitoring the level of infrared energy emitted by objects within a protected zone and meet ANSI PIR-01 Passive Infrared Motion Detector Standards Features for Enhancing False Alarm Immunity. An alarm shall be initiated when motion and temperature changes within set patterns are detected as follows.
2. The detector shall provide multiple detection zones distributed at a variety of angles and distance.

3. Sensors shall be passive in nature; no transmitted energy shall be required for detection.
4. Sensors shall be sensitive to infrared energy emitted at wavelengths corresponding to human body and other objects at ambient temperatures.
5. Sensors shall not alarm in response to general area thermal variations and shall be immune to radio frequency interference.
6. Sensors shall not be susceptible to changes in temperature due to an air conditioner being turned on or off.
7. Sensors shall be housed in a tamper-alarmed enclosure.
8. Sensor detectors shall include motion analyzer processing, adjustable lens, and walk test LED's visible from any angle.
9. Sensors shall provide some means of indicating an alarm condition during installation and calibration. A means of disabling the indication shall be provided within the sensor enclosure.
10. Sensor detectors shall include a motion monitoring verification circuit that will signal trouble or alarm if the detector fails to detect motion for an extended period.
11. PIR Technical Characteristics:

Power	Six (6) - 12 VDC 25 mA continuous current draw 38 mA peaks
Alarm Velocity	1500 mm (Five (5) ft.) at a velocity of 30 mm (0.1 ft.) per second, and one (1) step per second, assuming 150 mm (6 in.) per step.  Also, faster than 30 mm (1 foot) per second, up to 3000 mm (10 feet) per second
Maximum detection range	10.6 m (35 ft.)
Frequency range- non activation or setup use	26 to 950 MHz using a 50 watt transmitter located 1 ft. from the unit or attached wiring
Infrared detection	1 1/2°C (3°F) different from the background temperature
Detection Pattern	180 degrees for volumetric units, non PIR 360
PIR 360°Detection Pattern	Programmable 60 detection zones including one directly below
Mounting	Ceiling and walls



Ceiling heights	2.4 m (Eight (8) ft.) - 5.4 m (18 ft)
Sensitivity adjustments	Three (3) levels

#### M. Photoelectric Sensors

1. The sensor devices shall be able to detect an intruder presence by sending out a series of infrared or ultraviolet beams. Intrusion is based on disruption of the signal beams as follows.
  - a. Sensors shall consist of a modulating transmitter, focusing lenses, mirrors, demodulating receiver, power supply, and interconnecting lines.
  - b. Beam transmitters shall be designed to emit light. Beams may be reflected by one (1) or more mirrors before being received and amplified.
  - c. The photoelectric sensor shall initiate an alarm when the beam is interrupted with monitoring controls set at midrange.
  - d. Transmitted beams shall be uniquely modulated to prohibit defeat of the IDS system by shining another light source into the receiver.
  - e. Sensors shall provide a means of local alarm indication on the detector for use at the protected zone during installation and calibration.
  - f. Sensors shall include an indicator-disabling device within the sensor enclosure.
  - g. Sensors shall utilize automatic gain control or be provided with sensitivity adjustments to allow for various beam lengths.
  - h. Sensor controls shall be inaccessible to operating personnel.
  - i. Sensors that use multiple beams shall be tested by attempting to crawl under and jump through and over beams. Each system sensor shall provide cutoffs of at least 90% to handle a high percentage of light cutoffs prior to initiating an alarm.
  - j. Sensor components shall be housed in tamper-alarmed enclosure.
2. Photoelectric Sensor Technical Characteristics:

Power requirements	Nine (9)-16 VDC, protected against reverse polarity
Relay output	Normally closed. 18 ohm resistor in series with contacts. 0.5 amperes resistance/24 VDC

Current	Transmitter 15 mA, Receiver 15 mA
LED	Alignment, walk-test alarm, off
Range	Indoor: 39 m (130 ft.) Outdoor 19.5 m: (65 ft.)
Alarm relay contacts	Two (2) amperes at 120 VAC minimum
Enclosure	High impact acrylic
Type	Dual beam
Mounting	Wall, corner, flush
Beam width	Six (6) degrees
Receiver field of view	Six (6) degrees horizontal and vertical
Adjustments	Vertical +10 - 20 degrees Horizontal 30 degrees
Alarm period	Two (2) - three (3) sec
Infrared source	Long-life Gallium Arsenide LED
Infrared sensor	PIN photodiode
Transmitter Frequency	One (1) kHz 10 microsecond pulse width
IR Wavelength	950 nm

N. CCTV Video Motion Detection Sensors: Refer to Section 28 23 00 VIDEO SURVEILLANCE that outlines related video motion detection requirements.

## 2.12 TAMPER ALARM SWITCHES

A. The following IDS sensors shall be used to monitor and detect potential tampering of sensors, control panels and enclosures.

1. Tamper Switches: All enclosures including cabinets, housings, boxes, raceways, and fittings with hinged doors or removable covers containing circuits and power supplies related to the IDS shall include corrosion-resistant tamper switches.
2. Tamper alarms shall be annunciated to be clearly distinguishable from IDS alarms.
3. Tamper switches will not be in a viewable from a direct line of sight perspective. The minimum amount of time the tamper switch becomes active and sends a signal after an enclosure is opened or panel removable is attempted, shall be one (1) second.

4. Tamper switches will initiate when enclosure doors or covers is removed as little as 6.35 mm (1/4 inch) from the closed position unless otherwise indicated. Tamper switches shall be:
  - a. Push/pull automatic reset type;
  - b. Inaccessible until switch is activated;
  - c. Spring-loaded and held in closed position by door or cover; and
  - d. Wired to break a circuit when door or cover is removed with each sensor annunciated individually at a central reporting processor.
5. Fail-Safe Mode: Shall provide the capability to detect and annunciate diminished functional capabilities and perform self-tests. Fail-safe alarms shall be annunciated to be clearly distinguishable from other types of alarms.

### 2.13 POWER SUPPLY

- A. A power supply shall only be utilized if the control panel is unable to support the load requirements of the IDS system.
- B. All power supplies shall be UL rated and able to adequately power two entry control devices on a continuous base without failure.
- C. Power supplies shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ 2 amp
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to [insert number ]Ah, rechargeable
OUTPUT CURRENT	4 amp max. @ 13.8 VDC 3 amp max. @ 27.6 VDC
BATTERY FUSE SIZE	3.5 A @ 250 VAC
CHARGING CIRCUIT	Built-in standard

### 2.14 AUDIBLE AND VISUAL ALARM DEVICES

- A. Bell: Central-station control unit 10 inches (254 mm) in diameter, rated to produce a minimum sound output of 84 dB at 10 feet (3 m) from central-station control unit.
  1. Enclosure: Weather-resistant steel box equipped with tamper switches on cover and on back of box.
- B. Weatherproof Motor-Driven Hooter: UL listed, rated to produce a minimum sound output of 120 dB at 3 feet (1 m), plus or minus 3 dB, at

a frequency of 470 Hz. Rated for intermittent use: two minutes on and five minutes off.

1. Designed for use in industrial areas and in high noise, severe weather marine environments.

C. Siren: 30-W speaker with siren driver, rated to produce a minimum sound output of 103 dB at 10 feet (3 m) from central-station control unit.

1. Enclosure: Weather-resistant steel box with tamper switches on cover and on back of box.

D. Strobe: Xenon light complying with UL 1638, with a clear polycarbonate lens.

1. Light Output: 115 cd, minimum.

2. Flash Rate: 60 per minute.

## **2.15 SECURITY FASTENERS**

A. Security fasteners shall be operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

B. Drive System Types: Pinned Torx or pinned hex (Allen).

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

A. IDS installation shall be in accordance with Underwriters Laboratories (UL) 639 Standards for Intrusion Detection Units and UL 634 Standards for Connectors with Burglar Alarm Systems, and appropriate manufacture's installation manuals for each type of IDS.

B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.

C. The Contractor shall install all system components including VA furnished equipment, and appurtenances in accordance with the manufacturer's instructions and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

D. The IDS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated

with all associated security subsystems, whether the system is a stand alone or designed as a computer network.

- E. The IDS shall be able to be integrated with other security subsystems. Integration with these security subsystems shall be achieved by computer programming and the direct hardwiring of the systems. Determination for methodology shall be outlined when the system(s) is/are being designed and engineered. For installation purposes, the IDS shall utilize an output module for integration with other security subsystems. The Contractor will ensure all connections are per the OEM and that any and all software upgrades required to integrate the systems are installed prior to system start-up.
- F. For programming purposes, the Contractor shall refer to the manufacturer's requirements and Contracting Officer instructions for correct system operations. This includes ensuring computers being utilized for system integration meet or exceeds the minimum system requirements outlined in the IDS software packages.
- G. Lightning and power surges to the central alarm reporting and display unit shall be protected at both ends against excessive voltages. This requirement shall apply for circuits that are routed both in underground conduits and overhead runs.
- H. At a minimum, the Contractor shall install primary detection devices, such as three electrode gas-type surge arresters, and secondary protectors to reduce dangerous voltages to levels that will cause no damage. Fuses shall not be permitted as protection devices.
- I. The Contractor shall provide fail-safe gas tube type surge arresters on exposed IDS data circuits. In addition, transient protection shall protect against spikes up to 1000 volts peak voltage with a one-microsecond rise time and 100-microsecond decay time, without causing false alarms. The protective device shall be automatic and self-restoring. Also, circuits shall be designed or selected assuming a maximum of 25 ohms to ground.
- J. Product Delivery, Storage and Handling:
  - 1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name, equipment model and serial identification numbers, and UL logo. The Contracting Officer may inventory the IDS equipment at the time of delivery and reject items that do not conform to this requirement.

2. Storage and Handling: Store and protect equipment in a manner that will preclude damage as directed by the Contracting Officer.

K. Cleaning and Adjustments:

1. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
2. Prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or synchronization. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

L. Tamper Switches

1. Install tamper switches to initiate an alarm signal when a panel, box, or component housing door or cover is moved as little as 6.35 mm (1/4 inch) from the normally closed position unless otherwise specified.
2. Locate tamper switches within enclosures, cabinets, housings, boxes, raceways, and fittings to prevent direct line of sight to any internal components and to prevent tampering with switch or circuitry.
3. Conceal tamper switch mounting hardware so that the location of the switch within the enclosure cannot be determined from the exterior.

M. Unique IDS Installation Components:

1. BMS Surface Mounted:
  - a. Surface mounted BMS housing for the switch element shall have the capability to receive threaded conduit. Housing covers for surface mounted BMS, if made of cast aluminum, shall be secured by stainless steel screws. Magnet housing cover shall not be readily removable and BMS housings shall be protected from unauthorized access by a cover operated, corrosion-resistant tamper device.
  - b. Conductors running from a door to alarm circuits shall be contained within a flexible armored cord constructed from corrosion-resistant metal. Each end of the armored cord shall terminate in a junction box or other enclosure. Armored cord ends shall be mechanically secured to the junction boxes by clamps or bushings. Conductors within the armored cord shall be provided with lug terminals at each end. Conductors and the armored cord

shall experience no mechanical strain as the door is removed from fully open to closed position. Switch circuits shall initiate an alarm if a short circuit is applied to the door cord.

- c. For exterior application on double gates, both BMS elements must be mounted on the gate. Flexible armored cord constructed from corrosion-resistant metal shall be used to provide electrical connection.

2. BMS Recessed Mounted:

- a. Ball bearing door trips shall be mounted within vault door headers such that when the locking mechanism is secured, the door bolt engages an actuator, mechanically closing the switch.
- b. Door bolt locking mechanisms shall be fully engaged before the ball bearing door trip is activated. Also, circuit jumpers from the door shall be provided.

3. Vibration Sensors:

- a. Mount vibration sensors directly contacting the surface to be protected.
- b. Provide at least one (1) sensor on each monolithic slab or wall section, even though spacing closer than that required for midrange sensitivity may result.
- c. House sensors in protective mountings and fasten to surface with concealed mounting screws or an epoxy.
- d. Adjust discriminator on the job to precise needs of application. Connect sensors to an electronic control unit by means of wiring or fiber optics cable run in rigid steel conduit or electrical metallic tubing (EMT).

4. Passive Infrared Detectors: (PIR)

- a. The protective beam shall be focused in a straight line.
- b. Installed beam distance from transmitter to receiver shall not exceed 80% of the manufacturer's maximum recommended rating.
- c. Mirrors may be used to extend the beam or to establish a network of beams. Each mirror used shall not lower the rated maximum system range by more than 50%.
- d. Mirrors and photoelectric sources used in outdoor applications shall have self-heating capability to eliminate condensation and shall be housed in weatherproof enclosures.

5. Taut-Wire:

- a. Housing for switch assembly shall be covered by a neoprene cap to retain the center bolt (lever arm), which functions as a lever to translate movement of the attached horizontal wire into contact closure. When the neoprene cap is firmly seated on the cup-shaped polycarbonate housing, it shall function as the fulcrum for the lever (bolt).
- b. Upper exposed end of the lever shall be threaded to accommodate clamping to the horizontal wire. The lower end of the lever, which is fashioned to serve as the movable electrical contact, shall be held suspended in a small cup-shaped contact that floats in a plastic putty material.
- c. Plastic putty used shall retain a degree of elasticity under varying temperature conditions and provide the sensor switch with a self-adjusting property. This provides the switch with a built-in compensating mechanism that ignores small, very slow changes in lever alignment (i.e. which may result from environmental changes such as extreme temperature variations and ground seepage due to weather conditions) and to react to fast changes only, as caused by manual deflection or cutting of the wires.
- d. Contractor shall provide metal slider strips having slots through which the barbed wires pass. Wires shall be prevented from leaving the slots by rivets. A slider strip shall be used to translate normal forces to the barbed wire and to the horizontal displacement of the sensor.
- e. Install one (1) slider strip pair, upper and lower, on every fence post except where sensor posts or anchor strips are installed.
- f. Separation between slider elements along the fence shall be 3000 mm (10 feet).
- g. Attach wires of sensor to existing, specially installed fence posts, called anchor posts, located equidistant on both sides of sensor posts and at ends of sensor zone run.
- h. Anchor strip shall be a strip of steel plate on which fastening plates are installed. Weld or otherwise attach the strip to anchor post and ends of tensed barbed wires wrapped around the fastening plates. Attempts to climb on fastening plates or on the attached barbed wires shall cause plates to break off, creating



an alarm and making it impossible to defeat the system by climbing at the anchor post.

- i. The use of barbed wire as part of the IDS system shall be suitable for installation under a preload tension of approximately 392 N 88 pounds and be flexible enough for convenient manipulation during tensioning. Double-strand 15 1/2-gage barbed wire shall be the minimum acceptable.
6. Electromechanical Fence Sensors:
    - a. The fence length shall be divided into 100m (300 ft). or zones.
    - b. Sensors shall consist of individual electromechanical sensing units mounted every three-thousand and 3045mm (10 ft). on the fence fabric or posts and wired in series to a sensor zone control unit and associated power supply.
  7. Electrostatic Field Sensors:
    - a. Sensors shall be capable of following irregular contours and barrier bends without degrading sensitivity below the specified detection level.
    - b. In no case shall a single sensor zone exceed 100m (300 ft). or be long enough to significantly degrade sensitivity.
    - c. Adjacent zones shall provide continuous coverage to avoid a dead zone. Adjacent zones shall be designed to prevent crosstalk interference.
    - d. Exterior components shall be housed in rugged corrosion-resistant enclosures, protected from environmental degradation and include tamper switches.
    - e. Interfacing between exterior units shall be carried in underground cables.
    - f. Exterior support hardware shall be stainless or galvanized to avoid tension degradation.
    - g. Sensor and field wires shall be stainless steel. Wire spacing for various configurations shall be maintained constant throughout each zone and shall be uniform with respect to the ground and follow manufacturer's specifications.
    - h. Signal processing equipment shall be separately mounted such that no desensitized zones are created within the zone of detection.
  8. Microwave: Do not install microwave sensors where fluorescent lights may pose a problem due to radiated ionization from lights.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceways according to Section 28 05 28.33 "CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (20 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Wires and Cables:
  - 1. Conductors: Size as recommended in writing by system manufacturer, unless otherwise indicated.
  - 2. 120-V Power Wiring: Install according to Division 26 Section "LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES," unless otherwise indicated.
  - 3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable, unless otherwise indicated or if manufacturer recommends shielded cable, according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
  - 4. Computer and Data-Processing Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
  - 5. Television Signal Transmission Cables: Install according to Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- G. Install power supplies and other auxiliary components for detection devices at controllers, unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

- H. Identify components with engraved, laminated-plastic or metal nameplate for central-station control unit and each terminal cabinet, mounted with corrosion-resistant screws.

### **3.3 GROUNDING**

- A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.
- C. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS."

### **3.4 STARTUP AND TESTING**

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

### **3.5 COMMISSIONING**

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system.

### **3.6 TESTS AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- B. Provide services of manufacturer's technical representative for 4 hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

-----END-----



**SECTION 28 23 00**  
**VIDEO SURVEILLANCE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide and install a complete Video Surveillance System, which is identified as the Video Assessment and Surveillance System hereinafter referred to as the VASS System as specified in this section.
- B. This Section includes video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- G. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- J. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- K. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- L. Section 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS. Requirements for grounding of equipment.
- M. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- O. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system integration.
- P. Section 28 13 16 - PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- Q. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
- R. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.

**1.3 DEFINITIONS**

- A. AGC: Automatic gain control.

- B. B/W: Black and white.
- C. CCD: Charge-coupled device.
- D. CIF: Common Intermediate Format CIF images are 352 pixels wide and 88/240 (PAL/NTSC) pixels tall (352 x 288/240).
- E. 4CIF: resolution is 704 pixels wide and 576/480 (PAL/NTSC) pixels tall (704 x 576/480).
- F. H.264 (also known as MPEG4 Part 10): a encoding format that compresses video much more effectively than older (MPEG4) standards.
- G. ips: Images per second.
- H. MPEG: Moving picture experts group.
- I. MPEG4: a video encoding and compression standard that uses inter-frame encoding to significantly reduce the size of the video stream being transmitted.
- J. NTSC: National Television System Committee.
- K. UPS: Uninterruptible power supply.
- L. PTZ: refers to a movable camera that has the ability to pan left and right, tilt up and down, and zoom or magnify a scene.

#### **1.4 QUALITY ASSURANCE**

- A. The Contractor shall be responsible for providing, installing, and the operation of the VASS System as shown. The Contractor shall also provide certification as required.
- B. The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. The Contractor or security sub-contractor shall be a licensed security Contractor as required within the state or jurisdiction of where the installation work is being conducted.
- D. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- E. Product Qualification:
  - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.

2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

F. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Video Assessment and Surveillance System's (VASS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the VASS. The Contractor shall only utilize factory-trained technicians to install, terminate and service cameras, control, and recording equipment. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.

3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

### 1.5 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, Shop Drawings, Product Data, and Samples, and Section 02 41 00, Demolition Drawings.
- B. Provide certificates of compliance with Section 1.4, Quality Assurance.
- C. Provide a pre-installation and as-built design package in both electronic format and on paper, minimum size 762 x 1068 millimeters (4830 x 42 inches); drawing submittals shall be per the established project schedule.
- D. Pre-installation design and as-built packages shall include, but not be limited to:
  1. Index Sheet that shall:
    - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
    - b. Provide a list of all security abbreviations and symbols.
    - c. Reference all general notes that are utilized within the design package.
    - d. Specification and scope of work pages for all security systems that are applicable to the design package that will:
      - 1) Outline all general and job specific work required within the design package.
      - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
  2. Floor plans, site plans, and enlarged plans shall:
    - a. Include a title block as defined above.



- b. Define the drawings scale in both standard and metric measurements.
  - c. Provide device identification and location.
  - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
  - e. Identify all pull box and conduit locations, sizes, and fill capacities.
  - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A riser drawing for each applicable security subsystem shall:
- a. Indicate the sequence of operation.
  - b. Relationship of integrated components on one diagram.
  - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
  - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A system drawing for each applicable security system shall:
- a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
  - b. Provide full detail of all system components wiring from point-to-point.
  - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
  - d. Show device locations that correspond to the floor plans.
  - e. All general and drawing specific notes shall be included with the system drawings.
5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
- a. Device ID.
  - b. Device Location (e.g. site, building, floor, room number, location, and description).
  - c. Mounting type (e.g. flush, wall, surface, etc.).
  - d. Power supply or circuit breaker and power panel number.

- e. In addition, for the VASS Systems, provide the camera ID, camera type (e.g. fixed or pan/tilt/zoom (P/T/Z), lens type (e.g. for fixed cameras only) and housing model number.
- 6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall be reviewed by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
  - 1. 35 percent
  - 2. 65 percent
  - 3. 90 percent
  - 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS.
- H. Submit completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA):
  - 330-09.....Electrical Performance Standards for CCTV Cameras

375A-76.....Electrical Performance Standards for CCTV  
Monitors

C. Institute of Electrical and Electronics Engineers (IEEE):

C62.41-02.....IEEE Recommended Practice on Surge Voltages in  
Low-Voltage AC Power Circuits

802.3af-08.....Power over Ethernet Standard

D. Federal Communications Commission (FCC):

(47 CFR 15) Part 15 Limitations on the Use of Wireless Equipment/Systems

E. National Electrical Contractors Association (NECA):

303-2005.....Installing Closed Circuit Television (CCTV)  
Systems

F. National Fire Protection Association (NFPA):

70-08.....Article 780-National Electrical Code

G. Federal Information Processing Standard (FIPS):

140-2-02.....Security Requirements for Cryptographic Modules

H. Underwriters Laboratories, Inc. (UL):

983-06.....Standard for Surveillance Camera Units

3044-01.....Standard for Surveillance Closed Circuit  
Television Equipment

## 1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of video surveillance equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for video surveillance items that are behind finished surfaces or otherwise concealed.

## 1.8 WARRANTY OF CONSTRUCTION

- A. Warrant VASS System work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Video signal format shall comply with the NTSC standard composite video, interlaced. Composite video signal termination shall be 75 ohms.
- B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
- C. Power Connections: Comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2, as recommended by manufacturer for type of line being protected.
- D. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

### 2.2 CAMERAS

- A. All Cameras will be EIA 330 and UL 1. Minimum Protection for Power Connections 120 V and more: Auxiliary panel suppressors shall comply with requirements in Section 28 05 00 COMMON WORK REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY, Part 2.
- B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:
  - 1. Will be charge coupled device (CCD) cameras and shall conform to National Television System Committee (NTSC) formatting.
  - 2. Fixed cameras shall be color and the primary choice for monitoring following the activities described below. Pan/Tilt/Zoom (P/T/Z) cameras shall be color and are to be utilized to complement the fixed cameras.

3. Shall be powered by either 12 volts direct current (VDC) or 24 volts alternate current (VAC). Power supplies shall be Class 2 and UL compliant and have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
5. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
6. Will be home run to a monitoring and recording device via a controlling device such as a matrix switcher or network server and monitored on a 24 hour basis at a designated Security Management System location.
7. Each function and activity shall be addressed within the system by a unique user defined name, with minimum of twenty (20) characters. The use of codes or mnemonics identifying the VASS action shall not be accepted.
8. Shall come with built-in video motion detection that shall automatically monitor and process information from each camera. The camera motion detection shall detect motion within the camera's field of view and provide automatic visual, remote alarms as a result of detected motion.
10. Will be fitted with AI/DC lenses to ensure the image quality under different light conditions.
11. P/T/Z cameras shall be utilized in a manner that they complement fixed cameras and shall not be used as a primary means of monitoring activity.
12. Dummy or fake cameras will not be utilized at any time.
13. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

### **2.3 VIDEO MANAGEMENT SYSTEM (ANALOG)**

- A. The Video Management System (VMS) shall provide features and functions as specified below:
  1. Supports minimum of 20 client connections.
  2. The Video Management System shall be capable of recording more than 32 days on 1.6 TB of internal hard drive storage using the following parameters:
    - a. Resolution - 4CIF
    - b. Video Mode - NTSC
    - c. Quality - Normal

- d. Sensitivity - Normal
  - e. Number of Cameras - 16
  - f. Record Audio - On
  - g. Motion 50%] <insert number representing percentage of the time with motion during the day divided by 24 hours>.
3. The Digital Video Management System shall, at a minimum, combine multiplexing, alarm detection, video motion detection, video, audio, and text recording.

#### B. System Chassis

1. The Video Management System must utilize a chassis no larger than three rack units in height, and be suitable for either desktop or rack mount installations. The unit must fit within a standard video rack as well as a server rack.
2. The Video Management System's chassis shall include three indicator lights easily viewed from the front panel. These indicator lights must be colored red, yellow, and green to signify system status.
3. The Video Management System's chassis shall incorporate a minimum of four front accessible, swappable drive bays. The bays must be behind a locking front cover that restricts access not only to the drives, but also to the power switch and reset switch.

#### C. Operating System

1. The Video Management System's operating system and application must be installed on a separate solid-state system drive (flash memory card), with no moving parts to wear out or fail, to reduce the risk of system failure. Units with the operating system and/or application installed on a hard drive are not acceptable.

#### D. Recording

1. The Digital Video Management System shall use record mode settings as continuous or event activated.
2. The Digital Video Management System shall provide for simultaneous recording, playback, transmitting, database searching and archiving.
3. One channel of audio and up to sixteen text inputs shall be supported with required hardware properly installed and set up according to manufacturer's instructions. Live audio shall be available for listening while viewing live video. Up to 15 cameras shall be configurable as visible or covert by the authorized user.
4. The unit must simultaneously record, play back and archive video, text and audio while using sophisticated search functions to define

and find only those important events that meet certain criteria. The system must also have the ability to host multiple remote users, archive data, and search for data, all while recording multiple video and text streams.

5. The Video Management System shall offer recording rates of up to 480 ips at 1CIF, 480 ips at 2CIF, and 480 ips at 4CIF. The unit shall be able to mix record speeds and quality settings on a "per camera" basis.
6. The Video Management System shall have the ability to capture critical information with higher frame rates for certain cameras, and assign the remainder of the available images per second (ips) to non-critical cameras.
7. The Video Management System shall be available with up to 4 insert number TB of internal hard drive storage. A RAID 5 version shall be available with up to 3 TB of internal hard drive storage.
8. The Video Management System's recording format must give each image a unique identification "stamp" to ensure even though the file structure is PC compatible, the original video images cannot be altered or modified, enabling a solid chain of evidence.
9. The Video Management System shall be able to store recorded video on the RAID Storage System (RSS) via an iSCSI interface.
10. The Video Management System shall be able to manage storage of video, audio and text by exporting to Network Attached Storage (NAS), Storage Area Network (SAN) and Direct Attached Storage (DAS) devices using optional software.
11. The system shall provide option to set up the Video Management System in advanced security mode to enable both IT and security managers to collectively integrate the unit into existing IT network without compromising the security protocols in place.

#### E. Network Access

1. The Video Management System shall provide network access through two internal network connections that support 1/10 GB network operation.

#### F. User Interface

1. The Video Management System's user interface must be easy to use, allowing the user to access all operations using one-click buttons, pull-down menus, adjustable sliders, and tabbed screens.
2. The Video Management System shall include the ability to accept text through a network connection, as well as through a serial input with

an RS-232 connection. The unit shall be able to mix serial inputs and TCP/IP inputs in any combination up to 16 channels of text.

3. The system shall provide ability for user to specify text criteria, such as a specific ASCII text stream, to schedule recording and search for video, allowing for recording only the video associated with the specified text.

#### G. Live Video Display

1. The Digital Video Management System's live video display must provide real-time motion in any screen format (full, 2x2, 3x3, and 4x4). The operator shall have the ability to expand any view to full screen with a single click of the mouse.

#### H. Self-Monitoring Analysis

1. The Digital Video Management System must incorporate Self-Monitoring Analysis and Reporting Technology (S.M.A.R.T.), incorporating a suite of advanced diagnostics that monitor the internal operation of a drive and provide early warning for many types of potential problems. This shall allow for the drive to be repaired or replaced before any data is lost or damaged.

#### I. External Storage

1. Using the integrated CD/DVD writer (CD-RW or DVD-RW), the Digital Video Management System shall allow users to save video, audio, and text to a standard recordable CD or DVD. The option to include the player software on the CD or DVD shall be available so that no additional software needs to be purchased. The unit must include the ability to export the latest video, audio, and text to a CD or DVD until the CD or DVD is full.

#### J. Alarm Recording Settings:

1. The Digital Video Management System shall allow for the following Alarm Recording settings:
  - a. Image Rate
  - b. Quality
  - c. Sensitivity

#### K. Adjustable Alarm Duration

1. The Digital Video Management System shall incorporate an adjustable alarm duration with the pre-alarm and minimum alarm duration programmable from five seconds to five minutes. The units must also allow programmable recording times (alarm schedules) for each day of the week, in thirty minute increments.



L. Supported Dome Camera handlers

1. The Digital Video Management System shall work with the following dome camera handlers: AD168, MP48, AD1024 matrix, VM96RTT, RS422 Dome Control, VM16/ADTT16, VM16E/ADTT16E, Pelco Matrix Switch (models 6700, 6800, 8500, 9500, 9750 or 9760 Pelco P, Pelco D, Bosh, Autodome, BBV Starcard and USB-CCTV.

M. Alarm-Triggered Dome Events

1. The Digital Video Management System must include alarm-triggered dome events, allowing the operator to configure domes to respond to alarm conditions via Network Client™ or Intellex GUI (using supported dome control handlers). The event can be a motion filter (motion detection, perimeter protection, light change and motion exception), a wired alarm, video loss, or a manually generated alarm. The unit must have the ability to move a single dome, or multiple domes, to preset positions or patterns. This feature must be supported by the dome.

N. Email Support

1. The Digital Video Management System must include the ability to send an email via an email server to anyone, or any group, based upon an event. The events must include, but not necessarily limited to, the following:
  - a. System Event
  - b. Video Loss
  - c. Generated Alarm
  - d. Any Filter Alarm
  - e. Any Input Alarm
  - f. Individual Camera Alarm

O. API Support

1. The Digital Video Management System shall easily integrate with third party software application using an Application Programmers Interface (API). The manufacturer of the unit shall offer a Software Developers Kit (SDK) to select third party manufactures, in addition to sample modular programs with their source codes in both Visual Basic and Visual C++, allowing programmers to develop their own software to control the unit's functions.
2. The Digital Video Management System's API must be backwards compatible with previous versions of the software equal to or greater than v3.2

P. Recorded Event Search

1. In order to instantly retrieve recorded video of any event, the Digital Video Management System shall use a patented search feature to filter through hours of video to find only the essential events. The operator must have the ability to isolate video containing motion, and find video where perimeters were crossed, lights were turned on or off, alarms were triggered, and numerous additional scenarios.
2. In addition to the standard motion based mode, using advanced video analysis tools, the Digital Video Management System shall enable the user to schedule recording and search for video if the movement of an object meets specified size, speed, direction and Motion Exception criteria.

Q. Covert Camera Operation:

1. The Digital Video Management System shall include the ability to configure up to 15 cameras for "covert" operation, restricting their use to only those who are authorized.

R. Activity Log:

1. To provide for more effective security management, the Digital Video Management System must also allow for audits of the activity log to monitor changes to the settings and configurations. The activity log shall include, but not necessarily be limited to, the following information:
  - a. User Name - Login name of the user
  - b. Date/Time - Date and Time the action was performed
  - c. Access Loc - Whether the action was local to the unit or done through remote software
  - d. Category - The actions category
  - e. Activity - The action performed within the category
  - f. Data - Description of the action
2. The operator shall have the ability to export the entire log file, export the displayed log file, print the log file, or print the displayed log file locally and remotely through Network Client v4.3 software.

S. Antivirus Protection

1. The Digital Video Management System shall be compatible with the leading brands of anti-virus software in order to detect and deactivate malicious software that may attempt to attack the system.

T. Remote Configuration and Management software:

1. The Digital Video Management System must include support for Remote Configuration and Management software to allow a user to remotely configure the unit, view live video, or select video segments by time, date, alarm, or search results. The operator must have the ability to save, annotate, and organize copied video into "incident folders" to aid with investigations.
2. The remote management software must allow for up to 64 live video sessions, allowing the operator to view up to sixty four different cameras, from up to 64 different remote sites, simultaneously.
3. The remote management software shall also allow the exporting of video clips to an .avi file to play on any Microsoft Windows based PC. The software shall have the ability to enhance, print, or convert the individual images to standard formats.
4. The remote management software shall allow an operator to select units, cameras, and timeframes for automatic retrieval of video clips to an operators PC. This allows for downloads to be scheduled during times that network traffic restrictions are not an issue.

U. Playback and Multi-screen Playback

1. The Digital Video Management System shall incorporate playback and multi-screen playback functionality to allow the user to locate and select a single stored image to be enhanced using tools. The tools shall include, but not necessarily be limited to, the following:
  - a. Brightness
  - b. Contrast
  - c. Hue
  - d. Saturation
  - e. Lightness
  - f. Balance Light
  - g. Edge Detect
  - h. Enhance Light
  - i. Noise Reduction
  - j. Sharpen
  - k. Sharpen More
  - l. Smooth
  - m. Smooth More
  - n. Brightness Chart

V. Browser Client

1. A browser-based viewer (Browser Client) must also be available free of charge, enabling users to host and customize their own website to provide live viewing of the Digital Video Management System through a standard browser interface. Multiple viewers shall have the ability to access video and control domes remotely.

W. Minimum Performance Specifications

Power Supply	100-240 VAC, 50/60 Hz, 3.0/1.5A
Physical Characteristics:	Rack Mount Chassis Version Unit Dimensions (HxWxD) 130 mm (5.125") High, 429 mm (16.895") Wide, 546 mm (21.5") Deep Rack Height Three (3) units Desktop Chassis Version(HxWxD) 130 mm (5.125") High 429 mm (16.895") Wide 546 mm (21.5") Deep
Environmental Requirements	Operating Temperature 5° to 35° C (41° to 95° F) Humidity 5%-95% RH non-condensing
Regulatory	Immunity EN50130-4 (1996) (An Uninterruptable Power Supply must be used to fully comply with EN50130-4)

X. MATRIX SWITCHER

1. The matrix switcher shall meet the following minimum requirements:
  - a. Take multiple camera inputs and route them to multiple monitoring stations.
  - b. Allow for centralized user management controlling configurations.
  - c. Provide live viewing of all cameras.
  - d. Provide P/T/Z, focus, and iris control of all unitized cameras.
  - e. Be expandable to allow for the addition of multiple cameras and monitoring stations over the life of the system visual identification system by utilizing input and output video and controller cards.
  - f. Input cards shall allow for the addition of a minimum of four (4) camera inputs per card.

- g. Output cards shall allow for the addition of a minimum of eight (8) outputs per card.
  - h. Have the ability to be programmed either locally or remotely.
  - i. Remotely operate multiple cameras from multiple stations.
  - j. Be able to fully interface with a digital video recorder (DVR) for recording of all events.
  - k. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
  - l. Shall have an alarm interface that is compatible with all associated security subsystems. Alarm inputs shall be via either a relay or an EIA ANSI/EIA/TIA-232-F interface. The interface shall allow for a minimum of 24 alarm inputs and 12 alarm outputs.
  - m. The switcher response time to an alarm input shall not be less than 200 milliseconds from the time an alarm is sensed until a picture is displayed on a monitor.
  - n. The switcher shall have a built in buffer to allow for back-log of alarms. These alarms shall be viewable by an operator.
  - o. Be addressable in the event multiple matrix switchers are connected to the SMS.
  - p. Be configured, i.e. camera names, monitor names, sequences, alarms and alarm actions, etc. utilizing the configuration program and tools provided by the matrix manufacturer.
2. The matrix switcher shall meet the following minimum input/output requirements:

Camera inputs	16
Video outputs	4
Keyboard/Controller Outputs	4
Alarm inputs	323

3. The matrix switcher will have the following components and technical characteristics:
- a. Main Unit:

Functions	Monitor control Camera selection, tour sequence, group sequence, group preset, OSD display, Camera/Receiver control via coaxial or RS-485 cable communication, Recorder control
-----------	---

Alarm control	Alarm event, Alarm Acknowledge, Alarm reset, Alarm suspension, Alarm History Display, Timer event, and Camera event
RS-485 (Camera)Port	6-conductor modular jack x 12 (2- wire or 4- wire communication, With termination switches (MODE 1 to 4))
Extension Port	6-conductor modular jack x 2(With a (EXTENSION 1 IN, OUT) termination switch (TERM: ON, OFF))
Extension Port	37-pin D-sub connector x 2(EXTENSION IN 2 or 3)
Extension Port	37-pin D-sub connector x 2(EXTENSION OUT 2 or 3)

## b. Input Board:

Camera Input	1 V [P-P]/75 Ohm (BNC), composite video signal 0.5 V [P- P]/75 Ohm data signal and 2.5 V [P- P]/75 Ohm (25 pin D sub connector x 4)
Alarm Input	N.O. (Normally Open contact) or N.C. (Normally Close contact) selectable x 32 (37 pin D sub connector)

## c. Output Board:

Monitor Output	1 V [P-P]/75 Ohm (BNC)
Alarm Output	Open collector output x 32, Max. 24 VDC, 100 mA
Extension Port	6-conductor modular jack x 2
Serial Port	9-pin D-sub connector x 2

## Y. IP Network Encoder

1. The units shall be used for video monitoring and surveillance over IP networks. IP Network Encoder shall encode analog video to MPEG-4 digital video.
2. The encoder shall use MPEG-4 compression for distribution of images over a network.
3. The encoder shall be [rack][surface] <erase one> mounted unit.
4. The encoder shall include, but not be limited to the following:
  - a. The encoder shall use "hybrid" technology in providing both analog and network connections with the purpose of allowing users to integrate existing equipment and digital IP products.
    - 1) The encoder shall provide [one] <insert number of video inputs> composite video input(s).
    - 2) The encoder shall provide one Ethernet connection.

- b. The encoder shall have the following digital resolution:
  - a) D1: 720x576 (NTSC); 720x480 (PAL)
  - b) CIF: 352 x 288 (NTSC); 352 x 240 (PAL)
  - c) QCIF: 160 x 144 (NTSC); 160 x 112 (PAL)
- c. The encoder shall have a digital frame rate of up to 30 frames per second (NTSC) at 720x480 resolution or 25 fps (PAL) at 720x586 resolution.
- d. The encoder/decoder shall use the following protocols:
  - 1) TCP/IP
  - 2) UDP/IP
  - 3) DHCP
  - 4) Multicast
  - 5) Data Throttle
  - 6) Heart beat
- e. The encoder shall have the following connectors:
  - 1) Power connector: 3-pin male - for connecting the external power supply
  - 2) I/O connector: 16-pin male - for connecting alarm, audio, RS-232, RS-485 input and output
  - 3) Video I/O connector: SVHS style - for input and output connection of two composite monitors
  - 4) Ethernet port: RJ-45 - for connecting to a network
- f. The encoder/decoder shall have the following indicators:
  - 1) Power LED
  - 2) Link - indicates activity on the Ethernet port
  - 3) Tx activity
  - 4) Rx activity
- g. The encoder shall have the following additional specifications:
  - 1) Video
    - a) Video signal input: 1 V p-p  $\pm 10\%$  75 ohms, autosensing
    - b) Input termination: 75 ohm
    - c) Video compression standard: MPEG-4
    - d) Audio compression standard: MPEG-1 Layer 2
  - 2) Audio
    - a) Audio input: 315 mV, 40 kOhms, unbalanced
    - b) Audio output: 315 mV, 600 ohms, unbalanced
  - 3) Electrical
    - a) External power supply: 100 to 240 VAC

- b) Output voltage: 13.5 V, 1.33 A
- c) Power consumption: 0.5 W maximum

## 2.3 DIGITAL BASED VIDEO MANAGEMENT SYSTEM

### A. Key Features

1. Open Platform: Open API/SDK, supports seamless integration with third party applications.
2. Multi-server and multi-site video surveillance solution: Unlimited recording of video from IP cameras, IP video encoders and selected DVRs with analog cameras.
3. Optimized Recording Storage Management: Unique data storage and archiving solution that combines superior performance and scalability and cost efficient long-term video storage
4. Wide IP camera and device support: Supports connection of more than 839 IP cameras, IP video encoders and selected DVR models from over 79 different vendors through dedicated device integration
5. ONVIF™ and PSIA compliant: Supports ONVIF™ and PSIA compliant cameras and devices
6. Wide compression technology support: Supports the news compression methods; MPEG4 ASP, MxPEG and H.264, besides MJPEG and MPEG4
7. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration
8. Sequence Explorer: Displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
9. Overlay buttons: Intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
10. Independent Playback: Instant and independent playback function allows you to independently playback recorded video for one or more cameras, while in live viewing or playback mode
11. Built-in Video Motion Detection: Independent of camera model and supporting up to 64 cameras simultaneously per server
12. Multiple language support: Let operators use the system in their native language with support for 20 different languages
13. Multi-channel, two-way audio: Communicate with people at gates/entrances or broadcast messages to many people at once with multichannel, two-way audio



14. Fast evidence export: Quickly deliver authentic evidence to public authorities by exporting video to various formats, including video from multiple cameras with viewer, logs, and user notes included

#### B. Administration Features

1. Single Management Application: A new Management Application provides a consolidated single point management access to Recording Servers.
2. System configuration wizards: Guides the user through the process of adding cameras, configuring video and recording, adjustment of motion detection and user configuration.
3. Automated device discovery: Enables fast discovery of camera devices using methods such as Universal Plug And Play, Broadcast and IP Range scanning.
4. Smart bulk configuration option: Change settings across multiple devices simultaneously and in a very few clicks.
5. Adaptable application behavior: Guides novice users, while expert users can optimize the application for efficient use.
6. Export/import of system and user configuration data: System backup for reliable system operation and fast system recovery. System cloning for efficient rollout of multiple systems with the same, or similar, configuration.
7. Import of off-line configuration data: Enabling off-line editing of configuration data, including camera and device definitions.
8. Automatic system restore points: A 'Restore Point' is created each time a configuration change is confirmed.
9. Enables easy rollback to previously defined system configuration points and enables cancelation of undesired configuration changes and restoration of earlier valid configurations.

#### C. Integration Options

1. Open Software Development Kit (SDK) makes it possible to video enable your business processes, through seamless integration of third party applications, such as video analytics, access systems, etc.
2. Compatible with Central for alarm overviews and operational status in larger video surveillance installations.
3. Integrate with physical access control systems, alarms, gates, building management systems, etc. using hardware I/O, internal events and TCP/IP events

4. Create, import and use HTML pages for navigation between views or to trigger a Smart Wall preset
5. Develop third party plug-ins for the Smart Client to expand with new functionality

#### D. Server Modules

1. Recording Server
  - a. Simultaneous digital multi-channel video and audio recording and live viewing (relaying).
  - b. Two-way audio enables integrated control of microphones and speakers connected to IP devices.
  - c. Bandwidth optimized multi-streaming by splitting a single camera video stream to differentiated streams for live view and recording, where each can be optimized independently with respect to frame rate and resolution.
  - d. Connectivity to cameras, video encoders and selected DVRs supports MJPEG, MPEG4, MPEG4 ASP\*, H.264\* and MxPEG.
  - e. Auto-detect camera models during setup.
2. Flexible multi-site, multi-server license structure charged per camera.
3. Unlimited number of installed cameras; simultaneous recording and live view of up to 64 cameras per server.
4. Recording technology: secure high speed database holding JPEG images or MPEG4 and MxPEG streams including audio.
5. Recording speed: 30+ frames per second per camera, limited only by hardware.
6. Recording quality depends entirely on camera and video encoder capabilities: no software limitation.
7. Start cameras on live view requests from clients.
8. Unlimited recording capacity with multiple archives possible per day.
9. Hourly to daily database archiving with optional automatic move to network drive saves storage capacity on the local server - with images still available transparently for playback
10. Built-in, real-time, camera independent motion detection (VMD); fully adjustable sensitivity, zone exclusions, recording activation with frame rate speed up, and alert activation through email or SMS.
11. Start recording on event.

12. Client initiated start of recording based on pre-defined recording time and access privileges.
  13. Pan Tilt Zoom (PTZ) preset positions, up to 50 per camera.
  14. Absolute\* and relative PTZ positioning.
  15. PTZ go-to preset position on events.
  16. Combine PTZ patrolling and go-to positions on events.
  17. Set multiple patrolling schedules per camera per day: i.e. different for day/night/weekend.
  18. PTZ scanning on supported devices: viewing or recording while moving slowly between PTZ positions.
  19. VMD-sensitive PTZ patrolling among selected presets allows sending of Wipe and Wash commands to supported PTZ models.
  20. On pre-defined events Matrix remote commands are automatically sent to display live video remotely on computers running the Matrix Monitor or the Smart
  21. Client with Matrix Plug-in.
    - a. Flexible notification (sound, e-mail and SMS) and camera patrolling scheduling, triggered by time or event.
- E. Recording Server Manager
1. Local console management of the Recording Server accessible from the notification area.
  2. Start and stop Recording Server service.
  3. Access to Recording Server configuration settings.
  4. Access to Recording Server help system.
  5. View system status and log information.
- F. Image Server
1. Remote access for Smart and Remote Clients.
  2. Built-in web server for download and launch of clients and plug-ins.
  3. Set up one Master and multiple Slave Servers.
  4. Authenticate access based on Microsoft Active Directory user account, or user name and password.
  5. Authorize access privileges per Microsoft Active Directory user account/group, user profile or grant full access.
  6. User profiles control access to: Live view, PTZ, PTZ presets, Output control, Events, Listen to microphone, Talk to speaker, Manual recording; Playback, AVI export, JPG export, DB export, Sequences, Smart Search and audio. As well as Set up views, Edit private views and Edit shared public views.

7. Audit logs of exported evidence by user and file.
8. Audit logs of client user activity by time, locations and cameras.

#### G. Recording Viewer

1. Playback recorded video and audio locally on the

#### H. Recording Server.

1. View up to 16 cameras time-synched during playback.
2. Scrollable activity timeline with magnifying feature.
3. Instant search on recordings based on date/time and activity/alarm (Video Motion Detection).
4. 'Smart Search' for highlighted image zones and objects.
5. Evidence can be generated as a printed report, a JPEG image, an AVI film or in the native database format.
6. Export audio recordings in WAV or AVI format.
7. Export video digitally zoomed to view area of interest only and to minimize export footprint size.
8. Export 'Evidence CD' containing native database and Recording Viewer for instant, easy viewing by authorities.
9. Encryption & password protection option for exported recordings and files.
10. Ability to add comments to exported evidence, also encrypted.
11. Option to send email.
12. De-interlacing of video from analog cameras.
13. IPIX technology for PTZ in 360° recorded images.

#### I. PDA Server

1. Remote access for PDA Client.
2. Handle login and session requests between PDA clients and Image Server.
3. Resize video surveillance images to fit the screen layout of PDA Client.

#### J. Smart Client Module

1. Smart Client includes all the features of Remote Client plus more:
2. Installed per default on Recording Server for local viewing and playback of video and audio.
3. Start recording on cameras for a pre-defined time (default 5 minutes). Subject to privileges set by administrator.
4. • Independent Playback capability allows for instant playback of recorded video for one or more cameras, while in live and playback mode

5. Live view digital zoom allows zoomed-out recordings while the operator digitally can zoom in to see details.
6. 'Update On Motion Only' optimizes CPU usage by letting motion detection control whether the image should be decoded and displayed or not. The visual effect is a still image in the view until motion is detected.
7. Shared and private camera views offer 1x1 up to 10x10 layouts in addition to asymmetric views.
8. Views optimized for both 4:3 and 16:9 screen ratios.
9. Multiple computer monitor support with a main window and any number of either windowed or full screen views.
10. Hotspot function for working in details with a camera selected from a view containing multiple cameras.
11. Carousel function allows a specified view to rotate between pre-defined cameras with individual timing and order with multiple appearances. Carousel function can be controlled allowing the operator to pause carousel function and to switch to previous or next camera.
12. Overlay buttons provides intuitive control of cameras, camera-integrated devices and other integrated systems- directly from the camera view
13. Matrix function to view live video from multiple cameras through the Image Server in any view layout with customizable rotation path, remotely controlled by Smart
14. Clients or Recording Servers sending Matrix remote commands
15. Send Matrix remote commands to display live video remotely on computers running the Matrix Monitor or the Smart Client with Matrix Plug-in.
16. Cameras' built-in audio sources available in live and in playback.
17. Separate pop-up window displaying sequences and time intervals in thumbnail pre-views, the Sequence Explorer gives unparalleled visual overview of recorded video combined with smooth navigation
18. Presents recorded sequences for individual cameras, or all cameras in a view
19. Seamlessly available in both Live and Playback modes
20. Smooth navigation with sliding preview and "drag-andthrow" function for video thumbnails
21. Instant playback of video sequences

22. Application Options allows users to adapt the layout and personalize the application to their particular preferences

#### K. Remote Client

1. View live video or playback recordings for 1-16 cameras simultaneously; from the same or different servers.
2. Advanced video navigation including fast/slow playback, jump to date/time, single step and video motion search.
3. Individual views can be user-defined in various layouts: view or playback camera images from multiple servers simultaneously in the same view.
4. Shared views can be managed centrally via the server with admin/user rights and user groups.
5. Import static or active HTML maps for fast navigation to cameras and good premise overviews.
6. Control output port relay operation, for example control of gates.
7. Quick overview of sequences with detected motion and preview window.
8. Quick overview of events/alerts.
9. Control PTZ cameras remotely, also using preset positions.
10. Remote PTZ Point-and-Click control
11. Remote PTZ zoom to a marked rectangle.
12. Take manual control over a PTZ camera that runs a patrolling scheme; after a timeout with no activity the camera reverts to its scheduled patrolling.
13. IPIX 1x2 or 2x2 'Quad View' for viewing all 360° at once.
14. Optional video compression in streaming from server to client gives better use of bandwidth.
15. Create AVI files or save JPEG images.
16. Print incident reports with free-text user comments.
17. System logon using user name and password.
18. System logon using Microsoft Active Directory user accounts.

#### L. PDA Client

1. View live or playback video from a single server or from multiple servers in half-screen or full-screen formats.
2. In live view you can control Pan/Tilt/Zoom cameras manually or use preset positions, and control the cameras' output relays to trigger external actions like opening doors or gates, turning on lights, etc.

3. To find recordings, you can jump to specific time/date or to next detected motion, or use motion detection sequence overviews.
4. When viewing recordings, you can playback at variable speed or single step image by image.
5. The PDA client shall connect to the VMS server using any IP connection; typically wireless LAN, GPRS, etc.
6. Video compression from the server to PDA optimizes bandwidth usage.
7. System logon using user name and password.

#### M. Matrix Monitor

1. Virtual Matrix showing live video directly from up to 4 cameras at a time triggered remotely by Matrix remote commands.
2. Camera view shifts by FIFO (first-in-first-out)
3. Multiple events can control a single Matrix monitor and single events can control multiple monitors.

#### N. Minimum System Requirements VMS Server

1. HW Platform:
  - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
  - b. Minimum 1 GB disk space available, excluding space needed for recordings.
2. OS:
  - a. Microsoft® Windows® XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista™ Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*), Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).
3. Software:
  - a. Microsoft .NET 3.5 Framework SP1, or newer.
  - b. DirectX 9.0 or newer required to run Playback Viewer application.

#### O. Minimum System Requirements PDA Server

1. HW Platform:
  - a. Minimum 2.4 GHz CPU and 1 GB RAM (2.4 GHz dual core processor and 2 GB RAM or more recommended).
  - b. Minimum 1 GB disk space available.
2. OS:

- a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*).

3. Software:

- a. Microsoft .NET 2.0 (not compatible with newer versions). Internet Information Server (IIS) 5.1.

P. Minimum System Requirements VMS Client

1. HW Platform:

- a. Minimum 2.4 GHz CPU, 1 GB RAM (more powerful CPU and higher RAM recommended for Smart Clients running high number of cameras and multiple views and displays).

2. Graphics Card:

- a. AGP or PCI-Express, minimum 1024 x 768 (1280 x 1024 recommended), 16 bit colors.

3. OS:

- a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*), Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).

4. Software:

- a. DirectX 9.0 or newer required to run Playback Viewer application.
- b. Microsoft .NET 3.5 Framework SP1, or newer.

Q. Minimum System Requirements VMS Remote Client

1. HW Platform:

- a. Minimum 2.4 GHz CPU, RAM 1 GB (2 GB or higher recommended on Microsoft Windows Vista).

2. OS:

- a. Microsoft Windows XP Professional (32 bit or 64 bit\*), Windows Server 2003 (32 bit or 64 bit\*), Windows Server 2008 R1/R2 (32 bit or 64 bit\*), Windows Vista Business (32 bit or 64 bit\*), Windows Vista Enterprise (32 bit or 64 bit\*) and Windows Vista Ultimate (32 bit or 64 bit\*), Windows 7 Professional (32 bit or 64 bit\*), Windows 7 Enterprise (32 bit or 64 bit\*) and Windows 7 Ultimate (32 bit or 64 bit\*).

3. Software:



- a. DirectX 9.0 or newer required to run Playback Viewer Application
- Microsoft Internet Explorer 6.0, or newer, 32 bit version required

#### R. Licensing Structure

##### 1. Base Server License

- a. An VMS Base Server license is mandatory for installing the product.

##### 2. The Base Server license contains:

- a. Unlimited numbers of Recording Server licenses
- b. Unlimited numbers of Smart Clients, Remote Clients, PDA Clients and Matrix Monitor licenses

##### 3. Camera License

- a. To connect to a camera, a Device License per camera channel is required
- b. In total, for all copies of the product installed under a given Base Server license, the product may only be used with as many cameras as you have purchased camera licenses for • Video encoders and DVRs with multiple analog cameras require a license per channel to operate
- c. Camera Licenses can be purchased in any numbers. To extend the installation with additional Camera Licenses, the Base Server License number (SLC) is required when ordering.

##### 4. Client License:

- a. All client modules are not licensed and can be installed and used on any number of computers.

#### S. IP NETWORK DECODER

- 1. The unit shall be used for video monitoring and surveillance over IP networks. Network decoder shall decode MPEG-4 digital video to analog video.
- 2. The decoder shall use MPEG-4 compression for efficient distribution of images over a network.
- 3. The decoder shall be available as a standalone unit that can be horizontally or vertically mounted.
- 4. The decoder shall include, but not be limited to the following:
  - a. The decoder shall use "hybrid" technology in providing both analog and network connections with the purpose of allowing users to integrate existing equipment and digital IP products.

- 1) The decoder shall provide one composite video input and output connection.
- 2) The decoder shall provide one Ethernet connection.
- b. The decoder shall have the following digital resolution:
  - 1) D1: 720x576 (NTSC); 720x480 (PAL)
  - 2) CIF: 352 x 288 (NTSC); 352 x 240 (PAL)
  - 3) QCIF: 160 x 144 (NTSC); 160 x 112 (PAL)
- c. The decoder shall have a digital frame rate of up to 30 frames per second (NTSC) at 720x480 resolution or 25 fps (PAL) at 720x586 resolution.
- d. The decoder shall use the following protocols:
  - 1) TCP/IP
  - 2) UDP/IP
  - 3) DHCP
  - 4) Multicast
  - 5) Data Throttle
  - 6) Heart beat
- e. The decoder shall have the following connectors:
  - 1) Power connector: 3-pin male - for connecting the external power supply
  - 2) I/O connector: 16-pin male - for connecting alarm, audio, RS-232, RS-485 input and output
  - 3) Video I/O connector: SVHS style - for input and output connection of two composite monitors
  - 4) Ethernet port: RJ-45 - for connecting to a network
- f. The decoder shall have the following indicators:
  - 1) Power LED
  - 2) Link - indicates activity on the Ethernet port
  - 3) Tx activity
  - 4) Rx activity
5. The decoder shall have the following additional specifications:
  - a. Video
    - 1) Video signal output: 1 V p-p into 75 ohms
    - 2) Input termination: 75 ohm
    - 3) Video compression standard: MPEG-4
    - 4) Audio compression standard: MPEG-1 Layer 2
  - b. Audio
    - 1) Audio input: 315 mV, 40 kOhms, unbalanced

- 2) Audio output: 315 mV, 600 ohms, unbalanced
- c. Electrical
  - 1) External power supply: 100 to 240 VAC
  - 2) Output voltage: 13.5 V, 1.33 A
  - 3) Power consumption: 0.5 W maximum

## 2.4 VIDEO DISPLAY EQUIPMENT

### A. Video Display Equipment

- 1. Will consist of color monitors and shall be EIA 375A compliant.
- 2. Shall be able to display analog, digital, and other images in either NTSC or MPEG format associated with the operation of the Security Management System (SMS).
- 3. Shall:
  - a. Have front panel controls that provide for power on/off, horizontal and vertical hold, brightness, and contrast.
  - b. Accept multiple inputs, either directly or indirectly.
  - c. Have the capabilities to observe and program the VASS System.
  - d. Be installed in a manner that they cannot be witnessed by the general public.

### B. Color Video Monitors Technical Characteristics:

Sync Format	PAL/NTSC
Display Tube	90° deflection angle
Horizontal Resolution	250 TVL minimum, 300 TVL typical
Video Input	1.0 Vp-p, 75 Ohm
Front Panel Controls	Volume, Contrast, Brightness, Color
Connectors	BNC

### C. Liquid Crystal Display (LCD) Flat Panel Display Monitor

- D. The 17-inch color LCD monitor shall have a flat screen and 17-inch diagonal viewing area and consists of an LCD panel, bezel, and stand.
- E. The monitor shall meet or exceed the following specifications:
  - 1. The monitor shall incorporate a 17.1-inch active matrix TFT LCD panel.
    - a. The pixel pitch of the monitor's LCD panel shall be 0.264 mm horizontal and 0.264 mm vertical.

- b. The monitor shall have a maximum resolution of <500> <insert resolution> television lines.
  - c. The contrast ratio shall be 500:1.
  - d. The typical brightness shall be 250 cd/m<sup>2</sup>
  - e. The monitor shall display at least 16.7 million colors.
  - f. The light source for the LCD panel shall have a lifetime of 50,000 hours.
  - g. The scan frequency horizontal shall be 30 K to 80 KHz and the scan frequency vertical shall be 56 to 75 Hz.
  - h. The viewing angle for the monitor shall be 170 degrees horizontal and 170 degrees vertical.
- 2. The monitor shall have automatic NTSC or PAL recognition.
  - 3. The monitor shall have a picture-in-picture function.
  - 4. The monitor shall use the following signal connectors:
    - a. Video 1.0 V peak-to-peak at 75 ohms
    - b. BNC in/out
    - c. Y/C (S-video) in/out
    - d. Audio in/out
    - e. VGA 15-pin D-Sub
  - 5. The monitor shall have [one/two] <insert number> audio speaker(s).
    - a. The speaker shall be 0.5 W minimum.
  - 6. The monitor shall have the following front control panel buttons:
    - a. Power on/off
    - b. LED indicator
    - c. Mode
    - d. Increase (volume)
    - e. Decrease (volume)
    - f. Up (contrast adjustment)
    - g. Down (brightness adjustment)
    - h. Menu
    - i. Auto
  - 7. The monitor shall have the following options for adjustment in an onscreen display menu:
    - a. Color
    - b. Tint
      - 1) NTSC mode only
        - a) Brightness
        - b) Contrast

- c) Sharpness
- d) Volume
- e) Language
- f) Scan
- g) Color Temp
- h) H-Position
- i) Recall

F. The electrical specifications for the monitor shall be as follows:

- 1. Input voltage shall be 12 VDC/3 A.
- 2. Power consumption shall be 50 W maximum.

G. The environmental specifications for the monitor shall be as follows:

- 1. Operating temperature shall be 32 to 104 degrees Fahrenheit or 0 to 40 degrees Celsius.
- 2. Operating humidity shall be 10 to 85 percent.

H. The physical specifications for the monitor shall be as follows:

I. The monitor shall conform to these compliance standards:

- 1. FCC
- 2. CE (EMC/LVD)3. UL

## 2.5 CONTROLLING EQUIPMENT

- A. Shall be utilized to call up, operate, and program all cameras associated VASS System components.
- B. Will have the ability to operate the cameras locally and remotely. A matrix switcher or a network server shall be utilized as the VASS System controller.
- C. The controller shall be able to fit into a standard 47.5 cm (19 inch) equipment rack.
- D. Control and programming keyboards shall be provided with its own type of switcher. All keyboards shall:
  - 1. Be located at each monitoring station.
  - 2. Be addressable for programming purposes.
  - 3. Provide interface between the operator and the VASS System.
  - 4. Provide full control and programming of the switcher.
  - 5. Have the minimum following controls:
    - a. programming
    - b. switching
    - c. lens function
    - d. P/T/Z

- e. environmental housing
- f. annotation

## 2.6 VIDEO CAMERAS

- A. The cameras shall be high-resolution color video cameras with wide dynamic range capturing capability.
- B. The camera shall meet or exceed the following specifications:
  - 1. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
    - a. The image capturing device shall have a separate analog-to-digital converter for every pixel.
    - b. The image capturing device shall sample each pixel multiple times per second.
    - c. The dynamic range shall be 95 dB typical and 120 dB maximum.
  - 3. The camera shall optimize each pixel independently.
  - 4. The camera shall have onscreen display menus for programming of the camera's settings.
  - 5. The signal system shall be NTSC.
- C. The camera shall have composite video output.
- D. The camera shall come with a manual varifocal lens.
- E. The video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.
- H. Fixed Color Camera
  - 1. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
  - 2. Comply with UL 639.
  - 3. Pickup Device: [1/3]/[1/4] CCD interline transfer.
  - 4. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
  - 5. With AGC, manually selectable on or off.
  - 6. Manually selectable modes for backlight compensation or normal lighting.
  - 7. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
  - 8. White Balance: Auto-tracing white balance, with manually selectable fixed balance option.
  - 9. Fixed Color Cameras Technical Characteristics:

Pickup device	1/3" interline transfer CCD
---------------	-----------------------------

Total pixels	NTSC: 811(H) x 508(V)
Effective pixels	NTSC: 768(H) x 494(V)
Resolution	500 TV lines
Sync. System	Internal Sync
Scanning system	NTSC: 525 Lines/60 Fields
S/N ratio	More than 48 dB
Electronic shutter	Auto 1/60 (1/50) ~1/100,000 sec.
Min. illumination	0.2 lux F2.0
Video output	Composite 1.0 Vp-p/75 ohm
White balance	Auto
Automatic gain control	ON
Frequency horizontal	NTSC: 15.734 KHz
Frequency vertical	NTSC: 59.94Hz
Lens type	Board lens/[DC]/[AI] varifocal lens
Focal length	[3-12mm]<insert values>
Power source	DC12V/500mA or AC24/500mA
Power consumption	< 3W (Max)

10. Fixed color camera shall be enclosed in dome and have board mounted varifocal lens.

11. Camera accessories shall include:

- a. Surface mount adapter
- b. Wall mount adapter
- c. Flush mount adapter

## **2.7 AUTOMATIC COLOR DOME CAMERA - ANALOG**

- A. The camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
- B. Comply with UL 639.
- C. Pickup Device: 1/3 CCD interline transfer.
- D. Horizontal Resolution: 480 lines.
- E. Signal-to-Noise Ratio: Not less than 50 dB, with the camera AGC off.
- F. With AGC, manually selectable on or off.
- G. Sensitivity: Camera shall provide usable images in low-light conditions, delivering an image at a scene illumination of 3 lux at F1.4.
- H. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. The illumination for the test shall be

with lamps rated at approximately 2200-K color temperature, and with the camera AGC off.

- I. Manually selectable modes for backlight compensation or normal lighting.
- J. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be variable controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.
- K. Preset positioning: 64 user-definable scenes. Controls shall include the following:
  - 1. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
  - 2. Motion detection shall be available at each camera position.
- L. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.
- M. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
- N. Motion Detector: Built-in digital.
- O. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.
- P. Automatic Color Dome Camera Technical Characteristics:

Effective Pixels	768 (H) x 494 (V)
Scanning Area	1/4-type CCD
Synchronization	Internal/Line-lock/Multiplexed Vertical Drive (VD2)
Video Output	1.0 v[p-p] NTSC composite/75 ohm
H. Resolution	570-line at B/W, or 480-line at color imaging
Signal-to-noise Ratio	50dB (AGC off, weight on)
Super Dynamic II	64 times (36dB) (selectable on/off)
Minimum Illumination	0.06 lx (0.006 fc) at B/W, 1 lx(0.1 fc)
Zoom Speed	Approx. 2.1s (TELE/WIDE) in sequence mode
Focus Speed	Approx. 2s (FAR/NEAR) in sequence mode



Iris	Automatic (Open/Close is possible)/manual
Maximum Aperture Ratio	1:1.6 (Wide) ~ 3.0 (Tele)
Focal Length	3.79 ~ 83.4 mm
Angular Field of View	H 2.6° ~ 51.7° V 2.0° ~ 39.9°
Electronic Shutter	1/60 (off), 1/100, 1/250, 1/500, 1/1,000, 1/2,000, 1/4,000, 1/10,000 s
Zoom Ratio	Optical 22x w/10x electronic zoom
Iris Range	F1.6 ~ 64, Close
Panning Range	360° endless
Panning Speed	Manual: Approx. 0.1°/s ~ 120°/s 16 steps
Tilting Range	0 ~ 90° (Digital Flip off), 0 ~180° (Digital Flip on)
Tilting Speed	Manual: Approx. 0.1°/s ~ 120°/s. 16 steps
Pan/Tilt	Manual/Sequential position/Auto Pan
Controls	Pan/Tilt, Lens, 64 Preset Positions, Home Position
Video Connector	BNC
Controller I/F	Multiplex-coaxial

Q. Camera accessories shall include:

1. Surface mount adapter
2. Wall mount adapter
3. Flush mount adapter

R. Indoor/Outdoor Fixed Mini Dome System (IP)

1. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)
Dynamic Range	102 dB typical/120 dB maximum

	(DW/CW models only)															
Scanning System	2:1 interlace (progressive option on CW/DW models only)															
Synchronization	Internal															
Electronic Shutter Range	Auto (1/15-1/22,000)															
Lens Type	Varifocal with auto iris															
Format Size	1/3-inch															
Focal Length	3.0 mm-9.5 mm 9.0 mm-22.0 mm <list>															
Operation	Iris   Auto (DC-drive) Focus Manual Zoom   Manual															
Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)															
Compression	MPEG-4, MJPEG in Web viewing mode															
Video Streams	3, simultaneous															
Video Resolutions	<table><tr><td></td><td>NTSC</td><td>PAL</td></tr><tr><td>4CIF</td><td>704 x 480</td><td>704 x 576</td></tr><tr><td>2CIF</td><td>704 x 240</td><td>704 x 288</td></tr><tr><td>CIF</td><td>352 x 240</td><td>352 x 288</td></tr><tr><td>QCIF</td><td>176 x 120</td><td>176 x 144</td></tr></table>		NTSC	PAL	4CIF	704 x 480	704 x 576	2CIF	704 x 240	704 x 288	CIF	352 x 240	352 x 288	QCIF	176 x 120	176 x 144
	NTSC	PAL														
4CIF	704 x 480	704 x 576														
2CIF	704 x 240	704 x 288														
CIF	352 x 240	352 x 288														
QCIF	176 x 120	176 x 144														
Bit Rate	Configurable, 20 kbps to 2 Mbps per stream															
Web User Interface																
Environment	Low temperature, indoor/outdoor															
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X															
Cabling	CAT5 cable or better for 100BASE-TX															
Input Voltage	24 VAC (18-36) or PoE input voltage															
Power Consumption	<7.5 Watts,<13 Watts with heaters 24VAC: <0.5 Amps, <0.9 Amps with heaters															

Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)
Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°
Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

### 3. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount

### S. Megapixel High Definition Integrated Digital Network Camera

1. The network camera shall offer dual video streams with up to 3.1 megapixel resolution (2048 x 1536) in progressive scan format.
2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white (B-W).
7. The network camera shall have removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.

8. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.
9. The network camera shall support industry standard Power over Ethernet (PoE)
10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
13. The network camera shall support standard IT protocols.
14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.
15. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms) 0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG

Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution, and stream configuration)
Available Resolutions	<p>3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264</p> <p>2.1 MPx1920 x 1080; 16:9 aspect ratio: 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264</p> <p>1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264</p> <p>1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max., 10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264</p> <p>0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max., 1.6 Mbps bit rate H.264</p> <p>0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264</p> <p>Additional 640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176</p>
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to

	16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat5 cable or better for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)
Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

#### 16. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount

#### 17. Recommended Lenses

- a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
- b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
- c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
- d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

#### T. Indoor/Outdoor Camera Dome System

1. The indoor/outdoor camera dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
2. The indoor/outdoor camera dome system shall operate in open architecture connectivity for third-party software recording solutions.
3. The indoor/outdoor VASS camera dome system shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360° rotation; 1/4-inch high resolution color, or color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus; and

an enclosure consisting of a back box, lower dome, and a quick-install mounting.

4. Indoor/Outdoor fixed dome system technical specifications:

Imaging Device	1/4-inch CCD
Picture Elements	NTSC/PAL 768 x 494/752 x 582
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace
Synchronization	Internal
Electronic Shutter Range	Auto (1/15-1/22,000)
Lens Type	Lens f/1.4 (focal length, 3.4~119 mm; 35X optical zoom, 12X digital zoom)
Focus	Automatic with manual override
Pan Speed	Variable between 400° per second continuous pan to 0.1° per second
Vertical Tilt	Unobstructed tilt of +2° to -92°
Manual Control Speed	Pan speed of 0.1° to 80° per second, and pan at 150° per second in turbo mode. Tilt operation shall range from 0.1° to 40° per second
Automatic Preset Speed	Pan speed of 400° and a tilt speed of 200° per second
Presets	256 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, LowLight™ limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu  128 positions with a 20-character label available for each position; programmable camera settings, including selectable auto focus modes, iris level, LowLight limit, and backlight compensation for each preset; command to copy camera settings from one preset to another; and preset programming through control keyboard or through dome system on-screen menu
Preset Accuracy	± 0.1°

Zones	8 zones with up to 20-character labeling for each, with the ability to blank the video in the zone
Limit Stops	Programmable for manual panning, auto/random scanning, and frame scanning
Alarm Inputs	7
Alarm Output Programming	Auxiliary outputs can be alternately programmed to operate on alarm
Alarm Action	Individually programmed for 3 priority levels, initiating a stored pattern or going to a preassigned preset position
Resume after Alarm	After completion of alarm, dome returns to previously programmed state or its previous position
Window Blanking	8, four-sided user-defined shapes, each side with different lengths; window blanking setting to turn off at user-defined zoom ratio; window blanking set to opaque gray or translucent smear; blank all video above user-defined tilt angle; blank all video below user-defined tilt angle
Patterns	8 user-defined programmable patterns including pan/tilt/zoom and preset functions, and pattern programming through control keyboard or through dome system on-screen menu
Scheduler	Internal scheduling system for programming presets, patterns, window blanks, alarms, and auxiliary functions based on internal clock settings
Auto Flip	Rotates dome 180° at bottom of tilt travel
Password Protection	Programmable settings with optional password protection
Compass Display	On-screen display of compass heading and user-definable compass setup
Camera Title Overlay	20 user-definable characters on the screen camera title display
Video Output Level	User-selectable for normal or high output levels to compensate for long video wire runs



Motion Detection	User-definable motion detection settings for each preset scene, can activate auxiliary outputs, and contains three sensitivity levels per zone															
Electronic Image Stabilization	Electronic compensation for external vibration sources that cause image blurring; user selectable for 2 frequency ranges, 5 Hz (3-7 Hz) and 10 Hz (8-12 Hz)															
Wide Dynamic Range	128X															
Video Output	1 Vp-p, 75 ohms															
Minimum Illumination	NTSC/EIA 0.55 lux at 1/60 sec shutter speed (color), 0.063 lux at 1/4 sec shutter speed (color), 0.00018 lux at 1/2 sec shutter speed (B-W)  PAL/CCIR 0.55 lux at 1/50 sec shutter speed (color), 0.063 lux at 1/3 sec shutter speed (color), 0.00018 lux at 1/1.5 sec shutter speed (B-W)															
Compression	MPEG-4, MJPEG															
Video Streams	3, simultaneous															
Video Resolutions	<table><tr><td></td><td>NTSC</td><td>PAL</td></tr><tr><td>4CIF</td><td>704 x 480</td><td>704 x 576</td></tr><tr><td>2CIF</td><td>704 x 240</td><td>704 x 288</td></tr><tr><td>CIF</td><td>352 x 240</td><td>352 x 288</td></tr><tr><td>QCIF</td><td>176 x 120</td><td>176 x 144</td></tr></table>		NTSC	PAL	4CIF	704 x 480	704 x 576	2CIF	704 x 240	704 x 288	CIF	352 x 240	352 x 288	QCIF	176 x 120	176 x 144
	NTSC	PAL														
4CIF	704 x 480	704 x 576														
2CIF	704 x 240	704 x 288														
CIF	352 x 240	352 x 288														
QCIF	176 x 120	176 x 144														
Bit Rate	Configurable, MPEG-4 30 ips, 2 Mbps for primary stream, MJPEG 15 ips, 3 Mbps, MJPEG															
Web User Interface																
Environment	Low temperature, indoor/outdoor															
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X															
Cabling	CAT5 cable or better for 100BASE-TX															
Input Voltage	18 to 32 VAC; 24 VAC nominal 22 to 27 VDC; 24 VDC nominal															
Power Consumption	24 VAC 23 VA nominal (without heater);73 VA nominal (with heater) 24 VDC 0.7 A nominal (without heater);3 A nominal (with heater)															
Alarm Input	7															
Alarm Output	1															

CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards
----------------	---

#### 5. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount

#### U. Reinforced Fixed Dome Camera

1. The dome camera shall be a high-resolution color video camera with wide dynamic range capturing capability.
2. The camera shall meet or exceed the following specifications:
  - a. The camera shall have the form factor as typical of a traditional VASS dome video camera.
  - b. The image capturing device shall be a 1/3-inch image sensor designed for capturing wide dynamic images.
3. The camera shall optimize each pixel independently.
4. The camera shall have onscreen display menus for programming of the camera's settings.
5. The signal system shall be NTSC or PAL selectable.
6. The resolution that the camera provides shall be 470 television lines horizontal and 460 television lines vertical.
7. The camera shall have 720 horizontal and 540 vertical picture elements.
8. The scanning system shall be 525/60 lines NTSC or 625/50 lines PAL.
9. The synchronizing system shall be internal/AC line-lock.
10. The sensitivity shall be 0.6 lux at f1.2, 30 IRE.
11. The signal-to-noise ratio shall be 50 dB.
12. The electronic shutter shall have automatic adjustment, and operate from 1/60 NTSC to 1/100,000 second, automatic.
13. The camera shall have an automatic white balance range of 2800 to 11000 K.
14. The camera shall have automatic gain control.
15. The camera shall include a shroud to conceal the camera's position inside the dome.
16. The camera shall have composite video output.
17. The housing shall have the following specifications:
  - a. Construction: Aluminum

- b. The housing shall be heavy duty and tamper resistant.
    - c. Dome housing construction: 0.13-in polycarbonate.
    - d. Finish: Powder coat
  - 18. The camera shall come with a manual varifocal 4 to 9 mm lens.
  - 19. The electrical specifications for the camera shall be as follows:
    - a. Input voltage shall be 24 VAC or 12 VDC.
    - b. Power consumption shall be 12 VDC, 455 mA; or 24 VAC, 160 mA.
    - c. Power source shall be universal 18 to 30 VAC or 10 to 30 VDC.
    - d. Video output shall be composite: 1.0 volts peak-to-peak at 75-ohm load.
  - 20. The environmental specifications for the camera shall be as follows:
    - Operating temperature shall be -10 to 45 degrees Celsius or 14 to 113 degrees Fahrenheit.
  - 21. Accessories shall include:
    - a. Surface mount adapter
    - b. Wall mount adapter
    - c. Flush mount adapter
- V. Indoor/Outdoor Fixed Mini Dome System
- 1. The indoor/outdoor fixed mini dome system shall include a built-in 100Base-TX network interface for live streaming to a standard Web browser.
  - 2. The network mini dome shall be integrated into the back box design to accept multiple camera options without modification. The network mini dome shall operate in open architecture connectivity for third-party software recording solutions.
  - 3. The indoor/outdoor fixed mini dome system shall meet or exceed the following design and performance specifications.

Imaging Device	1/3-inch imager
Picture Elements	NTSC/PAL 720 (H) x 540 (V) 720 (H) x 540 (V)
Dynamic Range	102 dB typical/120 dB maximum (DW/CW models only)
Scanning System	2:1 interlace (progressive option on CW/DW models only)
Synchronization	Internal
Electronic Shutter Range	Auto (1/15-1/22,000)
Lens Type	Varifocal with auto iris
Format Size	1/3-inch

Focal Length	3.0 mm–9.5 mm 9.0 mm–22.0 mm <list>															
Operation	Iris   Auto (DC-drive) Focus Manual Zoom   Manual															
Minimum Illumination	Color (day): 0.8 lux, SENS 8X: 0.2 lux, B-W (night): 0.08 lux, SENS 8X: 0.02 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.15 lux, B-W (night): 0.015 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) Color (day): 0.8 lux, SENS 8X: 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance) 0.2 lux (F1.0, 40 IRE, AGC on, 75% scene reflectance)															
Compression	MPEG-4, MJPEG in Web viewing mode															
Video Streams	3, simultaneous															
Video Resolutions	<table><tr><td></td><td>NTSC</td><td>PAL</td></tr><tr><td>4CIF</td><td>704 x 480</td><td>704 x 576</td></tr><tr><td>2CIF</td><td>704 x 240</td><td>704 x 288</td></tr><tr><td>CIF</td><td>352 x 240</td><td>352 x 288</td></tr><tr><td>QCIF</td><td>176 x 120</td><td>176 x 144</td></tr></table>		NTSC	PAL	4CIF	704 x 480	704 x 576	2CIF	704 x 240	704 x 288	CIF	352 x 240	352 x 288	QCIF	176 x 120	176 x 144
	NTSC	PAL														
4CIF	704 x 480	704 x 576														
2CIF	704 x 240	704 x 288														
CIF	352 x 240	352 x 288														
QCIF	176 x 120	176 x 144														
Bit Rate	Configurable, 20 kbps to 2 Mbps per stream															
Web User Interface																
Environment	Low temperature, indoor/outdoor															
Connectors	RJ-45 for 100BASE-TX, Auto MDI/MDI-X															
Cabling	CAT5 cable or better for 100BASE-TX															
Input Voltage	24 VAC (18–36) or PoE input voltage															
Power Consumption	<7.5 Watts, <13 Watts with heaters 24VAC: <0.5 Amps, <0.9 Amps with heaters															
Alarm Input	10 VDC maximum, 5 mA maximum															
Alarm Output	0 to 15 VDC maximum, 75 mA maximum															
Service Connector	Internal to housing for 2.5 mm connector for NTSC/PAL video outputs															
Service Connector	3-conductor, 2.5 mm connector for video output to optional (IS-SC cable)															

Pan/Tilt Adjustment	Pan 360°, tilt 80° (20° to 100° range), and rotation 360°
Light Attenuation	smoked bubble, f/1.5 light loss; clear bubble, zero light loss
CERTIFICATIONS	CE, Class B UL Listed Meets NEMA Type 4X and IP66 standards

#### 4. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount

#### W. Megapixel High Definition Integrated Digital Network Camera

1. The network camera shall offer dual video streams with up to 3.1 megapixel resolution (2048 x 1536) in progressive scan format.
2. An alarm input and relay output shall be built in for integration with hard wired external sensors.
3. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.
4. The network camera shall offer auto back focus (ABF) functionality through a push button on the camera. ABF parameters shall also be configurable through a standard Web browser interface.
5. The network camera shall offer a video output port providing an NTSC/PAL analog video output signal for adjusting field of view and focus at the camera.
6. The network camera shall provide advanced low-light capabilities for color and day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white (B-W).
7. The network camera shall have removable IR cut filter mechanism for increased sensitivity in low-light installations. The sensitivity of IR cut filter removal shall be configurable through a Web browser.
8. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.

9. The network camera shall support industry standard Power over Ethernet (PoE)
  10. IEEE 802.3af to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.
  11. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.
  12. The network camera shall have a window blanking feature to conceal user-defined privacy areas that cannot be viewed by an operator. The network camera shall support up to four blanked windows. A blanked area shall appear on the screen as a solid gray window.
  13. The network camera shall support standard IT protocols.
  14. The network camera shall support open architecture best practices with a published API available to third-party network video recording and management systems.
- X. Megapixel High Definition Integrated Digital Network Camera Technical Specifications:

Imaging Device	1/3-inch, effective
Imager Type	CMOS, Progressive scan
Maximum Resolution	2048 x 1536
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1~1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850K; SNR >24dB Color (1x/33ms) 0.50 lux Color SENS (15x/500 ms) 0.12 lux Mono SENS (15x/500 ms) Mono (1x/33ms) 0.25 lux 0.03 lux
Dome Attenuation	Clear Zero light loss Smoke f/1.0 light loss
Compression	H.264 in base profile and MJPEG
Video Streams	Up to 2 simultaneous streams, the second Stream variable based on the setup of the primary stream
Frame Rate	Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6.5, 4, 3, 2, and 1 (depending upon coding, resolution,

	and stream configuration
Available Resolutions	<p>3.1 MPx2048 x 1536; 4:3 aspect ratio; 2.0 ips max., 10.0 Mbps bit rate for MJPEG; 3.0 ips max., 2.6 Mbps bit rate H.264</p> <p>2.1 MPx1920 x 1080; 16:9 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 5.0 ips max., 2.7 Mbps bit rate H.264 3.1.9 MPx1600 x 1200; 4:3 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 6.0 ips max., 2.6 Mbps bit rate H.264</p> <p>1.3 MPx1280 x 1024; 5:4 aspect ratio; 15.0 ips max., 10.0 Mbps bit rate for MJPEG; 8.0 ips max., 2.5 Mbps bit rate H.264</p> <p>1.2 MPx1280 x 960; 4:3 aspect ratio; 15.0 ips max., 9.8 Mbps bit rate for MJPEG; 9.8 ips max., 8.5 Mbps bit rate H.264 6.0.9 MPx1280 x 720; 16:9 aspect ratio; 30.0 ips max., 10.0 Mbps bit rate for MJPEG; 12.5 ips max., 2.5 Mbps bit rate H.264</p> <p>0.5 MPx800 x 600; 4:3 aspect ratio; 30.0 ips max., 5.8 Mbps bit rate for MJPEG; 25.0 ips max., 2.0 Mbps bit rate H.264 8.0.3 MPx640 x 480; 4:3 aspect ratio; 30.0 ips max., 3.7 Mbps bit rate for MJPEG; 30.0 ips max., 1.6 Mbps bit rate H.264</p> <p>0.1 MPx320 x 240; 4:3 aspect ratio; 30.0 ips max., 0.9 Mbps bit rate for MJPEG; 30.0 ips max., 0.4 Mbps bit rate H.264</p> <p>Additional 640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, 320 x 176</p>
Supported Protocols	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, SNMP, QoS, HTTP, HTTPS, LDAP(client), SSH, SSL, STMP, FTP, MDNS(Bonjour), and 802.1x (EAP)
Security Access	Password protected
Software Interface	Web browser view and setup, up to 16 cameras
Connectors	RJ-45 for 100Base-TX, Auto MDI/MDI-X
Cable	Cat5 cable or better for 100Base-TX
Input Voltage	24 VAC or PoE (IEEE802.3af class 3)

Power Consumption	6 W
Current Consumption	PoE <200 mA maximum 24 VAC <295 mA nominal; <390 mA maximum
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Lens Mount	CS mount, adjustable
Pan/Tilt Adjustment	Pan 368° Tilt 160° (10° to 170°) Rotate 355°

#### 1. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount

#### 2. Recommended Lenses

- a. Megapixel lens, varifocal, 2.2~6.0 mm, f/1.3~2.0
- b. Megapixel lens, varifocal, 2.8~8.0 mm, f/1.1~1.9
- c. Megapixel lens, varifocal, 2.8~12.0 mm, f/1.4~2.7
- d. Megapixel lens, varifocal, 15.0~50.0 mm, f/1.5~2.1

### Y. NETWORK CAMERAS

#### 1. Shall be IEEE 802.3af compliant.

- a. Shall be utilized for interior and exterior purposes.
- b. A Category CAT6 cable will be the primary source for carrying signals up to 100 m(300 ft. ) from a switch hub or network server. If any camera is installed greater than 100 m (300 ft.) from the controlling device then the following will be required:
  - 1) A local or remote 12 VDC or 24 VAC power source will be required from a Class 2, UL compliant power supply.
  - 2) A signal converter will be required to convert from a CAT6 cable over to a fiber optic or standard signal cable. The signal will need to be converted back to a CAT6 cable at the controlling device using a signal converter card.
- c. Shall be routed to a controlling device via a network switch.
- d. Shall be of hybrid design with both an Internet Protocol (IP) output and a monitor video output which produces a picture equivalent to an analog camera, and allows simultaneous output of both.



- e. Shall be a programmable IP address that allows for installation of multiple units in the same Local Area Network (LAN) environment.
  - d. Incorporate a minimum of Transmission Control Protocol (TCP)/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Real-Time Transport Protocol (RTP), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Simple Mail Transfer Protocol (SMTP), Internet Group Management Protocol (IGMP), and Differentiated Service Code Point (DSCP) protocols for various network applications.
- Z. Fixed Network Camera
1. The fixed network camera shall have following technical characteristics:

Video Standards	MPEG-4; M-JPEG
Video Data Rate	9.6 Kbps - 6 Mbps Constant & variable
Image Resolution	768x494 (NTSC)
Video Resolution	704 x 576/480 (4CIF: 25/30 IPS) 704 x 288/240 (2CIF: 25/30 IPS) 352 x 288/240 (CIF: 25/30 IPS) 176 x 144/120 (QCIF: 25/30 IPS)
Select Frame Rate	1-25/30 IPS (PAL/NTSC);Field/frame based coding
Network Protocols	RTP, Telnet, UDP, TCP, IP, HTTP, IGMP, ICMP
Software Update	Flash ROM, remote programmable
Configuration	Via web browser, built-in web server interfaces
//Video Out	1x Analog composite: NTSC or PAL; BNC connector 75 Ohm//
Sensitivity	1 0.65 lux (color) 0.26 lux (NightSense)
Minimum Illumination	0.30 lux (color)0.12 lux (NightSense)
Video Signal-to-Noise Ratio	50 dB
Video Signal Gain	21 dB, (max) Electronic Shutter Automatic, up to 1/150000 sec.

	(NTSC)
Alarm In	Automatic sensing (2500 - 9000 K)
Input Voltage	+5 V nominal, +40 VDC max VDC: 11-36 V (700 mA) VAC: 12-28 V (700 mA) PoE: IEEE 802.3af compliant

2. Camera accessories shall include:

- a. Surface mount adapter
- b. Wall mount adapter
- c. Flush mount adapter

AA. Wireless Cameras

1. Prior to installation of any wireless camera, ensure operating frequency is given full approval by the VA controlling authority. Wireless cameras shall be utilized as either part of a VASS network or a standard analog system.
2. Power for a wireless camera will be 110 VAC tied into a dedicated circuit breaker on a power panel that is dedicated to the security system and is fed from a power source with back-up in the event primary power to the VASS System is lost. Power will be run to the camera and connected at both ends in accordance with Division 26 of the VA Master Specification FOR NCA Projects, and the VA Electrical Manual. In addition, wireless systems are line of sight dependant and all considerations for environmental layout must be taken into consideration prior to design, engineering, and installation of this type of camera system. Proximity to transmitting and receiving devices, cell phone towers, and any and all electrical devices can also cause interference with the camera signal and must be considered in advance.
3. Shall be located within a minimum of one quarter of a mile from the receiving unit. Repeaters shall be used as required to ensure the strongest possible signal between transmitters and receivers.
4. Shall be Federal Communication Commission (FCC) approved and compliant.
5. If using wireless cameras, the following equipment shall be utilized to ensure operation of the system:
  - a. Receiver
  - b. Receiver antenna as required

- c. Repeater as required
- d. Mounting Hardware
- 6. Receivers shall only handle up to four (4) cameras per unit.
- 7. Technical Characteristics
  - a. Wireless Cameras:

Imaging Device	1/3-inch interline transfer CCD
Picture Elements	NTSC 510 (H) x 492 (V)
Sensing Area	6 mm diagonal
Scanning System	NTSC 525 lines, 21 interlace
Synchronization System	AC line lock/internal
Horizontal Resolution	330 TV lines
Iris Control	Selectable on/off
Electronic Shutter Range NTSC	1/60-1/100,000 second
Frequency range	2.41-2.47GHz
Modulation	FM
Video signal/noise ratio	48dB
Audio signal/noise ratio	45db
Minimum Illumination	0.6 lux
Signal to Noise Ratio	>50 dB
Automatic Gain Control	On/off switchable
Backlight Compensation	On/off switchable
Auto White Balance	On/off switchable
Video Output	1 Vp-p, 75 ohms
Lens Mount	C/CS mount (adjustable)

b. Receivers

Frequency range	2.4-2.49GHz
Video output	1Vp-p
Signal/noise ratio	38dB

BB. LENSES

- 1. Camera Field of View shall be set by the Contractor to produce full view of door or window opening and anyone entering or leaving through it. Follow the project construction drawings for design intent.

2. Camera Lenses shall be of the type supplied with the camera from the manufacture. All cameras which are not supplied with lenses from the factory are specified in this specification. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto-iris, DC iris, or motor zoom functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lenses shall be provided with pre-set capability.
3. Lenses shall have optical-quality coated optics, designed specifically for video surveillance applications, and matched to specified camera. Provide color-corrected lenses with color cameras, megapixel lenses for megapixel cameras, and lenses with day/night for color/b&w cameras.
4. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
5. Zoom Lenses: Motorized, remote-controlled units, rated as "quiet operating." Features include the following:
  - a. Electrical Leads: Filtered to minimize video signal interference.
  - b. Motor Speed: Variable.
  - c. Lens shall be available with preset positioning capability to recall the position of specific scenes.
6. Lenses: Shall be utilized in a manner that provides maximum coverage of the area being monitored by the camera. The lenses shall:
  - a. Be 1/3" to fit CCD fixed camera.
  - b. Be all glass with coated optics.
  - c. Have mounts that are compatible with the camera selected.
  - d. Be packaged and supplied with the camera.
  - e. Have a maximum f-stop of f/1.3 for fixed lenses, and a maximum f-stop of f/1.6 for variable focus lenses.
  - f. Be equipped with an auto-iris mechanism.
  - g. Have sufficient circle of illumination to cover the image sensor evenly.
  - h. Not be used on a camera with an image format larger than the lens is designed to cover.

- i. Be provided with pre-set capability.
- 7. Two types of lenses shall be utilized for both interior and exterior fixed cameras:
  - a. Manual Variable Focus
  - b. Auto Iris Fixed
- 8. Manual Variable Focus:
  - a. Shall be utilized in large areas that are being monitored by the camera. Examples of this are perimeter fence lines, vehicle entry points, parking areas, etc.
  - b. Shall allow for setting virtually any angle of field, which maximizes surveillance effects.
  - c. Technical Characteristics:

Image format	1/3 inch
Focal length	5-50mm
Iris range	F1.4 to close
Focus range	1m (3.3 ft)
Back focus distance	10.05 mm (0.4 in)
Angle view Wide (1/3 in)	53.4 x 40.1
Angle view Tele (1/3 in)	5.3 x 4.1
Iris control	manual
Focus ctrl	manual
Zoom ctrl	manual

#### CC. CAMERA HOUSINGS AND MOUNTS

- 1. This section pertains to all interior and exterior housings, domes, and applicable wall, ceiling, corner, pole, and rooftop mounts associated with the housing. Housings and mounts shall be specified in accordance to the type of cameras used.
- 2. All cameras and lenses shall be enclosed in a tamper resistant housing. Any additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.
- 3. The camera and lens contained inside the housing shall be installed on a camera mount. All additional mounting hardware required to install the camera housing at its specified location shall be provided along with the housing.

4. Shall be manufactured in a manner that are capable of supporting a maximum of three (3) cameras with housings, and meet environmental requirements for the geographical area the camera support equipment is being installed on or within.
5. Environmentally Sealed
  - a. Shall be designed in manner that it provides a condensation free environment for correct camera operation.
  - b. Shall be operated in a 100 percent condensing humidity atmosphere.
  - c. Shall be constructed in a manner that:
    - 1) Has a fill valve to allow for the introduction of nitrogen into the housing to eliminate existing atmospheric air and pressurize the housing to create moisture free conditions.
    - 2) Has an overpressure valve to prevent damage to the housing in the event of over pressurization.
    - 3) Is equipped with a humidity indicator that is visible to the eye to ensure correct atmospheric conditions at all times.
    - 4) The leak rate of the housing is not to be greater than 13.8kPa or 2 pounds per square inch at sea level within a 90 day period.
    - 5) It shall contain camera mounts or supports as needed to allow for correct positioning of the camera and lens.
    - 6) The housing and sunshield are to be white in color.
6. All electrical and signal cables required for correct operations shall be supplied in a hardened carrier system from the controller to the camera.
7. The mounting bracket shall be adjustable to allow for the housing weight of the camera and the housing unit it is placed in.
8. Accessibility to the camera and mounts shall be taken into consideration for maintenance and service purposes.

DD. Indoor Mounts

1. Ceiling Mounts:
  - a. This enclosure and mount shall be installed in a finished or suspended ceiling.
  - b. The enclosure and mount shall be fastened to the finished ceiling, and shall not depend on the ceiling tile grid for complete support.

- c. Suspended ceiling mounts shall be low profile, and shall be suitable for replacement of 610mm x 610mm (2 foot by 2 foot) ceiling tiles.

2. Wall Mounts:

- a. The enclosure shall be installed in manner that it matches the existing décor and placed at a height that it will be unobtrusive, unable to cause personal harm, and prevents tampering and vandalism.
- b. The mount shall contain a manual pan/tilt head that will provide 360 degrees of horizontal and vertical positioning from a horizontal position, and has a locking bar or screw to maintain its fixed position once it has been adjusted.

EE. Interior Domes

- 1. The interior dome shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mounted equipment.
- 2. The lower portion of the dome that provides camera viewing shall be made of black opaque acrylic and shall have a light attenuation factor of no more than 1 f-stop.
- 3. The housing shall be equipped with integral pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide a fully functional pan/tilt dome.
- 4. The pan/tilt mechanism shall be:
  - a. Constructed of heavy duty bearings and hardened steel gears.
  - b. Permanently lubricated to ensure smooth and consistent movement of all parts throughout the life of the product.
  - c. Equipped with motors that are thermally or impedance protected against overload damage.
  - d. Pan movements shall be 360 degrees and tilt movement shall not be less than +/- 90 degrees.
  - e. Pan speed shall be a minimum of 10 degrees per second.

FF. Exterior Domes

- 1. The exterior dome shall meet all requirements outlined in the interior dome paragraph above.
- 2. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity.

GG. Exterior Wall Mounts

1. Shall have an adjustable head for mounting the camera.
2. Shall be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish.
3. The head shall be adjustable for not less than plus and minus 90 degrees of pan, and not less than plus and minus 45 degrees of tilt. If the bracket is to be used in conjunction with a pan/tilt, the bracket shall be supplied without the adjustable mounting head, and shall have a bolt-hole pattern to match the pan/tilt base.
4. Shall be installed at a height that allows for maximum coverage of the area being monitored.

#### HH. Explosion Proof Housing

1. This housing shall meet or exceed all requirements of NEMA four (4) standards for hazardous locations.
2. It shall be supplied with the mounting brackets for the specified camera and lens.

### 2.8 POWER SUPPLIES

- A. Power supplies shall be a low-voltage power supplies matched for voltage and current requirements of cameras and accessories, type as recommended by camera[, infrared illuminator,] and lens manufacturer.
- B. Technical specifications:
  1. Input: 115VAC, 50/60Hz, 2.7 amps
  2. Outputs:
    - a. Number of outputs, 16
    - b. Fuse/PTC protected, power limited
    - c. Output voltage & power:
      - 1) 24VAC @ 12.5 amps (300VA) or 28VAC @ 10 amp (280VA) supply current
  3. Illuminated power disconnect circuit breaker with manual reset
  4. Surge suppression
  5. Camera synchronization
  6. [Wall/Rack] <insert mount type> mount.
  7. Enclosure: NEMA 250, Type 1.

### 2.9 INFRARED ILLUMINATORS

- A. Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.
  1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
  2. Rated Lamp Life: More than 8000 hours



- 3. Power Supply: 12-VAC/DC 120-VAC.
- B. Area Coverage: Illumination to 50 m (150 feet) in a narrow beam pattern.
- C. Exterior housings shall be suitable for same environmental conditions as associated camera.

#### **2.10 NETWORK SERVER**

- A. Allow for the transmission of live video, data, and audio over either an existing Ethernet network or a dedicated security system network, requiring an IP address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. The network shall operate in a box-to-box configuration allowing for encoded video to be decoded and displayed on an analog monitor.
- B. If a VASS System network is going to be utilized as the primary means of monitoring, operating, and recording cameras then the following equipment shall be required as part of the system:
  - 1. System Server
  - 2. Computer Workstation
  - 3. Recording Device
  - 4. Encoder/Decoder
  - 5. Monitor
  - 6. Hub/Switch
  - 7. Router
  - 8. Encryptor
- C. Shall provide overall control, programming, monitoring, and recording of all cameras and associated devices within the VASS System.
- D. All equipment on the network shall be IP addressable.
- E. The VASS System network shall meet or exceed the following design and performance specifications:
  - 1. Two MPEG-4 video streams for a total of 40 images per second will be provided.
  - 2. PC Software that manages the installation and maintenance of all hardware transmitters and receivers on the network shall be provided.
  - 3. Video Source that supports any NTSC video source to the computer network shall be addressed.
  - 4. Receivers that could be used to display the video on a standard analog NTSC or PAL monitor will be addressed.

F. The system shall support the following network protocols:

1. Internet connections: RTP, Real Time Control Protocol (RTCP), UDP, IP, TCP, ICMP, HTTP, Simple Network Management Protocol (SNMP), IGMP, DHCP, and ARP.
2. Video Display: MPEG-4, M-JPEG in server push mode only.
3. Have the ability to adjust bandwidth, image quality and image rate.
4. Support image sizes of either 704 x 576 pixels or 352 x 288 pixels.
5. Have an audio coding format of G.711 or G.728.
6. Provide a video frame rate of at least 30 images per second.
7. Support LAN Interface Ethernet 10/100BaseT and be auto sensing.
8. Have a LAN Data Rate of 9.6 Kbps to 5.0 Mbps.
9. Utilize data interface RS-232/RS-422/RS-485.

G. All connections within the system shall be via CAT-5 cable and RJ-45 jacks. If analog equipment is used as part of the system, then either an encoder or a decoder will be utilized to convert the analog signal to a digital one.

H. The VASS network system shall conform to all VA agency wide security standards for administrator and operator use.

I. Server Technical Characteristics:

Hardware	Personal Computer
CPU	Pentium IV, 3.0 GHz or better
Hard Disk Interface	IDE or better
RAM	256 MB
OS	Windows XP Home/XP Professional
Graphic Card	NVIDIA GeForce 6600 NVIDIA Quadro FX 1400      ATI RADEON X600/X800 or better
Ethernet Card	100 Mb
Software	DirectX 9.0c
Free Memory	120 MB

J. Network Switch Technical Characteristics

Protocol and standard	IEEE802.3 IEEE802.3u IEEE802.3ab
Ports	24 10/100/1000M auto-negotiation RJ-45 ports with auto MDI/MDI-X
Network media	Cat 5 UTP for 1,000Mbps    Cat 3 UTP for 10Mbps
Transmission method	store-and-forward

LED	indicator power, act/link, speed
-----	----------------------------------

## K. Router Technical Characteristics

Network Standards	IEEE 802.3, 802.3u 10Base-T Ethernet (WAN) 100Base-T Ethernet (LAN) IEEE 802.3x Flow Control IEEE802.1p Priority Queue ANS/IEEE 802.3 NWay auto-negotiation
Protocol	CSMA/CD, TCP, IP, UDP, PPPoE, AND DHCP (client and server)
VPN Supported	PPTP, IPSec pass-through
Management	Browser
Ports	4 x 10/100Base-T Auto sensing RJ45 ports, and an auto uplink RJ45port(s) 1 x 10Base-T RJ45 port, WAN
LEDs	Power, WAN Activity, LAN Link (10/100), LAN Activity

## L. Encryptor Technical Characteristics:

Cryptography	Standard - Triple DES 168-bit (ANSI 9.52) Rijndael - AES (128, 192, 256)
Performance	Throughput (end-to-end) @ 100 Mbps line speed: >188 Mbps full duplex (large frames) >200 kfps full duplex (small frames) Latency (end-to-end) @ 100 Mbps
Key Management	Automatic KEK/DEK Exchange Using Signed Diffie-Hellman Unit Authentication Using X.509 Certificates
Physical Interfaces	10BaseT or 10/100BaseT Ethernet (Host and Network Ports) 10BaseT Ethernet Management Port Back and Front-Panel Serial Control Port
Device Management	THALES Element Manager, Front Panel Viewer, and Certificate Manager 10Base T (RJ-45) or 9-pin Serial Control Port SNMP Network Monitoring
Security Features	Tamper Proof Cryptographic Envelope Tamper Evident Chassis Hardware Random Number Generator
Management	Channel Encrypted Using Same Algorithm as Data Traffic
Security Certifications	FIPS 140-2 Level 3 CAPS Baseline and Enhanced Grades Common Criteria EAL4 and EAL5 (under evaluation)
Regulatory	EN60950, FCC, UL, CE, EN 50082-1, and

## 2.11 RECORDING DEVICES

- A. All cameras on the VASS System shall be recorded in real time using a Digital Video Recorder (DVR), Network Video Recorder (NVR), or attached storage. The type of recording device utilized should be determined by the size and type of VASS System designed and installed, and to what extent the system is to be utilized.
- B. All recording devices shall be 47.5 cm (19 inch) rack-mountable.
- C. All DVR's and NVR's that are viewable over an Intranet or Internet will be routed through an encryptor.
- D. Encryptors shall:
  - 1. Comply with FIPS PUB 140-2.
  - 2. Support TCP/IP.
  - 3. Directly interfaces to low-cost commercial routers.
  - 4. Provide packet-based crypto synchronization.
  - 5. Encrypt source and destination IP addresses.
  - 6. Support web browser based management requiring no additional software.
  - 7. Have a high data sustained throughput – 1.544 Mbps (T1) full duplex data rate.
  - 8. Provide for both bridging and routing network architecture support.
  - 9. Support Electronic Key Management System (EKMS) compatible.
  - 10. Have remote management ability.
  - 11. Automatically reconfigure when secure network or wide area network changes.
- E. Digital Video Recorder (DVR)
  - 1. Shall record video to a hard drive-based digital storage medium in either NTSC or MPEG format.
  - 2. Shall meet the following minimum requirements:
    - a. Record at minimum rate of 30 images per second (IPS).
    - b. Have a minimum of eight (8) to 16 looping inputs.
    - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
    - d. Shall provide instantaneous playback of all recorded images.
    - e. Be IP addressable, if part of a VASS network.
    - f. Have built-in digital motion detection with masking and sensitivity adjustments.

- g. Provide easy playback and forward/reverse search capabilities.
  - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
  - i. DVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
  - j. Accessible locally and remotely via the Internet, Intranet, or a personal digital assistant (PDA).
  - k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
  - l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
  - m. Allow for independently adjustable frame rate settings.
  - n. Be compatible with the matrix switcher utilized to operate the cameras. The DVR could be utilized as a matrix switcher only if it meets all of the requirements listed in the matrix switcher section.
3. Technical Characteristics:

Compression	MPEG-4
Internal Storage Capacities.	[160] GB, [320] GB, [500] GB, [1] TB, and 2 TB. Available USB hard drive up to 250 GB. Optional internal DVD available
Digital Recording	Up to [16] video and [8] audio channels, or [8] video and [4] audio channels.
Full real-time video recording	Up to 400 IPS@352 x 288: PAL Up to 200 IPS@352 x 288: PAL
Multiple simultaneous functions	Live viewing, Recording, playback, network transmission, back-up
Search functions	Date/time search, event search, bookmark search, smart (pixel) Search
PTZ Control	Third party PTZ control
User ID security	3 levels
Connectivity to external devices:	Eight [8] or sixteen [16] video input and looping output channels. VGA and dual monitor BNC outputs. Four [4] or eight [8] audio inputs and one [1] audio output.

	<p>Ethernet 10/100BaseT network connection.</p> <p>Eight [8] to sixteen [16] alarm inputs and four [4] or eight [8] relay outputs.</p> <p>Biphase connection to control Bosch PTZ cameras.</p> <p>Third party PTZ control via RS-422/RS-485 connection.</p> <p>Front and back USB connectors to connect to a PC mouse, or archive video to a USB memory stick or similar device.</p>
PC requirements	<p>Windows 2000 or above; DirectX 8.1 or above.</p> <p>Intel Pentium III or above, AMD Athlon with 800 MHz or faster CPU.</p> <p>512 MB or more RAM.</p> <p>50 MB hard drive.</p> <p>AGP VGA with 64 MB video RAM or above.</p> <p>10/100-BaseT network interface.</p>
Electrical	<p>Power Input: 100 to 240 VAC; 50/60 Hz</p> <p>Power consumption: [120W]</p> <p>Max. [1.2] A</p>
Video	<p>Video standard: PAL or NTSC selectable.</p> <p>Resolution: 704 x 576 PAL, 704 x 480 NTSC</p> <p>Compression: MPEG-4</p> <p>Inputs: 8 or 16 composite video 0.5-2 Vpp, 75 Ohm automatic termination.</p> <p>Outputs 8 or 16 composite video 1 Vpp, 75 Ohm.</p>
Audio	<p>Inputs: 4 or 8 line in, 30 kOhm</p> <p>Output: 1 line, 100 kOhm</p>
Monitors	<p>VGA: analog RGB 800x600</p> <p>MON A: CVBS 1 Vpp±0.1 V, 75 Ohm, BNC</p> <p>Monitor A multi-screen (VGA or CVBS)</p> <p>MON B: CVBS 1 Vpp±0.1 V, 75 Ohm, BNC</p> <p>Monitor B spot/alarm</p>
Frame Rate and Resolution	<p>[16]-channels PAL: Up to 400 IPS@352x288, up to 200 IPS@704x288, up to 100 IPS@704x576.</p>
Alarm inputs	<p>[8] [16] configurable NO/NC, max. input 5 VDC.</p>
Alarm outputs	<p>[4] or [8] relay outputs, configurable NO/NC, max. rated 1A, 125 VAC.</p>

Connections	<p>Ethernet: RJ45 modular jack 8 pins shielded, 10/100 Base-T.</p> <p>Biphase: Screw terminal connector (5 outputs).</p> <p>Maximum 5 controllable cameras per Biphase output.</p> <p>PTZ control interfaces: RS485/RS422.</p> <p>Serial interface: RS232 output signal, DB9 male connector</p> <p>Keyboard: RJ11 modular jack 6 pins</p>
Network:	<p>Transmission speed: up to 120 IPS@352x240</p> <p>Bandwidth control: Automatic</p> <p>Remote users: Maximum 5 simultaneous connected Control Center users.</p>

Processor	Intel Pentium III 750 MHz
Memory	256 MB RAM
Operating System	Windows 98, NT, ME, 2000, and XP
Video Card	4 MB of RAM capable of 24-bit true color display
Free Hard Disk Space	160 MB for software installation
Network Card	10Base-T network for LAN operation
Archiving	80 GB, 160 GB, 320 GB and 640 GB Hard Drive; CD-RW
Video Input	1.0 Vpp (signal 714mV, sync 286mV) 75 ohms (BNC unbalanced)
Video Output Level	1.0 Vpp +/-10%, 75 ohms (BNC unbalanced)
Impedance	75 ohms/Hi- impedance x 16 switchable
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

#### F. Network Video Recorder (NVR)

1. Shall record video to a hard drive-based digital storage medium in MPEG, MPEG4 or H.264 format.
2. Shall meet the following minimum requirements:
  - a. Record at minimum rate of 30 IPS.
  - b. Have a minimum of eight (8) to 16 looping inputs.
  - c. Have a minimum of eight (8) to 16 alarm inputs and two (2) relay outputs.
  - d. Shall provide instantaneous playback of all recorded images.
  - e. Be IP addressable, if part of a VASS network.
  - f. Have built-in digital motion detection with masking and sensitivity adjustments.
  - g. Easy playback and forward/reverse search capabilities.
  - h. Complete audit trail database, with minimum of a six-month history that tracks all events related to the alarm; specifically who, what, where and when.
  - i. NVR management capability providing automatic video routing to a back-up spare recorder in case of failure.
  - j. Accessible locally and remotely via the internet, intranet, or a personal digital assistant (PDA).
  - k. Records all alarm events in real time, ensuring 60 seconds before and after the event are included in the recording.
  - l. Utilize RS-232 or fiber optic connections for integration with the SMS computer station via a remote port on a network hub.
  - m. Allow for independently adjustable frame rate settings.
  - n. Be compatible with the matrix switcher utilized to operate the cameras.
3. Technical Characteristics:

Hardware/CPU	Pentium III Xeon or IV, 1.8 GHz
HDD Interface	IDE or better; optional: SCSI II, SCSI Ultra, or Fiber Channel
RAM	1024 MB
Operating System	Windows 2000/XP Professional/Server 2003 Standard
Graphic	Card VGA
Ethernet Card	100/1000 MB
Memory	20 MB
Software Setup	Centralized setup from each authorized PC; access via integrated web server



Storage Media	All storage media possible (e.g., HD, RAID), depending on operating system
Storage Mode	Linear mode, ring mode (capacity-based)
Recording Configuration	Camera name assignment, bandwidth limit, frame rate, video quality
Recording Content	Video and/or audio data
Search Parameters	Time, date, event
Playback	Playback via any IP network (LAN/WAN) simultaneous recording, playback, and backup
Network Interface	Ethernet (RJ-45, 10/100M)
Network Protocol	TCP/IP, DHCP, HTTP, UDP
Network Capabilities	Live/Playback/P/T/Z control
Recording Rate	30 ips for 720 x 240 (NTSC)
Password Protection	Menu Setup, Remote Access
Recording Capacity	160 (1 or 2 fixed HDD) 1 CD-RW
Power Interrupt	Auto recovered to recording mode

## 2.12 WIRES AND CABLES

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. Will be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
- C. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
- D. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that will allow it to be distinguished from all other conduit and infrastructure.
- E. Conduit fills shall not exceed 50 percent unless otherwise documented.
- F. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.
- G. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area
- H. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for

the security system shall be defined as any cable or sets of cables carrying 30 VDC/VAC or higher.

- I. For all equipment that is carrying digital data between the Physical Access Control System and Database Management or at a remote monitoring station, shall not be less than 20 AWG and stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100% coverage. Cables with a single overall shield shall have a tinned copper shield drain wire.
- J. All cables and conductors, except fiber optic cables, that act as a control, communication, or signal lines shall include surge protection. Surge protection shall be furnished at the equipment end and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within 1 m. (3 ft.) of the building cable entrance. The inputs and outputs shall be tested in both normal and common mode using the following wave forms:
  1. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and peak current of 60 amperes.
  2. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and peak current of 500 amperes.
- K. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. Fuses and relays shall not be used as a means of surge protection.
- L. Coaxial Cables
  1. All video signal cables for the VASS System, with exception to the PoE cameras, shall be a coaxial cable and have a characteristic impedance of 75 ohms plus or minus 3 ohms.
  2. For runs up to 750 feet use of an RG-59/U is required. The RG-59/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 23 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
  3. For runs between 750 feet and 1250 feet, RG-6/U is required. RG-6/U shall be shielded which provides a minimum of 95 percent coverage, with a stranded copper center conductor of a minimum 18 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.
  4. For runs of 1250 to 2750 feet, RG-11/U is required. RG-11/U shall be shielded which provides a minimum of 95 percent coverage, with a

stranded copper center conductor of a minimum 14 AWG, polyethylene insulation, and black non-conductive polyvinylchloride (PVC) jacket.

5. All runs greater than 2750 feet will be substituted with a fiber optic cable. If using fiber optics as a signal carrier then the following equipment will be utilized:
  - a. Multimode fiber optic cable a minimum size of 62 microns
  - b. Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.
  - c. Video receiver, installed at the switcher.
6. RG-59/U Technical Characteristics

AWG	22
Stranding	7x29
Conductor Diameter	.031 in.
Conductor Material	BCC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.145 in.
Outer Shield Type	Braid/Braid
Outer Jacket Material	PVC
Overall Nominal Diameter	.242 in.
UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.094 $\mu$ H/ft
Nom. Capacitance	Conductor to Shield 17.0 pF/ft
Nom. Velocity of Propagation	80 %
Nom. Delay	1.3 ns/ft
Nom. Conductor DC Resistance @ 20°C	12.2 Ohms/1000 ft
Nom. Outer Shield DC Resistance @ 20°C	2.4 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

7. RG-6/U Technical Characteristics:

AWG	18
Stranding	7x27
Conductor Diameter	.040 in.

Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.180 in.
Outer Shield Material	Trade Name Duofoil
Outer Shield Type	Tape/Braid
Outer Shield %Coverage	100 %
Outer Jacket Material	PVC
Overall Nominal Diameter	.274 in.
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.106 $\mu$ H/ft
Nom. Capacitance	Conductor to Shield 16.2 pF/ft
Nom. Velocity of Propagation	82 %
Nom. Delay	1.24 ns/ft
Nom. Conductor DC Resistance	6.4 Ohms/1000 ft
Nominal Outer Shield DC Resistance @ 20°C	2.8 Ohms/1000 ft
Max. Operating Voltage	UL 300 V RMS

## 8. RG-11/U Technical Characteristics:

AWG	15
Stranding	19x27
Conductor Diameter	.064 in.
Conductor Material	BC
Insulation Material	Gas-injected FHDPE
Insulation Diameter	.312 in.
Inner Shield Type	Braid
Inner Shield Material	BC - Bare Copper
Inner Shield %Coverage	95 %
Inner Jacket Material	PE - Polyethylene
Inner Jacket Diameter	.391 in.
Outer Shield Type	Braid
Outer Shield Material	BC - Bare Copper
Outer Shield %Coverage	95 %
Outer Jacket Material	Trade Name Belflex
Outer Jacket Material	PVC Blend

Overall Nominal Diameter	.520 in.
Operating Temperature Range	-35°C To +75°C
Non-UL Temperature Rating	75°C
Nom. Characteristic Impedance	75 Ohms
Nom. Inductance	0.097 $\mu$ H/ft
Nom. Capacitance	Conductor to Shield 17.3 pF/ft
Nom. Velocity of Propagation	78 %
Nom. Delay	1.30 ns/ft
Nom. Conductor DC Resistance	3.1 Ohms/1000 ft
Nom. Inner Shield DC Resistance	1.8 Ohms/1000 ft
Nom. Outer Shield DC Resistance	1.4 Ohms/1000 ft
Max. Operating Voltage Non-UL	300 V RMS

9. Signal Cables:

- a. Signal wiring for PoE cameras depends on the distance the camera is being installed from either a hub or the server.
- b. If the camera is up to 300 ft from a hub or the server, then use a shielded UTP category 5 (CAT-V) cable with standard RJ-45 connector at each end. The cable must comply with the Power over Ethernet, IEEE802.3af, Standard.
- c. If the camera is over 300 ft from a hub or server then utilize a multimode fiber optic cable with a minimum size of 62 microns.
- d. Provide a separate cable for power.
- e. CAT-5 Technical Characteristics:

Number of Pairs	4
Total Number of Conductors	8
AWG	24
Stranding	Solid
Conductor Material	BC - Bare Copper
Insulation Material	PO - Polyolefin
Overall Nominal Diameter	.230 in.
IEC Specification	11801 Category 5
TIA/EIA Specification	568-B.2 Category 5e
Max. Capacitance Unbalance	(pF/100 m) 150 pF/100 m
Nom. Velocity of Propagation	70 %

Max. Delay	(ns/100 m) 538 @ 100MHz
Max. Delay Skew	(ns/100m) 45 ns/100 m
Max. Conductor DC Resistance	9.38 Ohms/100
Max. DCR Unbalance@ 20°C	3 %
Max. Operating Voltage	UL 300 V RMS

10. Fiber Optic Cables Technical Characteristics:

Fiber Type	62.5 Micron
Number of Fibers	4
Core Diameter 6	2.5 +/- 2.5 microns
Core Non-Circularity	5% Maximum
Clad Diameter	125 +/- 2 microns
Clad Non-Circularity	1% Maximum
Core-clad Offset	1.5 Microns Maximum
Primary Coating Material	Acrylate
Primary Coating Diameter	245 +/- 10 microns
Secondary Coating Material	Engineering Thermoplastic
Secondary Coating Diameter	900 +/- 50 microns
Strength Member Material	Aramid Yarn
Outer Jacket Material	PVC
Outer Jacket Color	Orange
Overall Diameter	.200 in.
Numerical Aperture	.275
Maximum Gigabit Ethernet	300 meters
Maximum Gigabit Ethernet	550 meters

11. Power Cables

- a. Will be sized accordingly and shall comply with the NEC. High voltage power cables will be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables will be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Will be utilized for all components of the VASS System that require either a 110 VAC 60 Hz or 220 VAC 50 Hz input. Each feed will be connected to a dedicated circuit breaker at a power panel that is primarily for the security system.
- c. All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms

described in IEEE C62.41. Fuses shall not be used as a means of surge protection.

- d. Shall be rated for either 110 or 220 VAC, 50 or 60 Hz, and shall comply with VA Master Spec 26 05 21 Low Voltage Electrical Power Conductors and Cables (600 Volts and Below).
- e. Low Voltage Power Cables
  - 1) Shall be a minimum of 18 AWG, Stranded and have a polyvinylchloride outer jacket.
  - 2) Cable size shall determined using a basic voltage over distance calculation and shall comply with the NEC's requirements for low voltage cables.

### **PART 3 - EXECUTION**

#### **3.1. GENERAL**

- A. Installation: The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable data transmission system.
- B. Identification and Labeling: The Contractor shall supply permanent identification labels for each cable at each end that will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
  - 1. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- C. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.

- D. Contractor's Field Test: The Contractor shall verify the complete operation of the data transmission system during the Contractor's Field Testing. Field test shall include a bit error rate test. The Contractor shall perform the test by sending a minimum of 1,000,000 bits of data on each DTM circuit and measuring the bit error rate. The bit error rate shall not be greater than one (1) bit out of each 100,000 bits sent for each dial-up DTM circuit, and one (1) bit out of 1,000,000 bits sent for each leased or private DTM circuit. The Contractor shall submit a report containing results of the field test.
- E. Acceptance Test and Endurance Test: The wire line data transmission system shall be tested as a part of the completed IDS and EECS during the Acceptance test and Endurance Test as specified.
- F. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. Cable shall be labeled at both end points and at intermediate hand holes, manholes, and junction boxes. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

### 3.2 INSTALLATION

- A. System installation shall be in accordance with NECA 303, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.
- D. The VASS System will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a complete network.
- E. For integration purposes, the VASS System shall be integrated where appropriate with the following associated security subsystems:



1. PACS:
  - a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings, as well as all emergency exits utilizing a fixed color camera.
  - b. Record cameras on a 24 hours basis.
  - c. Be programmed go into an alarm state when an emergency exit is opened, and notify the Physical Access Control System and Database Management of an alarm event.
2. IDS:
  - a. Provide a recorded alarm event via a color camera that is connected to the IDS system by either direct hardwire or a security system computer network.
  - b. Record cameras on a 24 hours basis.
  - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the PACS.
  - d. For additional VASS System requirements as they relate to the IDS, refer to Section 28 16 00 "INTRUSION DETECTION".
3. Security Access Detection:
  - a. Provide full coverage of all vehicle and lobby entrance screening areas utilizing a fixed color camera.
  - b. Record cameras on a 24 hours basis.
  - c. The VASS System should have facial recognition software to assist in identifying individuals for current and future purposes.
4. EPPS:
  - a. Provide a recorded alarm event via a color camera that is connected to the EPPS system by either direct hardwire or a security system computer network.
  - b. Record cameras on a 24 hours basis.
  - c. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
- F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.

- H. A complete VASS System shall be comprised of, but not limited to, the following components:
1. Cameras
  2. Lenses
  3. Video Display Equipment
  4. Camera Housings and Mounts
  5. Controlling Equipment
  6. Recording Devices
  7. Wiring and Cables
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment
1. The Contractor shall connect to and utilize existing video equipment, video and control signal transmission lines, and devices as outlined in the design package. Video equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
  2. The Contractor shall perform a field survey, including testing and inspection of all existing video equipment and signal lines intended to be incorporated into the VASS System, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
  3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.

4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or incorrect installation of equipment.
  5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- M. Interconnection of Console Video Equipment: The Contractor shall connect signal paths between video equipment as specified by the OEM. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.
- N. Cameras:
1. Install the cameras with the focal length lens as indicated for each zone.
  2. Connect power and signal lines to the camera.
  3. Aim camera to give field of view as needed to cover the alarm zone.
  4. Aim fixed mounted cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun.

5. Focus the lens to give a sharp picture (to include checking for day and night focus and image quality) over the entire field of view
6. Synchronize all cameras so the picture does not roll on the monitor when cameras are selected.
7. PTZ cameras shall have all preset positions and privacy areas defined and programmed.

O. Monitors:

1. Install the monitors as shown and specified in design and construction documents.
2. Connect all signal inputs and outputs as shown and specified.
3. Terminate video input signals as required.
4. Connect the monitor to AC power.

P. Switcher:

1. Install the switcher as shown in the design and construction documents, and according to the OEM.
2. Connect all subassemblies as specified by the manufacturer and as shown.
3. Connect video signal inputs and outputs as shown and specified; terminate video inputs as required.
4. Connect alarm signal inputs and outputs as shown and specified; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer and as shown.
5. Connect the switcher CPU and switcher subassemblies to AC power.
6. Load all software as specified and required for an operational VASS System configured for the site and building requirements, including data bases, operational parameters, and system, command, and application programs.
7. Provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test.
8. Program the video annotation for each camera.

Q. Video Encoder/Decoder

1. Install the Video Encoder/Decoder per design and construction documents, and as specified by the OEM.
2. Connect analog camera inputs to video encoder.
3. Connect network camera to video decoder.
4. Connect video encoder to VASS network.
5. Connect video decoder to video matrix, DVR, monitor etc.

6. Connect unit to AC power (UPS).
7. Configure the video encoder/decoder per manufacturer's recommendation and project requirements.

R. Video Server:

1. Install the video server per design and construction documents, and as specified by the OEM.
2. Connect video server to AC power (UPS).
3. Connect to VASS network.
4. Install operating system and Video Management Software.
5. Provide Video Management Software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
  - a. Camera names
  - b. Screen views
  - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
  - d. Video detection zones for each camera requiring video motion detection
  - e. Alarm interface
  - f. Alarm outputs
  - g. GUI maps, views, icons and actions
  - h. PTZ controls (presets, time schedules for privacy zones etc.)
  - i. Reports

S. Video Workstation:

1. Install the video workstation per design and construction documents, and as specified by the OEM.
2. Connect video workstation to AC power (UPS).
3. Connect to VASS network.
4. Install operating system and application software.
5. Provide application software programming per VA guidance and the requirements provided by the Owner. Programming shall include:
  - a. Screen views
  - b. Graphical User Interface (GUI) maps, views, icons and actions
  - c. Alarm outputs
  - d. Reports

T. Network Switch:

1. Install the network switch per design and construction documents, and as specified by the OEM.

2. Connect network switch to AC power (UPS).
3. Connect network cameras to network switch.
4. Configure the network switch per manufacturer's recommendation and project requirements.

#### U. Network Recording Equipment

1. Install the NVR or video storage unit as shown in the design and construction documents, and as specified by the OEM.
2. Connect recording device to AC power (UPS).
3. Connect recording device to network switch as shown and specified.
4. Configure network connections
5. Provide recording unit programming per VA guidance and the requirements provided by the Owner. Programming shall include:
  - a. Camera names
  - b. Screen views
  - c. Camera recording schedules (continuous and event) driven recording. Events include alarms from other systems (sensors), manual input, and video motion detection.
  - d. Video detection zones for each camera requiring video motion detection
  - e. Alarm interface
  - f. Alarm outputs
  - g. GUI maps, views, icons and actions
  - h. PTZ controls (presets, time schedules for privacy zones etc.)
  - i. Reports

#### V. Video Recording Equipment:

1. Install the video recording equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video signal inputs and outputs as shown and specified.
3. Connect alarm signal inputs and outputs as shown and specified.
4. Connect video recording equipment to AC power.
5. Program the video recording equipment;
  - a. Recording schedules
  - b. Camera caption

#### W. Video Signal Equipment:

1. Install the video signal equipment as shown in the design and construction documents, and as specified by the OEM.
2. Connect video or signal inputs and outputs as shown and specified.
3. Terminate video inputs as required.

4. Connect alarm signal inputs and outputs as required.
5. Connect control signal inputs and outputs as required
6. Connect electrically powered equipment to AC power.

X. Camera Housings, Mounts, and Poles:

1. Install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site.
2. Provide a foundation for each camera pole as specified and shown.
3. Provide a ground rod for each camera pole and connect the camera pole to the ground rod as specified in Division 26 of the VA Master Specification and the VA Electrical Manual 730.
4. Provide electrical and signal transmission cabling to the mount location via a hardened carrier system from the Physical Access Control System and Database Management to the device.
5. Connect signal lines and AC power to the housing interfaces.
6. Connect pole wiring harness to camera.

### 3.3 SYSTEM START-UP

- A. The Contractor shall not apply power to the VASS System until the following items have been completed:
  1. VASS System equipment items and have been set up in accordance with manufacturer's instructions.
  2. A visual inspection of the VASS System has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
  3. System wiring has been tested and verified as correctly connected as indicated.
  4. All system grounding and transient protection systems have been verified as installed and connected as indicated.
  5. Power supplies to be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.
- B. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

- C. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.

#### **3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL**

- A. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed VASS System; and are approved by the Contracting Officer.
- B. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
- C. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.
- D. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

#### **3.5 COMMISSIONING**

- A. Provide commissioning documentation for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system.

#### **3.6 DEMONSTRATION AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, "GENERAL REQUIREMENTS".
- B. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- C. Submit training plans and instructor qualifications.

-----END-----



**SECTION 28 31 00**  
**FIRE DETECTION AND ALARM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified. The fire alarm system shall not be combined with other systems such as building automation, energy management, security, etc.
- B. Fire alarm systems shall comply with requirements of the most recent VA FIRE PROTECTION DESIGN MANUAL and NFPA 72 unless variations to NFPA 72 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified NICET level III or a registered fire protection engineer. The NICET certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Resident Engineer, the COTR, or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.
- C. Fire alarm signals:
  - 1. 2. Building addition shall have a general evacuation fire alarm signal in accordance with ASA S3.41 to notify all occupants in the respective building to evacuate.
- D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit.
- E. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NFPA 72.

## 1.2 SCOPE

- A. A fully addressable fire alarm system shall be designed and installed to connect to the existing fire alarm system in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NFPA 72 and this specification.
- B. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.
- C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, valve tamper switches and waterflow/pressure switches may be reused only as specifically indicated on the drawings and provided the equipment:
  - 1. Meets this specification section
  - 2. Is UL listed or FM approved
  - 3. Is compatible with new equipment being installed
  - 4. Is verified as operable through contractor testing and inspection
  - 5. Is warranted as new by the contractor.
- D. Existing 120 VAC duct smoke detectors, waterflow/pressure switches, and valve tamper switches reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.
- E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.
- F. Basic Performance:
  - 1. Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.
  - 2. Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed 5 seconds.
  - 3. The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NFPA 72. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.

4. Initiating device circuits (IDC) shall be wired Style C in accordance with NFPA 72.
5. Signaling line circuits (SLC) within buildings shall be wired Style 4 in accordance with NFPA 72. Individual signaling line circuits shall be limited to covering 22,500 square feet (2,090 square meters) of floor space or 3 floors whichever is less.
6. Notification appliance circuits (NAC) shall be wired Style Y in accordance with NFPA 72.

### **1.3 RELATED WORK**

- A. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Requirements for procedures for submittals.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for fire proofing wall penetrations.
- C. Section 08 71 00 - DOOR HARDWARE. For combination Closer-Holders.
- D. Section 21 13 13 - WET-PIPE SPRINKLER SYSTEMS. Requirements for sprinkler systems.
- E. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. Requirements for general requirements that are common to more than one section in Division 28.
- F. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- G. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- H. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- I. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- J. Section 28 08 00, COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning - systems readiness checklists, and training.
- K. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for integration with physical access control system.

### **1.4 SUBMITTALS**

- A. General: Submit 5 copies in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. Prepare drawings using AutoCAD Release 14 software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COTR). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by VA.
2. Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.
3. Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, elevator control interface, HVAC shutdown interface, fire extinguishing system interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.
4. Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.
5. Two weeks prior to final inspection, the Contractor shall deliver to the COTR 3 sets of as-built drawings and one set of the as-built

drawing computer files. As-built drawings (floor plans) shall show all new and/or existing conduit used for the fire alarm system.

C. Manuals:

1. Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.
  - a. Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.
  - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
  - c. Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.
  - d. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturer's installation limitations including but not limited to circuit length limitations.
  - e. Complete listing of all digitized voice messages.
  - f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.
  - g. Include information indicating who will provide emergency service and perform post contract maintenance.
  - h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
  - i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the VAMC and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

- j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.
  - k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.
2. Two weeks prior to final inspection, deliver 4 copies of the final updated maintenance and operating manual to the COTR.
    - a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.
    - b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.
    - c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.
    - d. Certificate of Installation as required by NFPA 72 for each building. The certificate shall identify any variations from the National Fire Alarm Code.
    - e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.
- D. Certifications:
1. Together with the shop drawing submittal, submit the technician's NICET level III fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract maintenance. Also include the name and title of the manufacturer's representative who makes the certification.
  2. Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.
  3. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NFPA 72 requirements.

### 1.5 WARRANTY

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 one year from the date of acceptance of the entire installation by the Contracting Officer.

### 1.6 GUARANTY PERIOD SERVICES

- A. Complete inspection, testing, maintenance and repair service for the fire alarm system shall be provided by a factory trained authorized representative of the manufacturer of the major equipment for a period of 5 years from the date of acceptance of the entire installation by the Contracting Officer.
- B. Contractor shall provide all necessary test equipment, parts and labor to perform required inspection, testing, maintenance and repair.
- C. All inspection, testing, maintenance and permanent records required by NFPA 72, and recommended by the equipment manufacturer shall be provided by the contractor. Work shall include operation of sprinkler system alarm and supervisory devices as well as all reused existing equipment connected to the fire alarm system. It shall include all interfaced equipment including but not limited to elevators, HVAC shutdown, and extinguishing systems.
- D. Maintenance and testing shall be performed in accordance with NFPA 72. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment and cleaning of all equipment.
- E. Non-included Work: Repair service shall not include the performance of any work due to improper use, accidents, or negligence for which the contractor is not responsible.
- F. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of the work performed and parts replaced shall be provided to the VA Resident Engineer, the COTR, or his authorized representative.
- G. Emergency Service:
  - 1. Warranty Period Service: Service other than the preventative maintenance, inspection, and testing required by NFPA 72 shall be considered emergency call-back service and covered under the

- warranty of the installation during the first year of the warranty period, unless the required service is a result of abuse or misuse by the Government. Written notification shall not be required for emergency warranty period service and the contractor shall respond as outlined in the following sections on Normal and Overtime Emergency Call-Back Service. Warranty period service can be required during normal or overtime emergency call-back service time periods at the discretion of the Resident Engineer, the COTR, or his authorized representative.
2. Normal and overtime emergency call-back service shall consist of an on-site response within 2 hours of notification of a system trouble.
  3. Normal emergency call-back service times are between the hours of 7:30 a.m. and 4:00 p.m., Monday through Friday, exclusive of federal holidays. Service performed during all other times shall be considered to be overtime emergency call-back service. The cost of all normal emergency call-back service for years 2 through 5 shall be included in the cost of this contract.
  4. Overtime emergency call-back service shall be provided for the system when requested by the Government. The cost of the first 40 manhours per year of overtime call-back service during years 2 through 5 of this contract shall be provided under this contract. Payment for overtime emergency call-back service in excess of the 40 man hours per year requirement will be handled through separate purchase orders. The method of calculating overtime emergency call-back hours is based on actual time spent on site and does not include travel time.
- H. The contractor shall maintain a log at each fire alarm control unit. The log shall list the date and time of all examinations and trouble calls, condition of the system, and name of the technician. Each trouble call shall be fully described, including the nature of the trouble, necessary correction performed, and parts replaced.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. The publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only and the latest editions of these publications shall be applicable.
- B. National Fire Protection Association (NFPA):



- NFPA 13 .....Standard for the Installation of Sprinkler  
Systems, 2010 edition
- NFPA 14 .....Standard for the Installation of Standpipes and  
Hose Systems, 2010 edition
- NFPA 20 .....Standard for the Installation of Stationary  
Pumps for Fire Protection, 2010 edition
- NFPA 70.....National Electrical Code (NEC), 2010 edition
- NFPA 72.....National Fire Alarm Code, 2010 edition
- NFPA 90A.....Standard for the Installation of Air  
Conditioning and Ventilating Systems, 2009  
edition
- NFPA 101.....Life Safety Code, 2009 edition
- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment  
Directory
- D. Factory Mutual Research Corp (FM): Approval Guide, 2007-2011
- E. American National Standards Institute (ANSI):  
S3.41.....Audible Emergency Evacuation Signal, 1990  
edition, reaffirmed 2008
- F. International Code Council, International Building Code (IBC), 2009  
edition

SPEC WRITER NOTE: The following section, Part 2(A), addresses requirements for configuration/condition (1) as defined on page 1 of this specification. If Part 2(A) is applicable to this project, delete the "(A)" after "Part 2" and delete Part 2(B) and Part 2 (C) in their entirety.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS, GENERAL**

- A. All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

### **2.2 CONDUIT, BOXES, AND WIRE**

- A. Conduit shall be in accordance with Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY and as follows:
1. All new conduits shall be installed in accordance with NFPA 70.

2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
3. All new conduits shall be 3/4 inch (19 mm) minimum.

B. Wire:

1. Wiring shall be in accordance with NEC article 760, Section 28 05 13, CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.
2. Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.
3. Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.
4. All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. Shall be galvanized steel in accordance with UL requirements.
2. All boxes shall be sized and installed in accordance with NFPA 70.
3. covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 3/4 inch (19 mm) high.
4. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
5. Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the COTR.

## 2.3 FIRE ALARM CONTROL UNIT

### A. General:

1. Each building shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system.
2. Each power source shall be supervised from the other source for loss of power.
3. All circuits shall be monitored for integrity.
4. Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.
5. Transmit digital alarm information to the main fire alarm control unit.

### B. Enclosure:

1. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.

SPEC WRITER NOTE: An operators terminal is optional. Smaller individual buildings generally will not require this item to be specified.

### C. Operator terminal at main control unit:

1. Operator terminal shall consist of the central processing unit, display screen, keyboard and printer.
2. Display screen shall have a minimum 15-inch (380 mm) diagonal non-glare screen capable of displaying 24 lines of 80 characters each.
3. Keyboard shall consist of 60 alpha numeric and 12 user/functional control keys.
4. Printer shall be the automatic type, printing the date, time and location for all alarm, supervisory, and trouble conditions.

D. Power Supply:

1. The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.
3. Power supply for smoke detectors shall be taken from the fire alarm control unit.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.
5. Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.

E. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

F. Supervisory Devices: All sprinkler system valves, standpipe control valves, post indicator valves (PIV), and main gate valves shall be supervised for off-normal position. Closing a valve shall sound a supervisory signal at the control unit until silenced by an off switch. The specific location of all closed valves shall be identified at the control unit. Valve operation shall not cause an alarm signal. Low air pressure switches and duct detectors shall be monitored as supervisory signals. The power supply to the elevator shunt trip breaker shall be monitored by the fire alarm system as a supervisory signal.

G. Trouble signals:

1. Arrange the trouble signals for automatic reset (non-latching).
2. System trouble switch off and on lamps shall be visible through the control unit door.

H. Function Switches: Provide the following switches in addition to any other switches required for the system:

1. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off"

position. A system trouble signal shall be energized when switch is in the off position.

2. Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.
3. Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.
4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.
5. Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.
6. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
7. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
8. Elevator recall By-Pass Switch: Shall prevent the elevators from recalling upon operation of any of the devices installed to perform that function. A system trouble alarm shall be energized when the switch is in the abnormal position.
9. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.

I. Remote Transmissions:

1. Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.
2. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

J. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

- K. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of 20 percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

## **2.4 STANDBY POWER SUPPLY**

### **A. Uninterrupted Power Supply (UPS):**

1. The UPS system shall be comprised of a static inverter, a precision battery float charger, and sealed maintenance free batteries.
2. Under normal operating conditions, the load shall be filtered through a ferroresonant transformer.
3. When normal AC power fails, the inverter shall supply AC power to the transformer from the battery source. There shall be no break in output of the system during transfer of the system from normal to battery supply or back to normal.
4. Batteries shall be sealed, gel cell type.
5. UPS system shall be sized to operate the central processor, CRT, printer, and all other directly connected equipment for 5 minutes upon a normal AC power failure.

### **B. Batteries:**

1. Battery shall be of the sealed, maintenance free type, 24-volt nominal.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure.
3. Battery racks shall be steel with an alkali-resistant finish. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Uniform Building Code.

### **C. Battery Charger:**

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt, 60 hertz emergency power source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current-limiting features, and adjustable voltage controls.

## **2.5 ANNUNCIATION**

### **A. Annunciator, Alphanumeric Type (System):**

1. Shall be a supervised, LCD display containing a minimum of 2 lines of 40 characters for alarm annunciation in clear English text.
2. Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, waterflow alarm or trouble condition) on the second line.
3. The initial alarm received shall be indicated as such.
4. A selector switch shall be provided for viewing subsequent alarm messages.
5. The display shall be UL listed for fire alarm application.
6. Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the COTR.

### **B. Printers:**

1. System printers shall be high reliability digital input devices, UL approved, for fire alarm applications. The printers shall operate at a minimum speed of 30 characters per second. The printer shall be continually supervised.
2. Printers shall be programmable to either alarm only or event logging output.
  - a. Alarm printers shall provide a permanent (printed) record of all alarm information that occurs within the fire alarm system. Alarm information shall include the date, time, building number, floor, zone, device type, device address, and condition.
  - b. Event logging printers shall provide a permanent (printed) record of every change of status that occurs within the fire alarm system. Status information shall include date, time, building number, floor, zone, device type, device address and change of status (alarm, trouble, supervisory, reset/return to normal).
3. System printers shall provide tractor drive feed pins for conventional fan fold 8-1/2" x 11" (213 mm x 275 mm) paper.

4. The printers shall provide a printing and non-printing self test feature.
5. Power supply for printers shall be taken from and coordinated with the building emergency service.
6. Each printer shall be provided with a stand for the printer and paper.
7. Spare paper and ribbons for printers shall be stocked and maintained as part of the one year guarantee period services in addition to the one installed after the approval of the final acceptance test.

## **2.6 VOICE COMMUNICATION SYSTEM (VCS)**

### **A. General:**

1. The new devices shall connect and function within the existing fire alarm system.

## **2.7 ALARM NOTIFICATION APPLIANCES**

### **A. Bells:**

1. Shall be electric, single-stroke or vibrating, heavy-duty, under-dome, solenoid type.
2. Unless otherwise shown on the drawings, shall be 6 inches (150 mm) diameter and have a minimum nominal rating of 80 dBA at 10 feet (3,000 mm).
3. Mount on removable adapter plates on outlet boxes.
4. Bells located outdoors shall be weatherproof type with metal housing and protective grille.
5. Each bell circuit shall have a minimum of 20 percent spare capacity.

### **B. Speakers:**

1. Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the 1/2 watt tap. Speakers shall provide a minimum sound output of 80 dBA at 10 feet (3,000 mm) with the 1/2 watt tap.
2. Frequency response shall be a minimum of 400 HZ to 4,000 HZ.
3. Four inches (100 mm) or 8 inches (200 mm) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.

### **C. Strobes:**

1. Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall



- be synchronized where required by the National Fire Alarm Code (NFPA 72).
2. Backplate shall be red with 1/2 inch (13 mm) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.
  3. Each strobe circuit shall have a minimum of 20 percent spare capacity.
  4. Strobes may be combined with the audible notification appliances specified herein.
- D. Fire Alarm Horns:
1. Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.
  2. Shall be a minimum nominal rating of 80 dBA at 10 feet (3,000 mm).
  3. Mount on removable adapter plates on conduit boxes.
  4. Horns located outdoors shall be of weatherproof type with metal housing and protective grille.
  5. Each horn circuit shall have a minimum of 20 percent spare capacity.

## **2.8 ALARM INITIATING DEVICES**

- A. Manual Fire Alarm Stations:
1. Shall be non-breakglass, address reporting type.
  2. Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semi-flush type.
  3. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE."
  4. Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.
  5. Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.
- B. Smoke Detectors:
1. Smoke detectors shall be photoelectric type and UL listed for use with the fire alarm control unit being furnished.
  2. Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be

installed in accordance with the manufacturer's recommendations and NFPA 72.

3. Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.
4. All spot type and duct type detectors installed shall be of the photoelectric type.
5. Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.
6. Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.

C. Water Flow and Pressure Switches:

1. Wet pipe water flow switches and dry pipe alarm pressure switches for sprinkler systems shall be connected to the fire alarm system by way of an address reporting interface device.
2. All new water flow switches shall be of a single manufacturer and series and non-accumulative retard type. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches added. Connect all switches shown on the approved shop drawings.
3. All new switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds. Timing shall be recorded and documented during testing.

## **2.9 SUPERVISORY DEVICES**

A. Duct Smoke Detectors:

1. Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.

2. Interlocking with fans shall be provided in accordance with NFPA 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".
3. Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.

B. Sprinkler and Standpipe System Supervisory Switches:

1. Each sprinkler system water supply control valve, riser valve or zone control valve, and each 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 valve shall be equipped with a supervisory switch.
3. Valve supervisory switches shall be connected to the fire alarm system by way of address reporting interface device. See Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS for new switches to be added. Connect tamper switches for all control valves shown on the approved shop drawings.
4. The mechanism shall be contained in a weatherproof die-cast aluminum housing that shall provide a 3/4 inch (19 mm) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting.
6. Where dry-pipe sprinkler systems are installed, high and low air pressure switches shall be provided and monitored by way of an address reporting interface devices.

## **2.10 ADDRESS REPORTING INTERFACE DEVICE**

- A. Shall have unique addresses that reports directly to the building fire alarm panel.
- B. Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.
- C. Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.

- D. Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.
- E. Shall be mounted in weatherproof housings if mounted exterior to a building.

#### **2.11 SMOKE BARRIER DOOR CONTROL**

- A. Electromagnetic Door Holders:
  - 1. New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.
  - 2. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.
- B. A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.
- C. Door holder control circuits shall be electrically supervised.
- D. Smoke detectors shall not be incorporated as an integral part of door holders.

#### **2.12 UTILITY LOCKS AND KEYS:**

- A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.
- B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.
- C. All keys shall be delivered to the COTR.

#### **2.13 SPARE AND REPLACEMENT PARTS**

- A. Provide spare and replacement parts as follows:
  - 1. Manual pull stations - 5
  - 2. Fire alarm strobes - 5
  - 3. Fire alarm bells - 5
  - 4. Fire alarm speakers - 5
  - 5. Smoke detectors - 20
  - 6. Duct smoke detectors with all appurtenances - 1
  - 7. Sprinkler system water flow switch - 1 of each size
  - 8. Sprinkler valve tamper switch - 1 of each type
  - 9. Control equipment utility locksets - 5
  - 10. Control equipment keys - 25

- 11. 2.5 oz containers aerosol smoke - 12
- 12. Monitor modules - 3
- 13. Control modules - 3
- 14. Fire alarm SLC cable (same as installed) - 500 feet (152 m)
- B. Spare and replacement parts shall be in original packaging and submitted to the COTR.
- C. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the COTR.
- D. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

**2.14 INSTRUCTION CHART:**

Provide typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the COTR before being posted.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION:**

- A. Installation shall be in accordance with NFPA 70, 72, 90A, and 101 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed in accordance with, Section 28 05 13 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 26 GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY, Section 28 05 28.33 CONDUIT AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY, and all penetrations of smoke and fire barriers shall be protected as required by Section 07 84 00, FIRESTOPPING.
- B. All conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All new and reused exposed conduits shall be painted in accordance with Section 09 91 00, PAINTING to match surrounding finished areas and red in unfinished areas.
- D. All existing accessible fire alarm conduit not reused shall be removed.
- E. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and patched in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Restoration, and be re-painted in accordance with Section 09 91 00, PAINTING as necessary to match existing.
- F. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations are to be approved by the COTR.
- G. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.
- H. Strobes shall be flush wall mounted with the bottom of the unit located 80 inches (2,000 mm) above the floor or 6 inches (150 mm) below ceiling, whichever is lower. Locate and mount to maintain a minimum 36 inches (900 mm) clearance from side obstructions.

- I. Manual pull stations shall be installed not less than 42 inches (1,050 mm) or more than 48 inches (1,200 mm) from finished floor to bottom of device and within 60 inches (1,500 mm) of a stairway or an exit door.
- J. Where possible, locate water flow and pressure switches a minimum of 12 inches (300 mm) from a fitting that changes the direction of the flow and a minimum of 36 inches (900 mm) from a valve.
- K. Mount valve tamper switches so as not to interfere with the normal operation of the valve and adjust to operate within 2 revolutions toward the closed position of the valve control, or when the stem has moved no more than 1/5 of the distance from its normal position.
- L. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.
- M. Connect combination closer-holders installed under Section 08 71 00, DOOR HARDWARE.

### **3.2 TYPICAL OPERATION**

- A. Activation of any manual pull station, water flow or pressure switch, heat detector, kitchen hood suppression system, gaseous suppression system, or smoke detector shall cause the following operations to occur:
  - 1. Operate the emergency voice communication system in new wing of building. For sprinkler protected buildings, flash strobes continuously only in the zone of alarm. For buildings without sprinkler protection throughout, flash strobes continuously only on the floor of alarm.
  - 2. Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in new wing of building.
  - 3. Release only the magnetic door holders in the smoke zone on the floor from which alarm was initiated after the alert signal.
  - 4. Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.
  - 5. Unlock the electrically locked exit doors within the zone of alarm.
- B. Smoke detectors in the primary elevator lobbies of the Building shall, in addition to the above functions, return all elevators in the bank to the secondary floor.

- C. Smoke detectors in the remaining elevator lobbies, elevator machine room, or top of hoistway shall, in addition to the above functions, return all elevators in the bank to the primary floor.
- D. Operation of a smoke detector at a corridor door used for automatic closing shall also release only the magnetic door holders on that floor in that smoke zone.
- E. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.
- F. Operation of any sprinkler or standpipe system valve supervisory switch, high/low air pressure switch, or fire pump alarm switch shall cause a system supervisory condition.
- G. Alarm verification shall not be used for smoke detectors installed for the purpose of early warning.

### 3.3 TESTS

- A. Provide the service of a NICET level III, competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the COTR.
- B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the COTR. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the COTR, the contractor may request a final inspection.
  - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
  - 2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
  - 3. Run water through all flow switches. Check time delay on water flow switches. Submit a report listing all water flow switch operations and their retard time in seconds.
  - 4. Open each alarm initiating and notification circuit to see if trouble signal actuates.



5. Ground each alarm initiation and notification circuit and verify response of trouble signals.

### **3.4 FINAL INSPECTION AND ACCEPTANCE**

- A. Prior to final acceptance a minimum 30 day "burn-in" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burn-in" period and where the last 14 days is without a system or equipment malfunction.
- B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests in Article 3.3 TESTS and those required by NFPA 72. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a VA representative.

### **3.5 INSTRUCTION**

- A. The manufacturer's authorized representative shall provide instruction and training to the VA as follows:
  1. Six 1-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, 2 sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
  2. Four 2-hour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and 2 sessions 3 months after the completion of installation.
  3. Three 8-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one 8-hour refresher session 3 months after the completion of installation.
- B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the VA. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the

system. The INPUT/OUTPUT matrix format shall be as shown in Appendix A to NFPA 72.

- C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

#### **PART 4 - SCHEDULES**

##### **4.1 SMOKE ZONE DESCRIPTIONS:**

Emergency Department

##### **4.2 DIGITIZED VOICE MESSAGES:**

- A. Digitized voice messages shall be provided for each smoke zone of the Building. The messages shall be as the existing main fire alarm panel.

##### **4.3 LOCATION OF VOICE MESSAGES:**

All alarm signals shall be as on the existing main fire alarm panel.

- - END - -

**SECTION 28 52 31  
EMERGENCY CALL SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the complete and operating emergency call system, including instruments (stations), security strobe, stanchions and associated equipment here-in-after referred to as the "system".

**1.2 RELATED WORK**

- A. Electrical conductors and cables in electrical systems rated 600 V and below: Section 26 05 21, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- B. Lightning Protection: Section 26 41 00, FACILITY LIGHTNING PROTECTION.
- C. Requirements for personal safety and to provide a low impedance path for possible telecommunications ground fault currents: Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.
- D. Voice and data distribution sub-systems, and associated hardware including telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, and "break out" devices: Section 27 15 00, COMMUNICATIONS HORIZONTAL CABLING.
- E. Conduits and partitioned telecommunications raceways for Electronic Safety and Security systems: Section 28 05 28.33, CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY.
- F. Extension of a voice communication switching and routing system: Section 27 31 31, EMERGENCY VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT EXTENSION.
- G. Section 28 13 00, PHYSICAL ACCESS CONTROL SYSTEM.

**1.3 SUBMITTALS**

- A. In addition to requirements of Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS provide:
1. Names, locations and contact information for three or more installations of operating emergency call station systems of comparable size and complexity previously installed by contractor performing satisfactorily for at least one year after final acceptance by user.
  2. Copies of applicable licenses.
- B. Certifications:
1. Submit certification equipment provider has been OEM authorized distributor and service organization for three years.

2. Certification that technicians assigned to system are trained, qualified, and certified by OEM on engineering, installation, operation, and testing of system. Submit certificate of successful completion of OEM's installation/training school for every installing technician of equipment.
3. Submit OEM letter certifying authorization to pass OEM's warranty of equipment to Government.

C. Closeout Submittals:

1. Before the project closeout date submit:
  - a. Warranty certificate.
  - b. Evidence of compliance with requirements of governing authorities such as Low Voltage Certificate of Inspection.
  - c. Project record documents.
  - d. Instruction manuals and software that is a part of system.
2. Submit written notice that:
  - a. Contract Documents have been reviewed.
  - b. Project has been inspected for compliance with contract.
  - c. Work has been completed in accordance with the contract
3. Project Record Documents (As Builts):
  - a. Throughout progress of work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
4. Mark floor plans in pen to include the following:
  - a. Device locations with labels.
  - b. Conduit locations.
  - c. Equipment specific locations.
  - d. Wiring diagram.
  - e. Labeling and administration documentation.
  - f. Warranty certificate.
  - g. System test results.

#### **1.4 QUALITY ASSURANCE**

A. Supervision:

1. Assign a single project manager to this project to serve as point of contact for Government, General Contractor, and design professional.
2. Assigned individual to initiate and maintain discussion with General Contractor regarding the schedule for ceiling installation and complete cabling to meet that schedule.

- B. Approvals: Contact Office of Telecommunications, Special Communications Team (0050P2H3) at (202) 461-5310 to have a VA Certified Telecommunications AHJ assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and FMS Teams.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle products using means and methods that will prevents damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Plan to store materials off site due to limited storage available on site.
- D. Do not install damaged products. Remove damaged products from the site and replace with new products.

#### **1.6 WARRANTY**

- A. Comply with FAR clause 52.246-21, except as follows:
  - 1. Manufacturer shall warranty their equipment and certified installation for a minimum of two years from date of installation and final acceptance by the government. Submit manufacturer warranty during the submittal process.
  - 2. Provide, free of charge, product firmware/software upgrades for a period of two years from date of acceptance by Government including any product feature enhancements.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Coordinate features and select components to form an integrated system.
- B. Provide components and interconnections matched for optimum performance of specified functions.
- C. Equipment: Modular type, continuous duty rated.
- D. Weather-Resistant Equipment: Listed by a National Recognized Testing Laboratory (NRTL) for operation in damp or outdoor locations.

#### **2.2 PERFORMANCE CRITERIA**

- A. Provide functioning emergency call station system consisting of indoor or outdoor enclosures, stanchions, blue light and strobe lights, ADAAD compliant hands-free speakerphone communications devices and power supplies.
  - 1. Conform to VAAR 852.236.91 and intent indicated for complete emergency communications network, recognizing that work may be shown in diagrammatic form or have been impracticable to detail all items

because of variances in manufacturer's methods of achieving specified results.

- B. Provide integrated blue light and strobe to identify unit location.
  - 1. To call attention to location of emergency communication unit, Blue light must always be lit.
  - 2. When emergency instrument is activated, the strobe flashes at 1 million candlepower and 60 fpm to draw attention to the location.
  - 3. Strobe continuously flashes until actively terminated by personnel receiving the call.
- C. Provide systems firmware by OEM with a proven history of product reliability and sole control over all source code.
- D. Provide system with configuration programming capable of being executed remotely via a remote connection (when specifically accepted by Spectrum Management and COMSEC Services (SMCS 0050P2H3)) without any exchange of parts.

### **2.3 EMERGENCY CALL STATION (NOT USED)**

### **2.4 BLUE STROBE LIGHTS (NOT USED)**

### **2.5 STANCHION (NOT USED)**

### **2.6 SECURITY CALL STATION POWER SUPPLY**

- A. Provide power to operating and management console circuits and Multiple Call Instruments:
  - 1. Steel, NEMA 1 rated enclosure.
  - 2. AC power indicator with power On/Off switch with corresponding light.
  - 3. 120 or 230 VAC selectable input.
  - 4. 24VAC output.
  - 5. Main fused input.
  - 6. 10A current capacity.
  - 7. Minimum 8 fused outputs.
  - 8. Input wire size 12-16 gauge.
  - 9. Output wire size 12-22 gauge stranded wire.
- B. Security Call Station Cable:
  - 1. Meet or exceed OEM's requirement.
  - 2. Power cable: Minimum 14 AWG wire or as otherwise accepted home run from power supply to each call instruments.
  - 3. Cables installed underground in underground conduits: Rated for direct burial installation.

4. Cables inside Building: Plenum rated in plenum spaces; riser rated in other areas.

## **2.7 UNINTERRUPTIBLE POWER SUPPLY (UPS)**

- A. Provide a backup battery or a UPS for system head end at Security Service SMS console or its associated TR to allow normal operation and function (as if there was no AC power failure) in event of an AC power failure or during input power fluctuations for a minimum of one hour. Connect system to facility's Critical Generator Power Service.
  1. As an alternative solution, utilize facility telephone system UPS (if it is present) to meet this requirement at head end location, only when specifically accepted by COR.
  2. Obtain specific direction, in writing, from COR prior to any attachments or connection to facility's existing telephone system (if it exists).
- B. Provide UPS for active system components including:
  1. Head end.
  2. Master call instruments.
  3. Remote call instruments.
  4. Police SMS console.
  5. Emergency/Disaster control console (when made an extended control and monitoring part of system).

## **2.8 FINISHES**

- A. Finishes for any exposed work such as plates, racks, panels, towers, enclosures, intercom stations, etc. must be accepted by design professional, COR and SMCS 0050P2H3.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Review and coordinate with cabling trade contractor for location of security emergency call equipment in TRs.
- B. Before beginning work, verify location, quantity, size and access for the following:
  1. AC power circuits provided for systems.
  2. Pull boxes, back boxes, wire troughs, cable trays/ladders, conduit stubs and other related infrastructure for systems.
  3. System components installed by others.
  4. Overhead supports and rigging hardware installed by others.
  5. Telecommunications grounding busbar connected to telecommunications grounding system.

6. Immediately notify Government, general contractor and design professional of any discrepancies.

### 3.2 INSTALLATION

#### A. General:

1. Install work neatly, plumb and square and in a manner consistent with standard industry practice.
2. Protect work from dust, paint and moisture as dictated by site conditions. Contractor is responsible for protection of his work during construction phase up until final acceptance by Government.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including emergency call stations, stanchions, system cables, etc.
  - a. Support loads with mounts, fasteners, attachments and attachment points with a safety factor of at least 5:1.
  - b. Do not impose weight of equipment or fixtures on supports provided for other trades or systems.
  - c. Any suspended equipment or associated hardware must be certified by OEM for overhead suspension.
  - d. Contractor is responsible for means and methods in design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
6. Cutting and Patching:
  - a. Patch and paint any wall or surface that has been disturbed by execution of work.
  - b. Provide any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete work or to make its parts fit together.
  - c. Do not damage or endanger a portion of Work, or partially completed construction of Government or separate contractors, by cutting, patching or otherwise altering such construction, or by excavation. Do not cut or otherwise alter such construction by



Government or a separate contractor except with written consent of Government.

- d. Where coring of in-place concrete is required clearly identify location of such coring in the field and have location accepted by COR prior to commencement of coring.
7. Keep work areas clear of debris and clean daily at completion of work.

B. Wiring Practice:

1. Comply with requirements for raceways and boxes specified in Division 28, Section 28 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
2. Execute wiring in strict adherence to National Electrical Code, applicable local building codes and standard industry practices.
3. Classify wiring according to the following low voltage signal types:
  - a. Voice audio.
  - b. Low voltage DC control or power (less than 48VDC).
4. Where raceway is conduit, wiring of differing classifications must be run in separate conduit.
5. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share same enclosure must be mechanically partitioned and separated by minimum 102 mm (4 inches). Where cables of differing classifications cross, cross cabling perpendicular to one another.
6. Do not splice wiring anywhere along entire length of run.
7. Ensure cables are insulated and shielded from each other and from raceway for entire length of run.
8. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs.
9. Do not bend wires to less than radius recommended by manufacturer.
10. Replace entire length of run of any wire or cable that is damaged or abraded during installation. There are no acceptable methods of repairing damaged or abraded wiring.
11. Use wire pulling lubricants and pulling tensions recommended by OEM.
12. Use grommets around cut-outs and knock-outs where conduit or chase nipples are not installed.
13. Do not use tape-based or glue-based cable anchors.
14. Ground shields and drain wires as indicated or recommended by OEM.
15. Terminate field wiring entering equipment racks as follows:

- a. Provide service loops at harness break-outs, plates, panels and equipment to allow plates, panels and equipment to be removed for service and inspection.
  - b. If specified terminal blocks are not designed for rack mounting, utilize 19 mm (3/4 inch) plywood or 3 mm (1/8 inch) thick aluminum plates/blank panels as a mounting surface.
  - c. Do not mount terminal block on bottom of rack.
  - d. Employ permanent strain relief for any cable with an outside diameter of 25.4 mm (1 inch) or greater.
16. Make connections as follows:
- a. Use mechanical connectors appropriate to application.
  - b. For crimp-type connections, use only tools that are specified by manufacturer for the application.
  - c. Use only insulated spade lugs on screw terminals. Size spade lugs to fit wire gauge; do not exceed two lugs per terminal.
  - d. Wire connectors or electrical tape connections are not permitted for any application.
- C. Cable Installation: In addition to mandatory infrastructure requirements provided under, Section 27 15 00, STRUCTURED CABLING, adhere to the following additional practices:
- 1. Support cable on maximum 610 mm (2 feet) centers. Acceptable means of cable support are cable tray or conduit. Wrap cable bundles loosely to cable tray with plenum rated hook and loop straps. Plastic tie wraps are not permitted as a means to bundle cables.
  - 2. Run cables parallel to walls.
  - 3. Do not lay cables on top of luminaires, ceiling tiles, mechanical equipment, or ductwork. Maintain 61 cm (2 feet) clearance from shielded electrical apparatus.
  - 4. Test each cable after the total installation is complete. Document every test result including failures. Remedy any cabling problems or defects; this includes re-pull of new cable as required.
  - 5. Terminate cables on both ends per industry and OEM's recommendations.
  - 6. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off the floor until you are ready to terminate.

7. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps are not permitted.
  8. Elude runs through structural members or cable in contact with pipes, ducts, or other potentially damaging items.
  9. Separation of Wires: (Refer to Raceway Installation)
    - a. Separate communications cable, and power wiring runs.
    - b. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 30.5 cm (12 inches) apart for adjacent parallel power and telephone wiring.
    - c. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- D. Labeling:
1. Permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
  2. Permanently label cables at each end, including intra-rack connections with, electronically printed labels of type which include a clear protective wrap.
  3. Provide printed labels at both ends of cables.
  4. Ensure equipment has appropriate NRTL Label, for product category it will perform. Equipment not bearing NRTL label will not be permitted as part of system, and contractor must provide listed replacement equipment with NRTL label.
- E. System Programming: Provide programming required for a complete and operational system. Coordinate programming parameters with COR and FMS Engineer.
- F. Fireproofing:
1. Fireproof the openings where cables penetrate fire rated walls, floors and ceilings.
  2. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls. After cabling installation is complete, install fireproofing material in and around conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal floor and ceiling penetrations.
  3. Use only materials and methods that preserve integrity of fire stopping system and its rating.
- G. Grounding:

1. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.
2. Provide telecommunications grounding system per Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

### 3.3 FIELD QUALITY CONTROL

#### A. Intermediate Testing:

1. After completion of 25 percent of installation of equipment, including one emergency call station, and prior to any further work, this portion of system must be pretested, inspected, and certified. Check each item of installed equipment to ensure appropriate NRTL labels are affixed, NFPA, Life Safety, and Joint Commission guidelines are followed, and proper installation practices are followed. Include a full operational test.
2. Arrange for inspection and test to be conducted by a factory-certified representative and witnessed by Government and SMCS 0050P2H3.
3. An identical inspection must be conducted between 65 and 75 percent of system construction phase; COR has authority to waive this requirement.

#### B. Pretesting:

1. Upon completing installation of system:
  - a. Align, balance, and pretest entire system under full operating conditions.
  - b. Verify (utilizing accepted test equipment) system is operational and meets performance requirements of this standard.
  - c. Verify that system functions are operational, and no unwanted aural effects, (i.e. signal distortion, noise pulses, glitches, audio hum, poling noise, etc.) are present. Pretest each of the following locations:
    - 1) Networked locations.
    - 2) System trouble reporting.
    - 3) System electrical supervision.
    - 4) UPS operation.
2. Provide COR with recorded system pretest measurements and certification that system is ready for formal acceptance.

#### C. Acceptance Test:

1. After system has been pretested and contractor has submitted pretest results and certification to COR, schedule an acceptance test date by giving COR thirty days' written notice prior to date acceptance test is expected to begin. Include the duration of time for the test in the notification.
2. Test system in the presence of Government, SMCS 0050P2H3 and an OEM-certified representative.
3. Test utilizing accepted test equipment to certify proof of performance.
4. Perform only operator adjustments required to show proof of performance during test.
5. Demonstrate and verify that installed system complies with requirements of this section, under operating conditions.
6. Rate system as either acceptable or unacceptable at conclusion of test.
7. Terminate acceptance test of system for failure of any part of system that precludes completion of system testing, and which cannot be repaired in four hours. For repeated failures that result in a cumulative time of eight hours to affect repairs, Government will declare entire system to be unacceptable.
8. Reschedule retesting of unacceptable systems at the convenience of Government.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:
  - a. Prepare a system inventory including available spare parts. Check each item of installed equipment to ensure appropriate NRTL certification labels are affixed.
  - b. Formally inventory and review system diagrams, record drawings, equipment manuals, electronic drawing files, intermediate, and pretest results on portable storage drives.
  - c. Terminate testing for failure of system to meet requirements of this section.
2. Operational Test:
  - a. After physical and mechanical inspection, check equipment to verify system meets performance requirements. Use sound level meter to accomplish this requirement.
  - b. Individual Item Test: Government will select individual items of equipment for detailed proof of performance testing until 100

percent of system is tested and found to meet or exceed minimum requirements of specifications.

3. Test Conclusion: Government will accept results of the test or require additional testing on reported deficiencies and shortages. Retesting to comply with these specifications must be done at Government's convenience and contractor's expense.

E. Acceptable Test Equipment:

1. Provide test equipment with a calibration tag of an acceptable calibration service dated not more than twelve months prior to test.
2. As part of submittal, a test equipment list must be furnished that includes make and model number of the following type of equipment:
  - a. Signal Level Meter.
  - b. Sound Pressure Level (SPL) Meter.

### **3.4 CLEANING**

- A. Prior to final inspection and acceptance of work, remove debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from project site and thoroughly clean work area.

### **3.5 TRAINING**

- A. Provide thorough training of security staff assigned to units receiving communications from emergency call station system equipment. Implement training from security console officer's perspective, and likewise, for any person whose specific responsibilities include answering emergency calls and dispatching security response, provide operational training from their perspective. Use a separate training room that allows this type of individualized training utilizing an in-service training unit, prior to cut over of new system.
- B. Provide the following minimum training:
  1. 8 hours during opening week for security staff - both day and night shifts.
  2. 4 hours for supervisors and system administrators.

### **3.6 MAINTENANCE**

- A. Provide COR the ability to contact contractor and OEM's central emergency assistance maintenance center and request remote diagnostic testing and assistance in resolving technical problems at any time, during warranty period. Provide remote diagnostic testing and logistic assistance capability to Government.
- B. Response Time, during Warranty Period, for Security Emergency Call System Trouble Calls:

1. A standard work week is considered 8:00 A.M. to 5:00 P.M., Monday through Friday exclusive of Federal holidays.
2. Respond and correct on-site trouble calls, during the standard work week:
  - a. A routine trouble is considered a trouble which reports a single station or interface point is inoperable. Routine trouble call within one working day (12 hours) of its report.
  - b. An emergency trouble is considered a trouble which causes a sub system (ward), distribution point, terminal cabinet, to be inoperable at any time. Emergency trouble call within two hours of its report.
  - c. A catastrophic trouble is considered a trouble which a major portion of system fails; or, an entire system failure has happened. Catastrophic trouble call within one hour of its report.

- - - E N D - - -