

**SPECIFICATIONS**

**SECTION 00 01 10  
TABLE OF CONTENTS**

**VOLUME 1**

	DIVISION 00 – SPECIAL SECTIONS
00 10 00	Certification Page
00 01 15	List of Drawing Sheets
	DIVISION 01 – GENERAL REQUIREMENTS
01 00 00	General Requirements
01 00 00	General Requirements Appendices
01 33 23	Shop Drawings, Product Data, and Samples
01 42 19	Reference Standards
01 45 29	Testing Laboratory Services
01 57 19	Temporary Environmental Controls
01 74 19	Construction Waste Management
01 81 12	Sustainable Design Requirements
	DIVISION 02 – EXISTING CONDITIONS
02 41 00	Demolition
	DIVISION 03 – CONCRETE
03 30 00	Cast-in-Place Concrete
03 41 13	Precast Concrete Hollow Core Planks
03 41 33	Precast Structural Pretensioned Concrete
03 45 00	Precast Architectural Concrete
	DIVISION 04 – MASONRY
04 05 13	Masonry Mortaring
04 05 16	Masonry Grouting
04 20 00	Unit Masonry
	DIVISION 05 – METALS
05 12 00	Structural Steel Framing
05 50 00	Metal Fabrications
05 70 00	Decorative Metal
	DIVISION 06 – WOOD, PLASTICS AND COMPOSITES
06 10 00	Rough Carpentry
	DIVISION 07 – THERMAL AND MOISTURE PROTECTION
07 13 52	Modified Bituminous Sheet Waterproofing
07 18 16	Vehicular Traffic Coating
07 19 16	Silane Water Repellents
07 22 00	Roof and Deck Insulation

07 40 00	Roofing and Siding Panels
07 54 23	TPO Roofing
07 72 00	Roof Accessories
07 84 00	Fire Stopping
07 92 00	Joint Sealants
07 95 13	Expansion Joint Cover Assemblies

	DIVISION 08 – OPENINGS
08 11 13	Hollow Metal Doors and Frames
08 36 13	Sectional Doors
08 41 13	Aluminum Framed Entrances and Storefronts
08 44 13	Glazed Aluminum Curtain Walls
08 51 13	Aluminum Windows
08 71 00	Door Hardware
08 71 13	Power Door Operators
08 80 00	Glazing
08 90 00	Louvers and Vents

	DIVISION 09 – FINISHES
09 06 00	Schedule for Finishes
09 22 16	Non-Structural Metal Framing
09 29 00	Gypsum Board
09 30 13	Ceramic/Porcelain Tiling
09 54 23	Linear Metal Ceiling
09 91 00	Painting

	DIVISION 10 – SPECIALTIES
10 14 00	Signage
10 44 13	Fire Extinguisher Cabinets

	DIVISION 11 – EQUIPMENT
11 05 12	General Motor Requirements For Equipment
11 12 00	Parking Control Equipment

<b>VOLUME 2</b>	
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	DIVISION 14 – Conveying Equipment
14 24 00	Hydraulic Elevator

	DIVISION 22 – PLUMBING
22 05 11	Common Work Results for Plumbing
22 05 23	General Duty Valves for Plumbing Pipe
22 05 33	Heat Tracing for Plumbing Pipe
22 07 11	Plumbing Insulation
22 11 00	Facility Water Distribution
22 13 00	Facility Sanitary and Vent Piping
22 14 00	Facility Storm Drainage
22 33 00	Electric Domestic Water Heaters

22 40 00	Plumbing Fixtures

	DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)
23 05 11	Common Work Results for HVAC
23 09 23	Direct Digital Control Systems for HVAC
23 34 00	HVAC Fans
23 81 00	Decentralized Unitary HVAC Equipment
23 82 00	Convection Heating and Cooling Units
	DIVISION 26 – ELECTRICAL
26 05 11	Requirements for Electrical Installations
26 05 19	Low Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 33	Raceway and Boxes for Electrical Systems
26 05 41	Underground Electrical Construction
26 09 23	Lighting controls
26 22 00	Low Voltage Transformers
26 24 16	Panelboards
26 27 26	Wiring Devices
26 29 21	Enclosed Switches And Circuit Breakers
26 32 13	Engine Generators
26 36 23	Automatic Transfer Switches
26 41 00	Facility Lighting Protection
26 51 00	Interior Lighting
26 56 00	Exterior Lighting
	DIVISION 27 – COMMUNICATIONS
27 05 11	Requirements for Communications Installations
27 05 26	Grounding and Bonding for Communications Systems
27 05 33	Raceways and Boxes for Communications Systems
27 08 00	Commissioning for Communications Systems
27 10 00	Structured Cabling
27 11 00	Communications Equipment Room Fittings
27 15 00	Communications Horizontal Cabling
27 52 31	Security Emergency Call, Duress Alarm, and Telecommunications
	DIVISION 28 – ELECTRONIC SAFETY AND SECURITY
28 05 00	Common Work Results for Electronic Safety and Security
28 05 13	Conductors And Cables For Electronic Safety And Security
28 05 26	Grounding And Bonding For Electronic Safety And Security
28 05 28.33	Conduits And Backboxes For Electronic Safety And Security
28 13 00	Physical Access Control Systems
28 23 00	Video Surveillance
28 26 00	Electronic Personal Protection System

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

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28 31 00	Fire Detection And Alarm
	DIVISION 31 – Earthwork
31 20 00	Earthwork
31 23 19	Dewatering
	DIVISION 32 – Exterior Improvements
32 05 23	Cement and Concrete for Exterior Improvements
32 12 16	Asphalt Paving
32 17 23	Pavement Markings
32 90 00	Planting
	DIVISION 33 – Utilities
33 10 00	Water Utilities
33 30 00	Sanitary Sewerage Utilities
33 40 00	Storm Drainage Utilities
	DIVISION 34 – Vehicle Barriers
34 71 13	Vehicle Barriers

**SECTION 00 01 15**  
**LIST OF DRAWING SHEETS**

The drawings listed below accompanying this specification form a part of the contract.

<u>Drawing No.</u>	<u>Title</u>
GI001	TITLE PAGE
GI002	GENERAL NOTES & CONSTRUCTION SIGNS
GI101	LEVEL 1 LIFE SAFETY PLAN
GI102	LEVEL 2 LIFE SAFETY PLAN
GI103	LEVEL 3 LIFE SAFETY PLAN
GI104	LEVEL 4 LIFE SAFETY PLAN
VF101	TOPOGRAPHIC SURVEY
CC001	GENERAL CIVIL NOTES
CC002	SITE PHASING PLAN
CD101	SITE DEMOLITION PLAN
CD102	SITE DEMOLITION PLAN
CS101	SITE PLAN
CS102	SITE PLAN
CS501	SITE DETAILS
CG101	SITE GRADING PLAN
CG102	SITE GRADING PLAN
CU101	SITE UTILITY PLAN
CU102	SITE UTILITY PLAN
CU501	SITE UTILITY DETAILS
CU502	SITE UTILITY DETAILS
CU503	SITE UTILITY DETAILSCJ101 EROSION CONTROL PLAN
CJ101	EROSION CONTROL PLAN
CJ102	EROSION CONTROL PLAN
CJ501	EROSION CONTROL DETAILS
CK101	CONSTRUCTION ENTRANCE PLAN
CK601	CONSTRUCTION ENTRANCE TRAFFIC CONTROL PLAN
CW101	WAYFINDING PLAN
LP101	LANDSCAPE PLAN
LP501	LANDSCAPE DETAILS
SI001	ABBREVIATIONS AND SYMBOLS
SI002	STRUCTURAL GENERAL NOTES

SI003	SPECIAL INSP. NOTES AND TABLES
SI004	LOAD MAPS
SB101	AREA A FOUNDATION PLAN
SB102	AREA B FOUNDATION PLAN
SF101	LEVEL 1 - AREA A SLAB ON GRADE
SF102	LEVEL 1 - AREA B SLAB ON GRADE
SF103	LEVEL 2 - AREA A FRAMING PLAN
SF104	LEVEL 2 - AREA B FRAMING PLAN
SF105	LEVEL 3 - AREA A FRAMING PLAN
SF106	LEVEL 3 - AREA B FRAMING PLAN
SF107	LEVEL 4 - AREA A FRAMING PLAN
SF108	LEVEL 4 - AREA B FRAMING PLAN
SF201	SHEARWALL ELEVATIONS AND SCHEDULES
SF202	SHEARWALL ELEVATIONS AND SCHEDULES
SF301	BUILDING SECTIONS AND ELEVATIONS
SF401	ENLARGED PLANS
SF402	ENLARGED PLANS
SF403	ENLARGED PLANS
SF404	ENLARGED PLANS
SF405	ENLARGED BUILDING SECTIONS
SF501	FOUNDATION TYPICAL DETAILS AND SCHEDULES
SF502	FOUNDATION TYPICAL DETAILS AND SECTIONS
SF503	FOUNDATION SECTIONS
SF504	PILE/ PILE CAP DETAILS/ SCHEDULES
SF505	TYPICAL FRAMING SECTIONS AND DETAILS
SF506	TYPICAL FRAMING SECTIONS AND DETAILS
SF507	FRAMING SECTIONS AND DETAILS
SF508	FRAMING SECTIONS AND DETAILS
SF509	FRAMING SECTIONS AND DETAILS
SF510	MISCELLANEOUS DETAILS
SF511	TYPICAL STEEL/ CMU DETAILS AND SCHEDULES
	AXONOMETRICS
AS001	ABBREVIATIONS & SYMBOLS
AS101	LEVEL 1 - AREA A FLOORPLAN
AS102	LEVEL 1 AREA B FLOORPLAN
AS103	LEVEL 2 AREA A FLOORPLAN

AS104	LEVEL 2 AREA B FLOORPLAN
AS105	LEVEL 3 AREA A FLOORPLAN
AS106	LEVEL 3 AREA B FLOORPLAN
AS107	LEVEL 4 AREA A FLOORPLAN
AS108	LEVEL 4 AREA B FLOORPLAN
AS251	ROOF PLAN
AS301	BUILDING ELEVATIONS
AS302	BUILDING ELEVATIONS
AS311	ENLARGED ELEVATIONS
AS312	ENLARGED WINDOW ELEVATIONS
AS411	WALL SECTIONS
AS412	STAIR TOWER SECTIONS
AS413	STAIR TOWER SECTIONS
AS421	STAIR DETAILS
AS501	ENLARGED PLANS
AS502	ENLARGED PLANS
AS611	DETAILS
AS612	DETAILS
AS613	DETAILS
AS614	ENLARGED CEILING PLANS AND DETAILS
AS811	SCHEDULES
AP101	LEVEL 1 - AREA A FUNCTIONAL PLAN
AP102	LEVEL 1 - AREA B FUNCTIONAL PLAN
AP103	LEVEL 2 - AREA A FUNCTIONAL PLAN
AP104	LEVEL 2 - AREA B FUNCTIONAL PLAN
AP105	LEVEL 3 - AREA A FUNCTIONAL PLAN
AP106	LEVEL 3 - AREA B FUNCTIONAL PLAN
AP107	LEVEL 4 - AREA A FUNCTIONAL PLAN
AP108	LEVEL 4 - AREA B FUNCTIONAL PLAN
AP401	ENLARGED PLANS - ENTRANCES
AP501	STRIPING DETAILS & NOTES
AP601	SIGNAGE SCHEDULE, DETAIL, & NOTES
AW101	LEVEL 1 - AREA A WATERPROOFING PLAN
AW102	LEVEL 1 - AREA B WATERPROOFING PLAN
AW103	LEVEL 2 - AREA A WATERPROOFING PLAN
AW104	LEVEL 2 - AREA B WATERPROOFING PLAN

AW105	LEVEL 3 - AREA A WATERPROOFING PLAN
AW106	LEVEL 3 - AREA B WATERPROOFING PLAN
AW107	LEVEL 4 - AREA A WATERPROOFING PLAN
AW108	LEVEL 4 - AREA B WATERPROOFING PLAN
AW551	WATERPROOFING DETAILS
PI001	PLUMBING NOTES, SCHEDULES & DETAILS
PP101	LEVEL 1 - AREA A PLUMBING PLAN
PP102	LEVEL 1 - AREA B PLUMBING PLAN
PP103	LEVEL 2 - AREA A PLUMBING PLAN
PP104	LEVEL 2 - AREA B PLUMBING PLAN
PP105	LEVEL 3 - AREA A PLUMBING PLAN
PP106	LEVEL 3 - AREA B PLUMBING PLAN
PP107	LEVEL 4 - AREA A PLUMBING PLAN
PP108	LEVEL 4 - AREA B PLUMBING PLAN
PP301	PLUMBING RISERS
MI001	MECHANICAL NOTES, ABBREVIATIONS & DETAILS
MH101	MECHANICAL PLANS
EE001	ELECTRICAL NOTES, LEGENDS AND LIGHT FIXTURE SCHEDULE
EE101	ELECTRICAL SITE PLANS
EE102	BASEMENT LEVEL ELECTRICAL PLAN - MAIN HOSPITAL
EE103	LEVEL 1 - AREA A ELECTRICAL PLAN
EE104	LEVEL 1 - AREA B ELECTRICAL PLAN
EE105	LEVEL 2 - AREA A ELECTRICAL PLAN
EE106	LEVEL 2 - AREA B ELECTRICAL PLAN
EE107	LEVEL 3 - AREA A ELECTRICAL PLAN
EE108	LEVEL 3 - AREA B ELECTRICAL PLAN
EE109	LEVEL 4 - AREA A ELECTRICAL PLAN
EE110	LEVEL 4 - AREA B ELECTRICAL PLAN
EE401	ELECTRICAL PLAN ENLARGEMENTS
EE402	ELECTRICAL PLAN ENLARGEMENTS
EE501	ELECTRICAL DETAILS
EE601	SINGLE LINE DIAGRAM AND PANEL SCHEDULES

-- END --



**SECTION 01 00 00**  
**GENERAL REQUIREMENTS**

**TABLE OF CONTENTS**

1.1 GENERAL INTENTION .....	1
1.2 STATEMENT OF BID ITEM(S) .....	2
1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR .....	2
1.4 CONSTRUCTION SECURITY REQUIREMENTS.....	2
1.5 FIRE SAFETY.....	4
1.6 OPERATIONS AND STORAGE AREAS.....	7
1.7 INFECTION PREVENTION MEASURES.....	12
1.8 DISPOSAL AND RETENTION.....	15
1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS.....	16
1.10 RESTORATION.....	18
1.11 PHYSICAL DATA .....	18
1.12 PROFESSIONAL SURVEYING SERVICES .....	19
1.13 LAYOUT OF WORK.....	19
1.14 AS-BUILT DRAWINGS.....	21
1.15 USE OF ROADWAYS.....	21
1.16 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.....	22
1.17 TEMPORARY USE OF NEW ELEVATORS.....	23
1.18 TEMPORARY TOILETS.....	24
1.19 AVAILABILITY AND USE OF UTILITY SERVICES.....	24
1.20 NEW TELEPHONE EQUIPMENT .....	25
1.21 TESTS.....	25
1.22 INSTRUCTIONS.....	26

1.23 GOVERNMENT-FURNISHED PROPERTY .....	27
1.24 RELOCATED ITEMS .....	28
1.25 CONSTRUCTION SIGN.....	29
1.26 SAFETY SIGN .....	29

**SECTION 01 00 00  
GENERAL REQUIREMENTS**

**1.1 GENERAL INTENTION**

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor and materials and perform work for NEW PARKING GARAGE as required by drawings and specifications.
- B. The organized Site Visit will be the only opportunity for potential offerors to visit the site prior to the bid opening. The date, time, and location of the organized site visit are identified in the solicitation. The organized Site Visit will be the only opportunity for potential offerors to visit the site prior to the bid opening. The date, time, and location of the organized site visit are identified in the solicitation. The organized Site Visit will be the only opportunity for potential offerors to visit the site prior to the bid opening. The date, time, and location of the organized site visit are identified in the solicitation.
- C. Offices of GUIDON DESIGN INC, 905 N CAPITAL ST. INDIANAPOLIS IN. 46204 [www.GuidonDesign.com](http://www.GuidonDesign.com) as Architect-Engineers, will render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by Contracting Officer or his duly authorized representative.
- E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.
- F. Prior to commencing work, general contractor shall provide proof that a OSHA designated "competent person" (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.
- G. Training:

1. All employees of general contractor or subcontractors shall have the 10-hour or 30-hour OSHA Construction Safety course, Site Superintendent and Foremen of individual trades shall have 30-hour OSHA Construction Safety course, and other relevant competency training, as determined by COR acting as the Construction Safety Officer with input from the facility Construction Safety Committee.
2. Submit training records of all such employees for approval before the start of work.

H. VHA Directive 2011-36, Safety and Health during Construction, dated 9/22/2011 in its entirety is made a part of this section

#### **1.2 STATEMENT OF BID ITEM(S)**

- A. For a description of the Base Bid and subsequent bid deducts for this project, please refer to the Bid Items List which is located in the Invitation for Bid (IFB) solicitation.

#### **1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR**

- A. AFTER AWARD OF CONTRACT, digital PDF sets of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense.

#### **1.4 CONSTRUCTION SECURITY REQUIREMENTS**

- A. Security Plan:
  1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
  2. The General Contractor is responsible for assuring that all subcontractors working on the project and their employees also comply with these regulations.
- B. Security Procedures:
  1. General Contractor's employees shall not enter the project site without appropriate badge. They may also be subject to inspection of their personal effects when entering or leaving the project site.

2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the Contracting Officer so that security arrangements can be provided for the employees. This notice is separate from any notices required for utility shutdown described later in this section.
3. No photography of VA premises is allowed without written permission of the Contracting Officer.
4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the Contracting Officer.

C. Guards:

1. The general Contractor shall provide temporary video security equipment for recording of the premises.

D. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of every area of project including tool boxes and parked machines and take any emergency action.
2. The General Contractor shall turn over all permanent lock cylinders to the VA locksmith for permanent installation. See Section 08 71 00, DOOR HARDWARE and coordinate.

E. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified".

Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the Contracting Officer upon request.

4. These security documents shall not be removed or transmitted from the project site without the written approval of Contracting Officer.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify Contracting Officer and Site Security Officer immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
  - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
  - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

**F. Motor Vehicle Restrictions**

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours before the date and time of access. Access shall be restricted to picking up and dropping off materials and supplies.
2. Separate permits shall be issued for General Contractor and its employees for parking in designated areas only.

**1.5 FIRE SAFETY**

- A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

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

E84-2009.....Surface Burning Characteristics of Building  
Materials

2. National Fire Protection Association (NFPA):

10-2010.....Standard for Portable Fire Extinguishers

30-2008.....Flammable and Combustible Liquids Code

51B-2009.....Standard for Fire Prevention During Welding,  
Cutting and Other Hot Work

70-2011.....National Electrical Code

101-2012.....Life Safety Code

241-2009.....Standard for Safeguarding Construction,  
Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926.....Safety and Health Regulations for Construction

4. VHA Directive 2005-007

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to COR and Facility Safety Officer for review for compliance with VHA Directive 2005-007, NFPA 101 and NFPA 241. Prior to beginning work, all employees of the contractor and/or any subcontractors shall undergo a safety briefing provided by the general contractor's competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Provide documentation to the COR that all construction workers have undergone contractor's safety briefing.

C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

- D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).
- E. Temporary Construction Partitions:
  - 1. Close openings in smoke barriers and fire-rated construction to maintain fire ratings. Seal penetrations with listed through-penetration firestop materials in accordance with Section 07 84 00, FIRESTOPPING.
- F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.
- G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with COR and facility Safety Officer.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR and facility Safety Officer.
- I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- K. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with COR and facility Safety Officer. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the COR.



- L. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR and facility Officer.
- M. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with COR. Obtain permits from facility Safety Officer at least 24 hours in advance.
- N. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR and facility Safety Officer.
- O. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- P. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- Q. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.
- R. If required, submit documentation to the COR that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

#### **1.6 OPERATIONS AND STORAGE AREAS**

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting

Officer, the buildings and utilities may be abandoned and need not be removed.

- C. The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

**(FAR 52.236-10)**

- D. Working space and space available for storing materials shall be as shown on the drawings.
- E. Execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times.
- F. Execute work so as to interfere as little as possible with normal functioning of Medical Center as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others. Use of equipment and tools that transmit vibrations and noises through the building structure, are not permitted in buildings that are occupied, during construction, jointly by patients or medical personnel, and Contractor's personnel, except as permitted by COR where required by limited working space.
1. Do not store materials and equipment in other than assigned areas.
  2. Schedule delivery of materials and equipment to immediate construction working areas within buildings in use by Department of Veterans Affairs in quantities sufficient for not more than two work days. Provide unobstructed access to Medical Center areas required to remain in operation.

3. Where access by Medical Center personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.

G. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved:

1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

H. Phasing: To insure such executions, Contractor shall furnish the COR with a schedule of approximate /phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to Medical Center Director, COR and Contractor, as follows:

**Phase I: CONSTRUCTION ENTRANCE & WATER MAIN RELOCATION**

**Phase II: GARAGE & ASSOCIATED IMPROVEMENTS/PARKING**

Phase III: PATIENT DROP-OFF (Except when Deduct Alternate #9 is accepted)

I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2.1m (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. Remove the fence when directed by COR.

J. When a building is turned over to Contractor, Contractor shall accept entire responsibility therefore.

1. Contractor shall maintain a minimum temperature of 4 degrees C (40 degrees F) at all times, except as otherwise specified.
  2. Contractor shall maintain in operating condition existing fire protection and alarm equipment. In connection with fire alarm equipment, Contractor shall make arrangements for pre-inspection of site with Fire Department or Company (Department of Veterans Affairs or municipal) whichever will be required to respond to an alarm from Contractor's employee or watchman.
- K. Utilities Services: Maintain existing utility services for Medical Center at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, steam, gases, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Medical Center Director's prior knowledge and written approval. Refer to specification Sections 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, 27 05 11 REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS and 28 05 11, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS for additional requirements.
  2. Contractor shall submit a request to interrupt any such services to COR, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
  3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of Medical Center. Interruption time approved by Medical Center may occur at other than Contractor's normal working hours.

4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.
  5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
  6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. Ensure any vacated wires in conduits are removed. Lines where indicated on plans will require filling with flowable grout. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- M. To minimize interference of construction activities with flow of Medical Center traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
  2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- N. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

#### **1.7 INFECTION PREVENTION MEASURES**

- A. Implement the requirements of VAMC's Infection Control Risk Assessment (ICRA) team. ICRA Group may monitor dust in the vicinity of the construction work and require the Contractor to take corrective action immediately if the safe levels are exceeded.
- B. Establish and maintain a dust control program as part of the contractor's infection preventive measures in accordance with the guidelines provided by ICRA Group. Prior to start of work, prepare a plan detailing project-specific dust protection measures, including periodic status reports, and submit to COR and Facility ICRA team for review for compliance with contract requirements in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
  - 1. All personnel involved in the construction or renovation activity shall be educated and trained in infection prevention measures established by the medical center.
- C. Medical center Infection Control personnel shall monitor for airborne disease (e.g. aspergillosis) as appropriate during construction. A baseline of conditions may be established by the medical center prior to the start of work and periodically during the construction stage to determine impact of construction activities on indoor air quality. In addition:
  - 1. The COR and VAMC Infection Control personnel shall review pressure differential monitoring documentation to verify that pressure differentials in the construction zone and in the patient-care rooms are appropriate for their settings. The requirement for negative air pressure in the construction zone shall depend on the location and type of activity. Upon notification, the contractor shall implement corrective measures to restore proper pressure differentials as needed.
  - 2. In case of any problem, the medical center, along with assistance from the contractor, shall conduct an environmental assessment to find and eliminate the source.
- D. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.

1. Dampen debris to keep down dust and provide temporary construction partitions in existing structures where directed by COR. Blank off ducts and diffusers to prevent circulation of dust into occupied areas during construction.
2. Do not perform dust producing tasks within occupied areas without the approval of the COR. For construction in any areas that will remain jointly occupied by the medical Center and Contractor's workers, the Contractor shall:
  - a. Provide dust proof temporary drywall construction barriers to completely separate construction from the operational areas of the hospital in order to contain dirt debris and dust. Barriers shall be sealed and made presentable on hospital occupied side. Install a self-closing rated door in a metal frame, commensurate with the partition, to allow worker access. Maintain negative air at all times. A fire retardant polystyrene, 6-mil thick or greater plastic barrier meeting local fire codes may be used where dust control is the only hazard, and an agreement is reached with the COR and Medical Center.
  - b. HEPA filtration is required where the exhaust dust may reenter the breathing zone. Contractor shall verify that construction exhaust to exterior is not reintroduced to the medical center through intake vents, or building openings. Install HEPA (High Efficiency Particulate Accumulator) filter vacuum system rated at 95% capture of 0.3 microns including pollen, mold spores and dust particles. Insure continuous negative air pressures occurring within the work area. HEPA filters should have ASHRAE 85 or other prefilter to extend the useful life of the HEPA. Provide both primary and secondary filtrations units. Exhaust hoses shall be heavy duty, flexible steel reinforced and exhausted so that dust is not reintroduced to the medical center.
  - c. Adhesive Walk-off/Carpet Walk-off Mats, minimum 600mm x 900mm (24" x 36"), shall be used at all interior transitions from the construction area to occupied medical center area. These mats shall be changed as often as required to maintain clean work areas directly outside construction area at all times.

- d. Vacuum and wet mop all transition areas from construction to the occupied medical center at the end of each workday. Vacuum shall utilize HEPA filtration. Maintain surrounding area frequently. Remove debris as they are created. Transport these outside the construction area in containers with tightly fitting lids.
- e. The contractor shall not haul debris through patient-care areas without prior approval of the COR and the Medical Center. When, approved, debris shall be hauled in enclosed dust proof containers or wrapped in plastic and sealed with duct tape. No sharp objects should be allowed to cut through the plastic. Wipe down the exterior of the containers with a damp rag to remove dust. All equipment, tools, material, etc. transported through occupied areas shall be made free from dust and moisture by vacuuming and wipe down.
- f. Using a HEPA vacuum, clean inside the barrier and vacuum ceiling tile prior to replacement. Any ceiling access panels opened for investigation beyond sealed areas shall be sealed immediately when unattended.
- g. There shall be no standing water during construction. This includes water in equipment drip pans and open containers within the construction areas. All accidental spills must be cleaned up and dried within 12 hours. Remove and dispose of porous materials that remain damp for more than 72 hours.
- h. At completion, remove construction barriers and ceiling protection carefully, outside of normal work hours. Vacuum and clean all surfaces free of dust after the removal.

E. Final Cleanup:

- 1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.
- 2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
- 3. All new air ducts shall be cleaned prior to final inspection.



#### **1.8 DISPOSAL AND RETENTION**

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:

1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by COR.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Medical Center.
3. Items of portable equipment and furnishings located in rooms and spaces in which work is to be done under this contract shall remain the property of the Government. When rooms and spaces are vacated by the Department of Veterans Affairs during the alteration period, such items which are NOT required by drawings and specifications to be either relocated or reused will be removed by the Government in advance of work to avoid interfering with Contractor's operation.
4. PCB Transformers and Capacitors: The Contractor shall be responsible for disposal of the Polychlorinated Biphenyl (PCB) transformers and capacitors. The transformers and capacitors shall be taken out of service and handled in accordance with the procedures of the Environmental Protection Agency (EPA) and the Department of Transportation (DOT) as outlined in Code of Federal Regulation (CFR), Titled 40 and 49 respectively. The EPA's Toxic Substance Control Act (TSCA) Compliance Program Policy Nos. 6-PCB-6 and 6-PCB-7 also apply. Upon removal of PCB transformers and capacitors for disposal, the "originator" copy of the Uniform Hazardous Waste Manifest (EPA Form 8700-22), along with the Uniform Hazardous Waste Manifest Continuation Sheet (EPA Form 8700-22A) shall be returned to the Contracting Officer who will annotate the contract file and transmit the Manifest to the Medical Center's Chief.
  - a. Copies of the following listed CFR titles may be obtained from the Government Printing Office:

40 CFR 261.....Identification and Listing of Hazardous Waste

40 CFR 262.....Standards Applicable to Generators of Hazardous  
Waste

40 CFR 263.....Standards Applicable to Transporters of  
Hazardous Waste

40 CFR 761.....PCB Manufacturing, Processing, Distribution in  
Commerce, and use Prohibitions

49 CFR 172.....Hazardous Material tables and Hazardous Material  
Communications Regulations

49 CFR 173.....Shippers - General Requirements for Shipments  
and Packaging

49 CRR 173.....Subpart A General

49 CFR 173.....Subpart B Preparation of Hazardous Material for  
Transportation

49 CFR 173.....Subpart J Other Regulated Material; Definitions  
and Preparation

TSCA.....Compliance Program Policy Nos. 6-PCB-6 and  
6-PCB-7

#### **1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS**

- A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.
- B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by

the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

**(FAR 52.236-9)**

- C. Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.
- D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
- Designating areas for equipment maintenance and repair;
  - Providing waste receptacles at convenient locations and provide regular collection of wastes;
  - Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
  - Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
  - Providing adequately maintained sanitary facilities.

#### **1.10 RESTORATION**

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any ducts, plumbing, steam, gas, or electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.
- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

#### **1.11 PHYSICAL DATA**

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.
  - 1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by Terracon Consultants Inc. Raleigh, North Carolina.

**(FAR 52.236-4)**

- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration are shown diagrammatically on drawings.
- C. A copy of the soil report is included in the specifications and shall be considered part of the contract documents.
- D. Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine site of work and logs of borings; and, after investigation, decide for themselves character of materials and make their bids accordingly. Upon proper application to Department of Veterans Affairs, bidders will be permitted to make subsurface explorations of their own at site.

**1.12 PROFESSIONAL SURVEYING SERVICES**

A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

**1.13 LAYOUT OF WORK**

- A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

**(FAR 52.236-17)**

- B. Establish and plainly mark center lines for each building and/or addition to each existing building, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and/or addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, and particularly as work progresses from floor to floor, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the COR before any major items of concrete work are placed. In addition, Contractor shall upon request furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.
1. Lines of each building and/or addition.
  2. Elevations of bottoms of footings and tops of floors of each building and/or addition.
  3. Lines and elevations of sewers and of all outside distribution systems.

- E. Whenever changes from contract drawings are made in line or grading requiring certificates, record such changes on a reproducible drawing bearing the registered land surveyor or registered civil engineer seal, and forward these drawings upon completion of work to COR.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

#### **1.14 AS-BUILT DRAWINGS**

- A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after each completed phase and after the acceptance of the project by the COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

#### **1.15 USE OF ROADWAYS**

- A. For hauling, use only established public roads and roads on Medical Center property and, when authorized by the COR, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.
- B. When new permanent roads are to be a part of this contract, Contractor may construct them immediately for use to facilitate building operations. These roads may be used by all who have business thereon within zone of building operations.
- C. When certain buildings (or parts of certain buildings) are required to be completed in advance of general date of completion, all roads leading thereto must be completed and available for use at time set for completion of such buildings or parts thereof.

#### **1.16 TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT**

- A. Use of new installed mechanical and electrical equipment to provide heat, ventilation, plumbing, light and power will be permitted subject to compliance with the following provisions:
1. Permission to use each unit or system must be given by COR. If the equipment is not installed and maintained in accordance with the following provisions, the COR will withdraw permission for use of the equipment.
  2. Electrical installations used by the equipment shall be completed in accordance with the drawings and specifications to prevent damage to the equipment and the electrical systems, i.e. transformers, relays, circuit breakers, fuses, conductors, motor controllers and their overload elements shall be properly sized, coordinated and adjusted. Voltage supplied to each item of equipment shall be verified to be correct and it shall be determined that motors are not overloaded. The electrical equipment shall be thoroughly cleaned before using it and again immediately before final inspection including vacuum cleaning and wiping clean interior and exterior surfaces.
  3. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
  4. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
  5. The air filtering system utilized shall be that which is designed for the system when complete, and all filter elements shall be replaced at completion of construction and prior to testing and balancing of system.
  6. All components of heat production and distribution system, metering equipment, condensate returns, and other auxiliary facilities used in temporary service shall be cleaned prior to use; maintained to prevent corrosion internally and externally during use; and cleaned, maintained and inspected prior to acceptance by the Government.
- B. Prior to final inspection, the equipment or parts used which show wear and tear beyond normal, shall be replaced with identical replacements, at no additional cost to the Government.



- C. This paragraph shall not reduce the requirements of the mechanical and electrical specifications sections.

**1.17 TEMPORARY USE OF NEW ELEVATORS**

- A. The Contractor and his personnel shall be permitted use of new elevator(s) subject to the following provisions:
1. Contractor shall make arrangements with the COR for use of elevator(s). Contractor may obtain elevator(s) for exclusive use.
  2. Prior to the use of elevator(s), the Contractor shall have the elevator(s) inspected and accepted by an ASME accredited, certified elevator safety inspector. The acceptance report shall be submitted to the COR.
  3. Submit to the COR the schedule and procedures for maintaining equipment. Indicate the day or days of the week and total hours required for maintenance. A report shall be submitted to the COR monthly indicating the type of maintenance conducted, hours used, and any repairs made to the elevator(s).
  4. The Contractor shall be responsible for enforcing the maintenance procedures.
  5. During temporary use of elevator(s) all repairs, equipment replacement and cost of maintenance shall be the responsibility of the Contractor.
  6. Personnel for operating elevator(s) shall not be provided by the Department of Veterans Affairs.
  7. Contractor shall cover and provide maximum protection of the entire elevator(s) installation.
  8. The Contractor shall arrange for the elevator company to perform operation of the elevator(s) so that an ASME accredited, certified elevator safety inspector can evaluate the equipment. The Contractor shall be responsible for any costs of the elevator company.
  9. All elevator(s) parts worn or damaged during temporary use shall be removed and replaced with new parts. This shall be determined by an ASME accredited certified elevator safety inspector after temporary

use and before acceptance by the Government. Submit report to the COR for approval.

10. Elevator shall be tested as required by the testing section of the elevator(s) specifications before acceptance by the Department of Veterans Affairs.

#### **1.18 TEMPORARY TOILETS**

- A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by COR, provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

#### **1.19 AVAILABILITY AND USE OF UTILITY SERVICES**

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. Contractor shall install meters at Contractor's expense and furnish the Medical Center a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

E. Electricity (for Construction and Testing): Furnish all temporary electric services.

1. Obtain electricity by connecting to the Medical Center electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Medical Center water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from Medical Center's system.

G. Steam: Furnish steam system for testing required in various sections of specifications.

1. Obtain steam for testing by connecting to the Medical Center steam distribution system. Steam is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve steam-use so none is wasted. Failure to stop leakage or other waste will be cause for revocation (at COR's discretion), of use of steam from the Medical Center's system.

#### **1.20 NEW TELEPHONE EQUIPMENT**

The contractor shall coordinate with the work of installation of telephone equipment by others. This work shall be completed before the building is turned over to VA.

#### **1.21 TESTS**

A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before

requesting final tests. Final test will not be conducted unless pre-tested.

- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer. Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.
- C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, steam, chilled water, refrigerant, hot water, controls and electricity, etc. Another example of a complex which involves several components of different disciplines is a boiler installation. Efficient and acceptable boiler operation depends upon the coordination and proper operation of fuel, combustion air, controls, steam, feedwater, condensate and other related components.
- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

#### **1.22 INSTRUCTIONS**

- A. Contractor shall furnish Maintenance and Operating manuals (hard copies and electronic) and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals and one compact disc (four hard copies and one electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and

dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

- C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

#### **1.23 GOVERNMENT-FURNISHED PROPERTY**

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on the drawings.
- B. Equipment furnished by Government to be installed by Contractor will be furnished to Contractor at the Medical Center.

- C. Storage space for equipment will be provided by the Government and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Medical Center.
- D. Notify Contracting Officer in writing, 60 days in advance, of date on which Contractor will be prepared to receive equipment furnished by Government. Arrangements will then be made by the Government for delivery of equipment.
  - 1. Immediately upon delivery of equipment, Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of equipment described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
  - 2. Contractor thereafter is responsible for such equipment until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.
- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

#### **1.24 RELOCATED ITEMS**

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by text notes or otherwise shown to be relocated by the Contractor.

- B. Perform relocation of such equipment or items at such times and in such a manner as directed by the COR.
- C. Suitably cap existing service lines, such as steam, condensate return, water, drain, gas, air, vacuum and/or electrical, whenever such lines are disconnected from equipment to be relocated. Remove abandoned lines in finished areas and cap as specified herein before under paragraph "Abandoned Lines".
- D. Provide all mechanical and electrical service connections, fittings, fastenings and any other materials necessary for assembly and installation of relocated equipment; and leave such equipment in proper operating condition.
- F. All service lines such as noted above for relocated equipment shall be in place at point of relocation ready for use before any existing equipment is disconnected. Make relocated existing equipment ready for operation or use immediately after reinstallation.

#### **1.25 CONSTRUCTION SIGN**

- A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is shown on the drawings.

#### **1.26 SAFETY SIGN**

- A. Provide a Safety Sign where directed by COR. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm

(three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- C. Maintain sign and remove it when directed by COR.
- D. Standard Detail Drawing Number SD10000-02(Found on VA TIL) of safety sign showing required legend and other characteristics of sign is shown on the drawings.
- E. Post the number of accident free days on a daily basis.

- - - E N D - - -



## APPENDICES

**Note: Forms with VAMC policy applicable to this project for specification section follow on next page. These are subject to change and newer versions shall be obtained from COR.**

## ATTACHMENT A - PERMIT FOR CUTTING AND WELDING WITH PORTABLE GAS OR ARC EQUIPMENT

DATE: \_\_\_\_\_

BUILDING: \_\_\_\_\_

DEPT.: \_\_\_\_\_

WORK TO BE DONE: \_\_\_\_\_

\_\_\_\_\_

SPECIAL PRECAUTIONS: \_\_\_\_\_

\_\_\_\_\_

IS FIRE WATCH REQUIRED? \_\_\_\_\_

LOCATION WHERE THIS WORK IS TO BE DONE HAS BEEN EXAMINED, NECESSARY PRECAUTIONS TAKEN  
AND PERMISSION IS GRANTED FOR THIS WORK (SEE REVERSE).

PERMIT EXPIRES: \_\_\_\_\_

SIGNED: \_\_\_\_\_ (Individual responsible for authorizing welding and cutting)

TIME STARTED: \_\_\_\_\_ COMPLETED: \_\_\_\_\_

\_\_\_\_\_

### **FINAL CHECK-UP**

Work areas and all adjacent areas to which sparks and heat might have spread (including floors above and below and on opposite walls) were inspected 30 minutes after the work was completed and were found fire safe.

SIGNED: \_\_\_\_\_ (Supervisor or Fire Watcher)

ATTENTION: BEFORE APPROVING ANY CUTTING AND WELDING PERMIT, THE SAFETY OFFICE SHALL INSPECT THE WORK AREA AND CONFIRM THAT PRECAUTIONS HAVE BEEN TAKEN TO PREVENT FIRE IN ACCORDANCE WITH NFPA 51 B.

#### ***PRECAUTIONS***

Sprinklers in service

Cutting and welding equipment in good repair

#### ***WITHIN 35 FT. OF WORK***

Floors swept clean of combustibles

Combustible floors wet-down, covered with damp sand, metal or other shields

No combustible material or flammable liquids

Combustibles and flammable liquids protected with covers, guards or metal shields

All wall and floor openings covered

Covers suspended beneath work to collect sparks

***WORK ON WALLS OR CEILINGS***

Construction noncombustible and without combustible covering

Combustibles moved away from opposite side of wall

***WORK ON ENCLOSED EQUIPMENT***

(Tanks, containers, ducts dust collectors, etc.)

Equipment cleaned of all combustibles

Containers purged of flammable vapors

***FIRE WATCH***

(To be provided during and 30 minutes after operation)

Supplied with extinguisher and small hose

Trained in use of equipment and in sounding fire alarm

***FINAL CHECK-UP***

(To be made 30 minutes after completion of any operation unless fire watch is provided)

SIGNED: \_\_\_\_\_

(Supervisor )

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

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Construct New Parking Garage  
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## **ATTACHMENT B - INTERIM LIFE SAFETY MEASURE (ILSM) FORMS**

ATTACHMENT A  
INTERIM LIFE SAFETY REQUIREMENTS

PROJECT/ACTIVITY TITLE \_\_\_\_\_  
PROJECT NO. (if any) \_\_\_\_\_  
DATE/TIME START \_\_\_\_\_ DATE/TIME END \_\_\_\_\_  
SCOPE OF WORK \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Utilities to be taken out of service water ☐ electricity ☐ HVAC ☐ None ☐. If a utility is checked, a Utility outage permit must be completed and attached to this ISLM before the ISLM can be implemented.

Complete the ISLM Assessment matrix and circle those items required or considered and required for this project. Matrix attached ☐

Complete the ISLM Inspection Checklist at Attachment C based on the items identified in the matrix. The supervisor of the work site is responsible for daily inspection of the interim measures. The COTR or Asst Chief Engineer will make periodic inspections to ensure compliance with the ISLM requirements.

Describe specific actions here: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Notifications:

- |   |     |
|---|-----|
| <input type="checkbox"/> Electrical shop                  | POC |
| <input type="checkbox"/> Plumbing shop                    | POC |
| <input type="checkbox"/> Grounds/Transportation           | POC |
| <input type="checkbox"/> HVAC shop                        | POC |
| <input type="checkbox"/> Safety office                    | POC |
| <input type="checkbox"/> Security                         | POC |
| <input type="checkbox"/> Fire Department                  | POC |
| <input type="checkbox"/> POC who will conduct inspections | POC |
| <input type="checkbox"/> Chief Engineering                | POC |
| <input type="checkbox"/> Director's Office (as required)  | POC |

_____	_____	_____	_____
Project Manager	Date	Safety Manager	Date

NOTE: Matrix and inspection sheets will be attached to the project documentation for record.

ATTACHMENT B

ILSM Inspection Checklist										
<p><i>Enter the dates across the top squares; inspect the items 'X-ed' in the left column and initial for that item in the date column. This checklist must be turned into the COTR at the end of the ILSM period or end of the week - whichever comes first or to Safety Office if internal activity. COTR/Safety additional may be entered after the last standard measure.</i></p>										
<b>CONSTRUCTION SUPERVISOR Requirement:</b>										
Required (X)	Measure to inspect and date inspected. Initial each required item below the date									
	Notify fire department of outage									
	Ensure free and unobstructed exits									
	Modify EXIT signage to meet modification/identify alternate									
	Ensure Access for Emergency Responders									
	Construct Non-Combustible Temporary Partitions									
	Prohibit Smoking									
	Control combustible loads (storage, housekeeping, debris and waste)									
	Increase Hazard Surveillance/Inspections									
	Implement Fire Watch with communication and extra extinguisher									
	Inspect exits in affected areas daily									
	Provide Additional Education to all Personnel									
	Provide additional fire extinguishers									
	Inspect, test and document temporary systems monthly									
<b>VAMC Requirement: COTR/Safety will confirm completion of these measures.</b>										
	Provide equivalent alarm/notification to impacted staff									
	Conduct 2 fire drills per shift in LOCAL areas									
	Conduct 2 fire drills per shift in all areas									
	Train staff to Compensate for Deficiencies									
<p>Comments:</p>										



## Interim measure clarification

☐ Ensuring free and unobstructed exits. Staff receives additional information/communication when alternative exits are designated. Buildings or areas under construction must maintain escape routes for construction workers at all times, and the means of exiting construction areas are inspected daily.

☐ Ensuring free and unobstructed access to emergency services and for fire, police, and other emergency forces

☐ Ensuring that fire alarm, detection, and suppression systems are in good working order. A temporary but equivalent system must be provided when any fire system is impaired. Temporary systems must be inspected and tested monthly.<sup>1</sup>

<sup>1</sup> = NFPA 101 fire watch requirements can be found at NFPA 101, 2006 Edition, 9.6.1.6

☐ \* Ensuring that temporary construction partitions are smoke-tight and built of noncombustible or limited combustible materials that will not contribute to the development or spread of fire

☐ \*\* Providing additional fire-fighting equipment and training staff in its use

☐ \* Prohibiting smoking throughout the hospital's buildings and in and near construction areas

☐ \* Developing and enforcing storage, housekeeping, and debris-removal practices that reduce the building's flammable and combustible fire load to the lowest feasible level

☐ \*\* Conducting a minimum of two fire drills per shift per quarter

☐ \*\* Increasing surveillance of buildings, grounds, and equipment, with special attention to excavations, construction areas, construction storage, and field offices

☐ \*\* Training staff to compensate for impaired structural or compartmentalization features of fire safety

☐ \*\* Conducting hospital wide safety education programs to promote awareness of fire safety building deficiencies, construction hazards, and ILSMs

☐ \* Notifications/coordination completed with (check as appropriate). POC is point of contact to whom notification or coordination was made:

ILSM DECISION MATRIX																	
This matrix should be used to assess appropriate interim measures to implement for activities that will reduce a life safety component(s) for four or more hours. Recommend the matrix be attached to each ILSM with the R or C circled to show evaluation and requirements. The results will also be used to identify the items to be inspected each day the life																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	Notify fire department of outage	Ensure free and unobstructed exits	Modify EXIT signage to meet modification/identif	Ensure Access for Emergency Responders	Construct Non-Combustible Temporary	Prohibit Smoking	Control combustible loads (storage, housekeeping,	Conduct 2 fire drills per shift in LOCAL areas	Conduct 2 fire drills per shift in all areas	Increase Hazard Surveillance/Inspe ctions	Train staff to Compensate for Deficiencies	Provide Additional Education to all Personnel	Implement Fire Watch with communication	Inspect exits in affected areas	Provide equivalent alarm/notification to impacted staff	Provide additional fire extinguishers	Inspect, test and document temporary systems
CODE DEFICIENCIES																	
1. Exit stair discharges improperly			R			R		R	C		R	C		C			
2. Smoke barrier is deficient						R		R		R	R					R	
3. Exit path reduces protection level			C			R				C				R			
4. Vertical opening improperly protected						R											
5. Building construction type is nonconforming						R	R		R			R				R	
6. Hazardous room is improperly protected (laundry, linen storage, flammable storage, boiler, kitchen, etc)						R			R							R	
7. Corridor wall is deficient						R	R	R		R	R						
8. Exit is closed or impaired (any portion from work area to exterior assembly)						R	R	R	C	R	R	R		C		R	
CONSTRUCTION HAZARD																	
9. Significantly modifying a smoke barrier					R	R	R	R	C	R	C	C					
10. Constructing a building addition to an existing building	C	R	R	R	R	R		R	C	R		R		C			
11. Significantly renovating an occupied floor.		R			R	R	R	R		C		C		C		R	
LIFE SAFETY SYSTEM DISRUPTIONS																	
11. Fire alarm out of service						R					R	C			R		C
12. Fire detection out of service						R	R				R	C	R		C	R	C
13. Fire supression out of service	R					R	R			R	R	C	R			R	C

Yellow indicates a VAMC requirement.

R = required actions

C = these actions must be considered. Documentation of the negative should be on the or project documentation.

## **ATTACHMENT C - UTILITY SYSTEMS SERVICE/OUTAGE NOTIFICATION FORM**

To Be Provided

# ATTACHMENT D - INFECTION CONTROL RISK ASSESSMENT FORMS

## Requirements

(Failure to comply with these requirements will result in stoppage of all work until compliant)

<b>CLASS OF PROJECT:</b> <input type="checkbox"/> I <input type="checkbox"/> II <input type="checkbox"/> III <input type="checkbox"/> IV	
<b>DURING CLASS I CONSTRUCTION PROJECTS:</b> <ul style="list-style-type: none"> <li>• <b>Dress:</b> Appropriate for area (i.e. shoe covers, etc., in OR).</li> <li>• <b>Ventilation:</b> Execute work by methods to minimize raising dust.</li> <li>• <b>Barriers:</b> Use care removing ceiling tiles, clean up disturbed dust immediately by HEPA (defined as one capturing 99.97% of particles <math>\geq 0.3</math> microns in size) vacuuming and/or wet mopping. Immediately replace any ceiling tiles displaced for visual inspection or replacement. No dust tracks outside work zone.</li> <li>• <b>Debris:</b> Remove from work site in a closed/sealed container</li> </ul>	<b>UPON COMPLETION OF PROJECT:</b> <ul style="list-style-type: none"> <li>• Damp-wipe tools when removed from the work site</li> <li>• Clean work area upon completion of task.</li> </ul>
<b>DURING CLASS II CONSTRUCTION PROJECTS:</b> <p><b>NOTE: Include activities in Class I above</b></p> <ul style="list-style-type: none"> <li>• <b>Traffic:</b> Route patient/visitor/staff traffic away from project/activity.</li> <li>• <b>Ventilation:</b> Provide means to prevent airborne dust from dispersing into atmosphere.</li> <li>• <b>Barriers:</b> Water mist work surfaces to control dust while cutting. Seal unused doors with duct tape. Place dust mat at entrance &amp; exit of work area</li> </ul>	<b>UPON COMPLETION OF PROJECT:</b> <ul style="list-style-type: none"> <li>• Wipe work surface with disinfectant.</li> <li>• Contain construction waste before transport in tightly covered containers.</li> <li>• Wet mop and /or vacuum with HEPA filtered vacuum before leaving work area.</li> </ul>
<b>DURING CLASS III CONSTRUCTION PROJECTS:</b> <p><b>NOTE: Include activities in Class I and II above</b></p> <ul style="list-style-type: none"> <li>• <b>Traffic:</b> Post signs identifying alternate routes and that construction project are underway. Workers should not walk in hallways or patient-care areas with dust-covered work clothes.</li> <li>• <b>Ventilation:</b> Remove or isolate HVAC system in area where work is being done to prevent contamination of duct system. Block/seal HVAC supply air sources (ducts, grilles, pipes, conduits, and wall/ceiling/floor penetrations). Exhaust air to the outside if possible. If re-circulated air from the construction zone is unavoidable, use a pre-filter and a HEPA filter before the air returns to the HVAC system. When vibration-related is being done that may dislodge dust in the ventilation system, or when modifications are made to duct work serving occupied spaces, install filters on the supply air grilles temporarily. Maintain negative pressure in work site relative to patient areas. Use HEPA-filtered fans if needed (monitor need to change or clean filters during construction).</li> <li>• <b>Barriers:</b> Must be provided to contain dust in the negative pressure work site. Complete all dust barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method(cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Examples include isolating area by closing/sealing existing doors/windows, or erecting an airtight 4- to 6-mil plastic or dry wall barrier that extends from floor to upper deck (or dropped ceiling). Seams in plastic sheeting must be sealed with duct tape and the barrier taped securely to the ceiling and floor. A plastic entrance must have a 2-foot flap. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. Doors in a dry wall barrier must have gaskets to prevent exhaust of dust. Place tack mats at entrance and wet mop area outside of barrier if dust is tracked outside work site. Construct anteroom and require all personnel, equipment, materials, and debris containers to pass through this room when entering or exiting the work site. Water mains, branch mains, risers, and branches to a group of fixtures have stop valves. Ceiling access panels must be closed when unattended.</li> </ul>	<b>UPON COMPLETION OF PROJECT</b> <ul style="list-style-type: none"> <li>• Do not remove barriers from work area until project is inspected by COTR and Infection Control, and thoroughly cleaned.</li> <li>• Vacuum work area with HEPA filtered vacuums.</li> <li>• Wet mop area with hospital disinfectant at completion of project or at the end of the day for jobs lasting more than one day.</li> <li>• Remove barrier materials carefully to minimize spreading of dirt debris associated with construction and clean residual dust.</li> <li>• Remove isolation of HVAC system and HEPA filters in areas where work is being performed.</li> <li>• Vent system cleaned after completion of construction.</li> <li>• Flush the main water system to clear dust-contaminated lines.</li> <li>• Contact Infection Control for inspection prior to patient occupation.</li> <li>• Wet ceiling tiles: if porous, remove and replace; if nonporous, remove, clean with dilute hypochlorite (10% household bleach) and dry before replacement.</li> </ul>

<b>DURING CLASS III CONSTRUCTION PROJECTS (continued):</b>	<b>UPON COMPLETION OF PROJECT</b>
<ul style="list-style-type: none"> <li>• <b>Barriers:</b> Elevator shafts, dumb waiters, and stair wells within the field of construction must have proper barriers installed and air leaks sealed. Mist work surfaces to control dust when drilling or cutting, or HEPA-filtered vacuum cleaner concurrently with drilling work. Place dust mat at entrance and exit of work area.</li> <li>• <b>Debris:</b> Debris is to be removed by specified route only. Transport debris during low patient activity periods if possible (nights and weekends). Contain construction waste before transport in tightly covered containers. Cover transport receptacles or carts. Tape covering unless solid lid. Mist debris and cover and damp wipe (including wheels and casters) containers used to transport debris. Consider use of chutes to the outside for debris removal. For personnel transporting debris, cover gown or equivalent and shoe covers required if dust cannot be removed from clothing with HEPA vacuum.</li> </ul>	
<b>DURING CLASS IV CONSTRUCTION PROJECTS:</b>	<b>UPON COMPLETION OF PROJECT:</b>
<p><b>NOTE: Include activities in Class I, II and III above</b></p> <ul style="list-style-type: none"> <li>• <b>Ventilation:</b> Isolate HVAC system in area where work is being done to prevent contamination of duct system.</li> <li>• <b>Barriers:</b> Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method(cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. Seal holes, pipes, conduits, and punctures appropriately. Construct anteroom and requires all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave the work site. Do not remove barriers from work area until project is inspected by COTR and thoroughly cleaned.</li> </ul>	<ul style="list-style-type: none"> <li>• Remove barriers material carefully to minimize spreading of dirt and debris associated with construction.</li> <li>• Contain construction waste before transport in tightly covered containers.</li> <li>• Cover transport receptacles or carts. Tapes covering unless solid lid.</li> <li>• Vacuum work area with disinfectant.</li> <li>• Wet mop area with disinfectant</li> <li>• Remove isolation of HVAC system in areas where work is being performed</li> </ul>

Additional Requirements: \_\_\_\_\_

<b>WHEN INFECTION CONTROL MEASURES ARE IN PLACE IC STAFF HAS CONDUCTED CONTRACTOR BRIEFINGS &amp; TRAINING</b>	<b>N/A</b>	<b>DATE &amp; INITIALS</b>
Met with Services/Sections surrounding construction site to inform them of impact/precautions to be taken & to instruct them in Basic I/C requirements (see attached).	<input type="checkbox"/>	
Met with the Construction Manager, Construction Crews, and Sub-Contractors to inform them of impact/precautions to be taken & to instruct them in Basic I/C requirements.	<input type="checkbox"/>	
Informed the Project Coordinator That Barriers Are Not To Be Removed From Work Area Until Completed Project Is Inspected By The EOC And Infection Control Staff And Thoroughly Cleaned By The Environmental Management Service.	<input type="checkbox"/>	

\_\_\_\_\_  
Signature of Project Engineer or Supervisor

\_\_\_\_\_  
Date

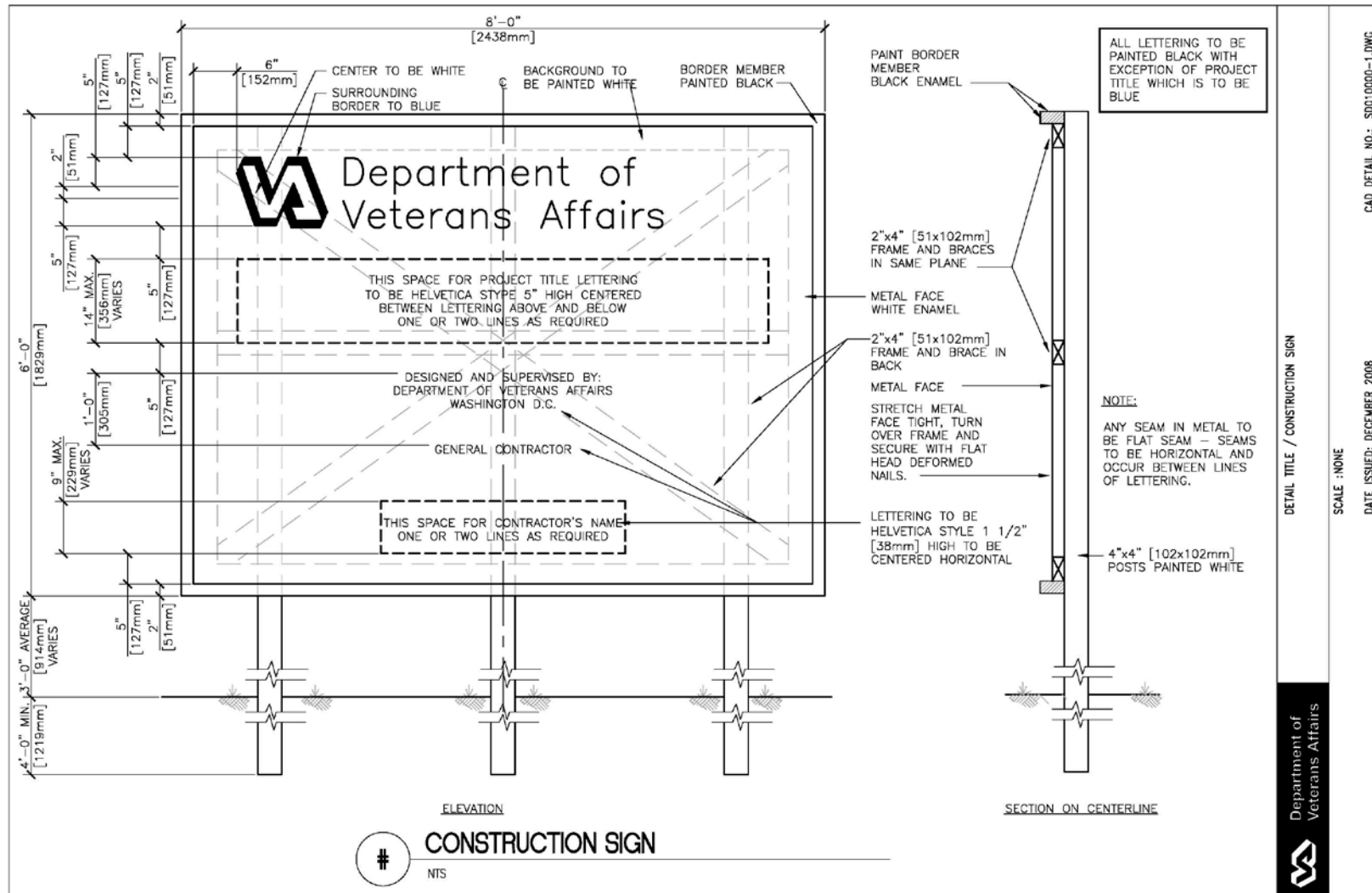
\_\_\_\_\_  
Signature of Chief Engineer

\_\_\_\_\_  
Date

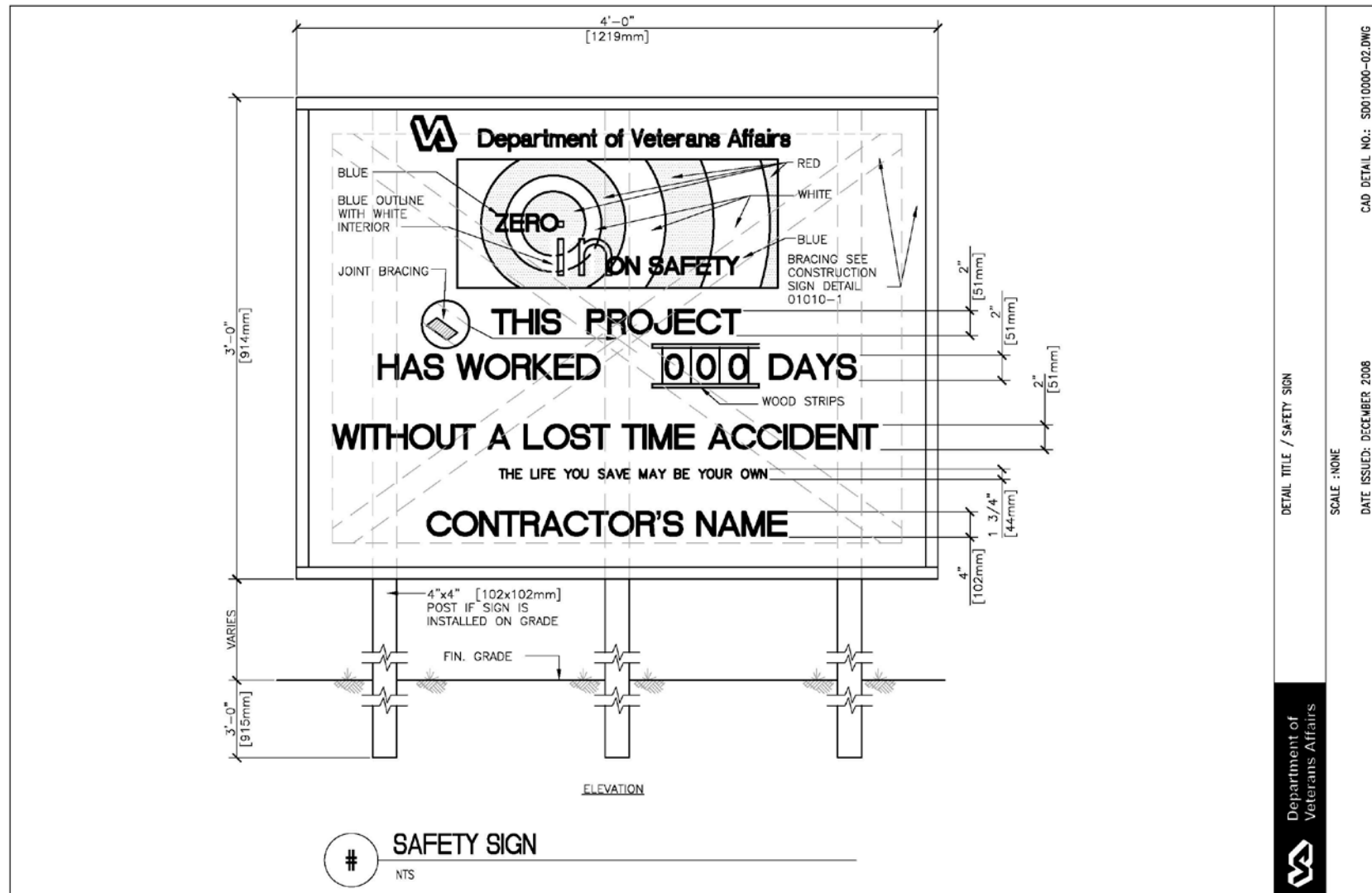
\_\_\_\_\_  
Signature of Infection Control

\_\_\_\_\_  
Date

## ATTACHMENT E – CONSTRUCTION SIGN



## ATTACHMENT F – SAFETY SIGN



**SECTION 01 33 23**  
**SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES**

- 1.1 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1.2 For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1.3 Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  - A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
  - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
  - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1.4 Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1.5 Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by COR on behalf of the Contracting Officer.
- 1.6 Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.
- 1.7 The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional



submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

- 1.8 Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect-Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1.9 Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.
  - A. Submit samples required by Section 09 06 00, SCHEDULE FOR FINISHES, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
  - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail, email and shall contain the list of items, name of Medical Center, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
    1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
    2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Medical Center, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.

3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
  2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
  3. Samples and laboratory tests shall be sent directly to approved commercial testing laboratory.
  4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
  4. Contractor shall forward a copy of transmittal letter to COR simultaneously with submission to a commercial testing laboratory.
  5. A Copy of Laboratory test reports shall be sent directly to COR for appropriate action.
  6. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
  7. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.
- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract,

samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
2. Reproducible shall be full size.
3. Each drawing shall have marked thereon, proper descriptive title, including Medical Center location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1.10 Samples (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

Guidon Design Inc.

905 N. Capitol Ave. Suite 100

Indianapolis, IN. 46204

1.11 At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COR.

- - - E N D - - -

**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

**1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)**

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

**1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)**

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS  
Office of Construction & Facilities Management  
Facilities Quality Service (00CFM1A)  
425 Eye Street N.W, (sixth floor)  
Washington, DC 20001  
Telephone Numbers: (202) 632-5249 or (202) 632-5178  
Between 9:00 AM - 3:00 PM

**1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)**

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA	Aluminum Association Inc. <a href="http://www.aluminum.org">http://www.aluminum.org</a>
AABC	Associated Air Balance Council <a href="http://www.aabchq.com">http://www.aabchq.com</a>
AAMA	American Architectural Manufacturer's Association <a href="http://www.aamanet.org">http://www.aamanet.org</a>
AAN	American Nursery and Landscape Association <a href="http://www.anla.org">http://www.anla.org</a>
AASHTO	American Association of State Highway and Transportation Officials <a href="http://www.aashto.org">http://www.aashto.org</a>
AATCC	American Association of Textile Chemists and Colorists <a href="http://www.aatcc.org">http://www.aatcc.org</a>
ACGIH	American Conference of Governmental Industrial Hygienists <a href="http://www.acgih.org">http://www.acgih.org</a>
ACI	American Concrete Institute <a href="http://www.aci-int.net">http://www.aci-int.net</a>
ACPA	American Concrete Pipe Association <a href="http://www.concrete-pipe.org">http://www.concrete-pipe.org</a>
ACPPA	American Concrete Pressure Pipe Association <a href="http://www.acppa.org">http://www.acppa.org</a>
ADC	Air Diffusion Council <a href="http://flexibleduct.org">http://flexibleduct.org</a>
AGA	American Gas Association <a href="http://www.aga.org">http://www.aga.org</a>
AGC	Associated General Contractors of America <a href="http://www.agc.org">http://www.agc.org</a>

AGMA	American Gear Manufacturers Association, Inc. <a href="http://www.agma.org">http://www.agma.org</a>
AHAM	Association of Home Appliance Manufacturers <a href="http://www.aham.org">http://www.aham.org</a>
AISC	American Institute of Steel Construction <a href="http://www.aisc.org">http://www.aisc.org</a>
AISI	American Iron and Steel Institute <a href="http://www.steel.org">http://www.steel.org</a>
AITC	American Institute of Timber Construction <a href="http://www.aitc-glulam.org">http://www.aitc-glulam.org</a>
AMCA	Air Movement and Control Association, Inc. <a href="http://www.amca.org">http://www.amca.org</a>
ANLA	American Nursery & Landscape Association <a href="http://www.anla.org">http://www.anla.org</a>
ANSI	American National Standards Institute, Inc. <a href="http://www.ansi.org">http://www.ansi.org</a>
APA	The Engineered Wood Association <a href="http://www.apawood.org">http://www.apawood.org</a>
ARI	Air-Conditioning and Refrigeration Institute <a href="http://www.ari.org">http://www.ari.org</a>
ASAE	American Society of Agricultural Engineers <a href="http://www.asae.org">http://www.asae.org</a>
ASCE	American Society of Civil Engineers <a href="http://www.asce.org">http://www.asce.org</a>
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers <a href="http://www.ashrae.org">http://www.ashrae.org</a>
ASME	American Society of Mechanical Engineers <a href="http://www.asme.org">http://www.asme.org</a>
ASSE	American Society of Sanitary Engineering <a href="http://www.asse-plumbing.org">http://www.asse-plumbing.org</a>

ASTM	American Society for Testing and Materials <a href="http://www.astm.org">http://www.astm.org</a>
AWI	Architectural Woodwork Institute <a href="http://www.awinet.org">http://www.awinet.org</a>
AWS	American Welding Society <a href="http://www.aws.org">http://www.aws.org</a>
AWWA	American Water Works Association <a href="http://www.awwa.org">http://www.awwa.org</a>
BHMA	Builders Hardware Manufacturers Association <a href="http://www.buildershardware.com">http://www.buildershardware.com</a>
BIA	Brick Institute of America <a href="http://www.bia.org">http://www.bia.org</a>
CAGI	Compressed Air and Gas Institute <a href="http://www.cagi.org">http://www.cagi.org</a>
CGA	Compressed Gas Association, Inc. <a href="http://www.cganet.com">http://www.cganet.com</a>
CI	The Chlorine Institute, Inc. <a href="http://www.chlorineinstitute.org">http://www.chlorineinstitute.org</a>
CISCA	Ceilings and Interior Systems Construction Association <a href="http://www.cisca.org">http://www.cisca.org</a>
CISPI	Cast Iron Soil Pipe Institute <a href="http://www.cispi.org">http://www.cispi.org</a>
CLFMI	Chain Link Fence Manufacturers Institute <a href="http://www.chainlinkinfo.org">http://www.chainlinkinfo.org</a>
CPMB	Concrete Plant Manufacturers Bureau <a href="http://www.cpmc.org">http://www.cpmc.org</a>
CRA	California Redwood Association <a href="http://www.calredwood.org">http://www.calredwood.org</a>
CRSI	Concrete Reinforcing Steel Institute <a href="http://www.crsi.org">http://www.crsi.org</a>

CTI	Cooling Technology Institute <a href="http://www.cti.org">http://www.cti.org</a>
DHI	Door and Hardware Institute <a href="http://www.dhi.org">http://www.dhi.org</a>
EGSA	Electrical Generating Systems Association <a href="http://www.egsa.org">http://www.egsa.org</a>
EEI	Edison Electric Institute <a href="http://www.eei.org">http://www.eei.org</a>
EPA	Environmental Protection Agency <a href="http://www.epa.gov">http://www.epa.gov</a>
ETL	ETL Testing Laboratories, Inc. <a href="http://www.etl.com">http://www.etl.com</a>
FAA	Federal Aviation Administration <a href="http://www.faa.gov">http://www.faa.gov</a>
FCC	Federal Communications Commission <a href="http://www.fcc.gov">http://www.fcc.gov</a>
FPS	The Forest Products Society <a href="http://www.forestprod.org">http://www.forestprod.org</a>
GANA	Glass Association of North America <a href="http://www.cssinfo.com/info/gana.html/">http://www.cssinfo.com/info/gana.html/</a>
FM	Factory Mutual Insurance <a href="http://www.fmglobal.com">http://www.fmglobal.com</a>
GA	Gypsum Association <a href="http://www.gypsum.org">http://www.gypsum.org</a>
GSA	General Services Administration <a href="http://www.gsa.gov">http://www.gsa.gov</a>
HI	Hydraulic Institute <a href="http://www.pumps.org">http://www.pumps.org</a>
HPVA	Hardwood Plywood & Veneer Association <a href="http://www.hpva.org">http://www.hpva.org</a>



ICBO	International Conference of Building Officials <a href="http://www.icbo.org">http://www.icbo.org</a>
ICEA	Insulated Cable Engineers Association Inc. <a href="http://www.icea.net">http://www.icea.net</a>
\ICAC	Institute of Clean Air Companies <a href="http://www.icac.com">http://www.icac.com</a>
IEEE	Institute of Electrical and Electronics Engineers <a href="http://www.ieee.org">http://www.ieee.org</a>
IMSA	International Municipal Signal Association <a href="http://www.imsasafety.org">http://www.imsasafety.org</a>
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association <a href="http://www.mbma.com">http://www.mbma.com</a>
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. <a href="http://www.mss-hq.com">http://www.mss-hq.com</a>
NAAMM	National Association of Architectural Metal Manufacturers <a href="http://www.naamm.org">http://www.naamm.org</a>
NAPHCC	Plumbing-Heating-Cooling Contractors Association <a href="http://www.phccweb.org.org">http://www.phccweb.org.org</a>
NBS	National Bureau of Standards See - NIST
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors <a href="http://www.nationboard.org">http://www.nationboard.org</a>
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association <a href="http://www.nema.org">http://www.nema.org</a>
NFPA	National Fire Protection Association <a href="http://www.nfpa.org">http://www.nfpa.org</a>

NHLA	National Hardwood Lumber Association <a href="http://www.natlhardwood.org">http://www.natlhardwood.org</a>
NIH	National Institute of Health <a href="http://www.nih.gov">http://www.nih.gov</a>
NIST	National Institute of Standards and Technology <a href="http://www.nist.gov">http://www.nist.gov</a>
NLMA	Northeastern Lumber Manufacturers Association, Inc. <a href="http://www.nelma.org">http://www.nelma.org</a>
NPA	National Particleboard Association 18928 Premiere Court Gaithersburg, MD 20879 (301) 670-0604
NSF	National Sanitation Foundation <a href="http://www.nsf.org">http://www.nsf.org</a>
NWWDA	Window and Door Manufacturers Association <a href="http://www.nwwda.org">http://www.nwwda.org</a>
OSHA	Occupational Safety and Health Administration Department of Labor <a href="http://www.osha.gov">http://www.osha.gov</a>
PCA	Portland Cement Association <a href="http://www.portcement.org">http://www.portcement.org</a>
PCI	Precast Prestressed Concrete Institute <a href="http://www.pci.org">http://www.pci.org</a>
PPI	The Plastic Pipe Institute <a href="http://www.plasticpipe.org">http://www.plasticpipe.org</a>
PEI	Porcelain Enamel Institute, Inc. <a href="http://www.porcelainenamel.com">http://www.porcelainenamel.com</a>
PTI	Post-Tensioning Institute <a href="http://www.post-tensioning.org">http://www.post-tensioning.org</a>
RFCI	The Resilient Floor Covering Institute <a href="http://www.rfci.com">http://www.rfci.com</a>

RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. <a href="http://www.rma.org">http://www.rma.org</a>
SCMA	Southern Cypress Manufacturers Association <a href="http://www.cypressinfo.org">http://www.cypressinfo.org</a>
SDI	Steel Door Institute <a href="http://www.steeldoor.org">http://www.steeldoor.org</a>
IGMA	Insulating Glass Manufacturers Alliance <a href="http://www.igmaonline.org">http://www.igmaonline.org</a>
SJI	Steel Joist Institute <a href="http://www.steeljoist.org">http://www.steeljoist.org</a>
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. <a href="http://www.smacna.org">http://www.smacna.org</a>
SSPC	The Society for Protective Coatings <a href="http://www.sspc.org">http://www.sspc.org</a>
STI	Steel Tank Institute <a href="http://www.steeltank.com">http://www.steeltank.com</a>
SWI	Steel Window Institute <a href="http://www.steelwindows.com">http://www.steelwindows.com</a>
TCA	Tile Council of America, Inc. <a href="http://www.tileusa.com">http://www.tileusa.com</a>
TEMA	Tubular Exchange Manufacturers Association <a href="http://www.tema.org">http://www.tema.org</a>
TPI	Truss Plate Institute, Inc. 583 D'Onofrio Drive; Suite 200 Madison, WI 53719 (608) 833-5900
UBC	The Uniform Building Code See ICBO

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

UL Underwriters' Laboratories Incorporated  
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada  
<http://www.ulc.ca>

WCLIB West Coast Lumber Inspection Bureau  
6980 SW Varns Road, P.O. Box 23145  
Portland, OR 97223  
(503) 639-0651

WRCLA Western Red Cedar Lumber Association  
P.O. Box 120786  
New Brighton, MN 55112  
(612) 633-4334

WWPA Western Wood Products Association  
<http://www.wwpa.org>

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**SECTION 01 45 29**  
**TESTING LABORATORY SERVICES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies materials testing activities and inspection services required during project construction to be provided by a Certified and approved testing laboratory retained by the General Contractor".

**1.2 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
  - T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  - T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
  - T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
  - T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
  - T191-02(R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Society for Testing and Materials (ASTM):
  - A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
  - A370-12.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products
  - A416/A416M-10.....Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A490-12.....Standard Specification for Heat Treated Steel  
Structural Bolts, 150 ksi Minimum Tensile  
Strength

C31/C31M-10.....Standard Practice for Making and Curing Concrete  
Test Specimens in the Field

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength of  
Cylindrical Concrete Specimens

C109/C109M-11b.....Standard Test Method for Compressive Strength of  
Hydraulic Cement Mortars

C136-06.....Standard Test Method for Sieve Analysis of Fine  
and Coarse Aggregates

C138/C138M-10b.....Standard Test Method for Density (Unit Weight),  
Yield, and Air Content (Gravimetric) of Concrete

C140-12.....Standard Test Methods for Sampling and Testing  
Concrete Masonry Units and Related Units

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic  
Cement Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed  
Concrete

C173/C173M-10b.....Standard Test Method for Air Content of freshly  
Mixed Concrete by the Volumetric Method

C330/C330M-09.....Standard Specification for Lightweight  
Aggregates for Structural Concrete

C567/C567M-11.....Standard Test Method for Density Structural  
Lightweight Concrete

C780-11.....Standard Test Method for Pre-construction and  
Construction Evaluation of Mortars for Plain and  
Reinforced Unit Masonry

C1019-11.....Standard Test Method for Sampling and Testing  
Grout

C1064/C1064M-11.....Standard Test Method for Temperature of Freshly  
Mixed Portland Cement Concrete

C1077-11c.....Standard Practice for Agencies Testing Concrete  
and Concrete Aggregates for Use in Construction  
and Criteria for Testing Agency Evaluation

C1314-11a.....Standard Test Method for Compressive Strength of  
Masonry Prisms

D422-63(2007).....Standard Test Method for Particle-Size Analysis  
of Soils

D698-07e1.....Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Standard Effort  
D1140-00(2006).....Standard Test Methods for Amount of Material in  
Soils Finer than No. 200 Sieve  
D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations Under  
Static Axial Compressive Load  
D1188-07e1.....Standard Test Method for Bulk Specific Gravity  
and Density of Compacted Bituminous Mixtures  
Using Coated Samples  
D1556-07.....Standard Test Method for Density and Unit Weight  
of Soil in Place by the Sand-Cone Method  
D1557-09.....Standard Test Methods for Laboratory Compaction  
Characteristics of Soil Using Modified Effort  
(56,000ft lbf/ft<sup>3</sup> (2,700 KNm/m<sup>3</sup>))  
D2166-06.....Standard Test Method for Unconfined Compressive  
Strength of Cohesive Soil  
D2167-08).....Standard Test Method for Density and Unit Weight  
of Soil in Place by the Rubber Balloon Method  
D2216-10.....Standard Test Methods for Laboratory  
Determination of Water (Moisture) Content of  
Soil and Rock by Mass  
D2974-07a.....Standard Test Methods for Moisture, Ash, and  
Organic Matter of Peat and Other Organic Soils  
D3666-11.....Standard Specification for Minimum Requirements  
for Agencies Testing and Inspecting Road and  
Paving Materials  
D3740-11.....Standard Practice for Minimum Requirements for  
Agencies Engaged in Testing and/or Inspection  
of Soil and Rock as used in Engineering Design  
and Construction  
D6938-10.....Standard Test Method for In-Place Density and  
Water Content of Soil and Soil-Aggregate by  
Nuclear Methods (Shallow Depth)  
E94-04(2010).....Standard Guide for Radiographic Examination  
E164-08.....Standard Practice for Contact Ultrasonic Testing  
of Weldments  
E329-11c.....Standard Specification for Agencies Engaged in  
Construction Inspection, Testing, or Special  
Inspection

- E543-09.....Standard Specification for Agencies Performing  
Non-Destructive Testing
- E605-93(R2011).....Standard Test Methods for Thickness and Density  
of Sprayed Fire Resistive Material (SFRM)  
Applied to Structural Members
- E709-08.....Standard Guide for Magnetic Particle Examination
- E1155-96(R2008).....Determining FF Floor Flatness and FL Floor  
Levelness Numbers
- E. American Welding Society (AWS):
- D1.D1.1M-10.....Structural Welding Code-Steel

### **1.3 REQUIREMENTS:**

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by A/E. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of A/E to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to A/E, Contractor, unless other arrangements are agreed to in writing by the A/E. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to A/E immediately of any irregularity.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 EARTHWORK:**

- A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:



1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Confirm or dispute Geotechnical recommendations to the A/E regarding suitability or unsuitability of areas where proof-rolling was observed, with seasonal considerations. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to A/E extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in building areas associated with deep foundations and provide part time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556 or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the A/E before the tests are conducted.
  - a. Building Slab Subgrade: At least one test of subgrade for every 185 m<sup>2</sup> (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m<sup>2</sup> (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
  - b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
  - c. Pavement Subgrade: One test for each 335 m<sup>2</sup> (400 square yards), but in no case fewer than two tests.
  - d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.

- e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
- f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to A/E. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.
- C. Fill and Backfill Material Gradation: One test per 20 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C136/.
- D. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- E. Testing Materials: Test suitability of on-site and off-site borrow as directed by A/E.

### **3.2 FOUNDATION PILES:**

- A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.
- B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to A/E.
- C. Auger-Placed Piles: Take and test samples of grout in accordance with ASTM C109 for conformance with specified strength requirements. Not less than six cubes shall be made for each day of casting. Test three cubes at 7 days and three at 28 days.

### **3.3 LANDSCAPING:**

- A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
  - 1. Test for organic material by using ASTM D2974.
  - 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to A/E.

### **3.4 ASPHALT CONCRETE PAVING:**

#### **A. Aggregate Base Course:**

1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D and ASTM Standard D-698.
2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

### **3.5 SITE WORK CONCRETE:**

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

### **3.6 CONCRETE:**

#### **A. Batch Plant Inspection and Materials Testing:**

1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of A/E with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by A/E.
2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to A/E.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times of concrete placement to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m<sup>3</sup> (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by A/E make three cylinders for each 80 m<sup>3</sup> (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. A/E may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m<sup>3</sup> (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m<sup>3</sup> (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.

10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
  - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
  - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
  - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
  - b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
  - a. Monitor and record amount of water added at project site.
  - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
  - a. Perform Floor Tolerance Measurements  $F_F$  and  $F_L$  in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
  - b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.

- c. Provide the Contractor and the A/E with the results of all profile tests, including a running tabulation of the overall  $F_F$  and  $F_L$  values for all slabs installed to date, within 72 hours after each slab installation.

19. Other inspections:

- a. Grouting under base plates.
- b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by A/E. Compile laboratory test reports as follows:  
Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to A/E. In test report, indicate the following information:
  - a. Cylinder identification number and date cast.
  - b. Specific location at which test samples were taken.
  - c. Type of concrete, slump, and percent air.
  - d. Compressive strength of concrete in MPa (psi).
  - e. Weight of lightweight structural concrete in  $\text{kg/m}^3$  (pounds per cubic foot).
  - f. Weather conditions during placing.
  - g. Temperature of concrete in each test cylinder when test cylinder was molded.
  - h. Maximum and minimum ambient temperature during placing.
  - i. Ambient temperature when concrete sample in test cylinder was taken.
  - j. Date delivered to laboratory and date tested.

**3.7 ARCHITECTURAL PRECAST CONCRETE:**

- A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.
- B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

- C. Inspect members to insure specification requirements for curing and finishes have been met.

**3.8 MASONRY:**

A. Mortar Tests:

- 1. Laboratory compressive strength test:
  - a. Comply with ASTM C780.
  - b. Obtain samples during or immediately after discharge from batch mixer.
  - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
  - d. Test one sample at 7 days and 2 samples at 28 days.
- 2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

- 1. Laboratory compressive strength test:
  - a. Comply with ASTM C1019.
  - b. Test one sample at 7 days and 2 samples at 28 days.
  - c. Perform test for each 230 m<sup>2</sup> (2500 square feet) of masonry.

C. Masonry Unit Tests:

- 1. Laboratory Compressive Strength Test:
  - a. Comply with ASTM C140.
  - b. Test 3 samples for each 460 m<sup>2</sup> (5000 square feet) of wall area.

- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m<sup>2</sup> (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

**3.9 STRUCTURAL STEEL:**

- A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

- 1. Review design and shop detail drawings for size, length, type and location of all welds to be made.
- 2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
- 3. Approve welder qualifications by certification or retesting.
- 4. Approve procedure for control of distortion and shrinkage stresses.
- 5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:

- 1. Weld Inspection:

- a. Inspect welding equipment for capacity, maintenance and working condition.
  - b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
  - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
  - d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
  - e. Measure 25 percent of fillet welds.
  - f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
    - 1) 20 percent of all shear plate fillet welds at random, final pass only.
    - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
    - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
    - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
    - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
2. Bolt Inspection:
- a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
  - b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
  - d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.



- e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
  - f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.
- D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to A/E.

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**SECTION 01 57 19**  
**TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
  - 1. Adversely effect human health or welfare,
  - 2. Unfavorably alter ecological balances of importance to human life,
  - 3. Effect other species of importance to humankind, or;
  - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
  - 1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
  - 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
  - 3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
  - 4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
  - 5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
  - 6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.

7. Sanitary Wastes:

- a. Sewage: Domestic sanitary sewage and human and animal waste.
- b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

**1.2 QUALITY CONTROL**

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

**1.3 REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):  
33 CFR 328.....Definitions

**1.4 SUBMITTALS**

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
  - 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Resident Engineer to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Resident Engineer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
    - a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
    - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
    - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
    - d. Description of the Contractor's environmental protection personnel training program.
    - e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

- f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
  - g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
  - h. Permits, licenses, and the location of the solid waste disposal area.
  - i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.
  - j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
  - k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

#### **1.5 PROTECTION OF ENVIRONMENTAL RESOURCES**

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.
- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Resident Engineer. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
  - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
  - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
  - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.
  - a. Sediment Basins: Trap sediment from construction areas in temporary sediment basins in accordance with the City Richmond Virginia Stormwater Management Program. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
  - a. Reuse or conserve the collected topsoil sediment as directed by the Resident Engineer.
  - b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and

- permanent erosion and sedimentation control features on the Environmental Protection Plan. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
  7. Manage and control spoil areas on Government property to limit spoil to areas on the Environmental Protection Plan and prevent erosion of soil or sediment from entering nearby water courses or lakes.
  8. Protect adjacent areas from despoilment by temporary excavations and embankments.
  9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
  10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
  11. Handle discarded materials other than those included in the solid waste category as directed by the Resident Engineer.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
  2. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict

accordance with the State of Virginia and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.

1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
  2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
  3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
  4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00 p.m unless otherwise permitted by local ordinance or the Resident Engineer. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:

- a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	n/a
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Use shields or other physical barriers to restrict noise transmission.
- c. Provide soundproof housings or enclosures for noise-producing machinery.
- d. Use efficient silencers on equipment air intakes.
- e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
- f. Line hoppers and storage bins with sound deadening material.
- g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no



additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Resident Engineer. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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**SECTION 01 74 19**  
**CONSTRUCTION WASTE MANAGEMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
  - 1. Waste Management Plan development and implementation.
  - 2. Techniques to minimize waste generation.
  - 3. Sorting and separating of waste materials.
  - 4. Salvage of existing materials and items for reuse or resale.
  - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
  - 1. Soil.
  - 2. Inerts (eg, concrete, masonry and asphalt).
  - 3. Clean dimensional wood and palette wood.
  - 4. Green waste (biodegradable landscaping materials).
  - 5. Engineered wood products (plywood, particle board and I-joists, etc).
  - 6. Metal products (eg, steel, wire, beverage containers, copper, etc).
  - 7. Cardboard, paper and packaging.
  - 8. Bitumen roofing materials.
  - 9. Plastics (eg, ABS, PVC).
  - 10. Carpet and/or pad.
  - 11. Gypsum board.
  - 12. Insulation.
  - 13. Paint.
  - 14. Fluorescent lamps.

**1.2 RELATED WORK**

- A. Section 02 41 00, DEMOLITION.

B. Section 01 00 00, GENERAL REQUIREMENTS.

C. Lead Paint: Section 02 83 33.13, LEAD BASED PAINT REMOVAL AND DISPOSAL.

### **1.3 QUALITY ASSURANCE**

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
1. Excess or unusable construction materials.
  2. Packaging used for construction products.
  3. Poor planning and/or layout.
  4. Construction error.
  5. Over ordering.
  6. Weather damage.
  7. Contamination.
  8. Mishandling.
  9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to recycle construction and demolition waste to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website <http://www.wbdg.org/tools/cwm.php> provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to

be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.

- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

#### **1.4 TERMINOLOGY**

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.
- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.

- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
  2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.
- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

#### **1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

B. Prepare and submit to the Resident Engineer a written demolition debris management plan. The plan shall include, but not be limited to, the following information:

1. Procedures to be used for debris management.
2. Techniques to be used to minimize waste generation.
3. Analysis of the estimated job site waste to be generated:
  - a. List of each material and quantity to be salvaged, reused, recycled.
  - b. List of each material and quantity proposed to be taken to a landfill.
4. Detailed description of the Means/Methods to be used for material handling.
  - a. On site: Material separation, storage, protection where applicable.
  - b. Off site: Transportation means and destination. Include list of materials.
    - 1) Description of materials to be site-separated and self-hauled to designated facilities.
    - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
  - c. The names and locations of mixed debris reuse and recycling facilities or sites.
  - d. The names and locations of trash disposal landfill facilities or sites.
  - e. Documentation that the facilities or sites are approved to receive the materials.

C. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.

D. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

#### **1.6 APPLICABLE PUBLICATIONS**

A Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

B. U.S. Green Building Council (USGBC):

LEED Green Building Rating System for New Construction

**1.7 RECORDS**

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

**PART 3 - EXECUTION**

**3.1 COLLECTION**

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

**3.2 DISPOSAL**

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

**3.3 REPORT**

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.

- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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**SECTION 01 81 11**

**SUSTAINABLE DESIGN REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

This Section describes general requirements and procedures to comply with the Guiding Principles for Leadership in High Performance and Sustainable Buildings Memorandum of Understanding incorporated in the Executive Orders 13423 and 13514; Energy Policy Act of 2005 (EPA 2005) and the Energy Independence and Security Act of 2007 (EISA 2007).

**1.2 OBJECTIVES**

- A. To maximize resource efficiency and reduce the environmental impacts of construction and operation, the Contractor during the construction phase of this project shall implement the following procedures:
1. Select products that minimize consumption of energy, water and non-renewable resources, while minimizing the amounts of pollution resulting from the production and employment of building technologies. It is the intent of this project to conform with EPA's Five Guiding Principles on environmentally preferable purchasing. The five principles are:
    - a. Include environmental considerations as part of the normal purchasing process.
    - b. Emphasize pollution prevention early in the purchasing process.
    - c. Examine multiple environmental attributes throughout a product's or service's life cycle.
    - d. Compare relevant environmental impacts when selecting products and services.
    - e. Collect and base purchasing decisions on accurate and meaningful information about environmental performance.
  2. Control sources for potential Indoor Air Quality (IAQ) pollutants by controlled selection of materials and processes used in project construction in order to attain superior IAQ.
  3. Products and processes that achieve the above objectives to the extent currently possible and practical have been selected and included in these Construction Documents. The Contractor is responsible to maintain and support these objectives in developing means and methods for performing the work of this Contract and in

- proposing product substitutions and/or changes to specified processes.
4. Use building practices that insure construction debris and particulates do not contaminate or enter duct work prior to system startup and turn over.

### **1.3 RELATED DOCUMENTS**

- A. Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT
- B. Section 01 81 09 TESTING FOR INDOOR AIR QUALITY (not written yet)
- C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS

### **1.4 DEFINITIONS**

- A. Agrifiber Products: Composite panel products derived from agricultural fiber
- B. Biobased Product: As defined in the 2002 Farm Bill, a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials
- C. Biobased Content: The weight of the biobased material divided by the total weight of the product and expressed as a percentage by weight
- D. Certificates of Chain-of-Custody: Certificates signed by manufacturers certifying that wood used to make products has been tracked through its extraction and fabrication to ensure that it was obtained from forests certified by a specified certification program
- E. Composite Wood: A product consisting of wood fiber or other plant particles bonded together by a resin or binder
- F. Construction and Demolition Waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair and demolition operations. A construction waste management plan is to be provided by the Contractor as defined in Section 01 74 19.
- G. Third Party Certification: Certification of levels of environmental achievement by nationally recognized sustainability rating system.
- H. Light Pollution: Light that extends beyond its source such that the additional light is wasted in an unwanted area or in an area where it inhibits view of the night sky

- I. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock
- J. Post-Consumer Recycled Content: The percentage by weight of constituent materials that have been recovered or otherwise diverted from the solid-waste stream after consumer use
- K. Pre-Consumer Recycled Content: Materials that have been recovered or otherwise diverted from the solid-waste stream during the manufacturing process. Pre-consumer content must be material that would not have otherwise entered the waste stream as per Section 5 of the FTC Act, Part 260 "Guidelines for the Use of Environmental Marketing Claims": [www.ftc.gov/bcp/grnrule/guides980427](http://www.ftc.gov/bcp/grnrule/guides980427)
- L. Regional Materials: Materials that are extracted, harvested, recovered, and manufactured within a radius of 250 miles (400 km) from the Project site
- M. Salvaged or Reused Materials: Materials extracted from existing buildings in order to be reused in other buildings without being manufactured
- N. Sealant: Any material that fills and seals gaps between other materials
- O. Type 1 Finishes: Materials and finishes which have a potential for short-term levels of off gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in the process of installation and/or curing.
- P. Type 2 Finishes: "Fuzzy" materials and finishes which are woven, fibrous, or porous in nature and tend to adsorb chemicals offgas
- Q. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

#### **1.5 SUBMITTALS**

- A. Sustainable Design Submittals:
  - 1. Alternative Transportation: Provide manufacturer's cut sheets for all bike racks installed on site, including the total number of bicycle storage slots provided. Also, provide manufacturer's cut

sheets for any alternative-fuel refueling stations installed on site, including fueling capacity information for an 8-hour period.

2. Heat Island Effect:

a. Site Paving: Provide manufacturer's cut sheets for all impervious paving materials, highlighting the Solar Reflectance Index (SRI) of the material. Also, provide cut sheets for all pervious paving materials.

b. Roofing Materials: Submittals for roofing materials must include manufacturer's cut sheets or product data highlighting the Solar Reflectance Index (SRI) of the material.

3. Exterior Lighting Fixtures: Submittals must include cut sheets with manufacturer's data on initial fixture lumens above 90° from nadir for all exterior lighting fixtures, and, for parking lot lighting, verification that the fixtures are classified by the IESNA as "full cutoff" (FCO); OR provide documentation that exterior luminaires are IDA-Approved as Dark-Sky Friendly by the International Dark Sky Association (IDA) Fixture Seal of Approval Program.

4. Irrigation Systems: Provide manufacturer's cut sheets for all permanent landscape irrigation system components and for any rainwater harvesting system components, such as cisterns.

5. Water Conserving Fixtures: Submittals must include manufacturer's cut sheets for all water-consuming plumbing fixtures and fittings (toilets, urinals, faucets, showerheads, etc.) highlighting maximum flow rates and/or flush rates. Include cut sheets for any automatic faucet-control devices.

6. Process Water Use: Provide manufacturer's cut sheets for all water-consuming commercial equipment (clothes washers, dishwashers, ice machines, etc.), highlighting water consumption performance. Include manufacturer's cut sheets or product data for any cooling towers, highlighting water consumption estimates, water use reduction measures, and corrosion inhibitors.

7. Elimination of CFCs AND HCFCs: Provide manufacturer's cut sheets for all cooling equipment with manufacturer's product data, highlighting refrigerants; provide manufacturer's cut sheets for all fire-suppression equipment, highlighting fire-suppression agents; provide manufacturer's cut-sheets for all polystyrene insulation (XPS) and

- closed-cell spray foam polyurethane insulation, highlighting the blowing agent(s).
8. Appliances and Equipment: Provide copies of manufacturer's product data for all Energy Star eligible equipment and appliances, including office equipment, computers and printers, electronics, and commercial food service equipment (excluding HVAC and lighting components), verifying compliance with EPA's Energy Star program.
  9. On-Site Renewable Energy Systems: Provide cut sheets and manufacturer's product data for all on-site renewable energy generating components and equipment, including documentation of output capacity.
  10. Measurement and Verification Systems: Provide cut sheets and manufacturer's product data for all controls systems, highlighting electrical metering and trending capability components.
  11. Salvaged or Reused Materials: Provide documentation that lists each salvaged or reused material, the source or vendor of the material, the purchase price, and the replacement cost if greater than the purchase price.
  12. Recycled Content: Submittals for all materials with recycled content (excluding MEP systems equipment and components) must include the following documentation: Manufacturer's product data, product literature, or a letter from the manufacturer verifying the percentage of post-consumer and pre-consumer recycled content (by weight) of each material or product
    - a. An electronic spreadsheet that tabulates the Project's total materials cost and combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value) expressed as a percentage of total materials cost. This spreadsheet shall be submitted every third month with the Contractor's Certificate and Application for Payment. It should indicate, on an ongoing basis, line items for each material, including cost, pre-consumer recycled content, post-consumer recycled content, and combined recycled content value.
  13. Regional Materials: Submittals for all products or materials expected to contribute to the regional calculation (excluding MEP

systems equipment and components) must include the following documentation:

- a. Cost of each material or product, excluding cost of labor and equipment for installation
  - b. Location of product manufacture and distance from point of manufacture to the Project Site
  - c. Location of point of extraction, harvest, or recovery for each raw material in each product and distance from the point of extraction, harvest, or recovery to the Project Site
  - d. Manufacturer's product data, product literature, or a letter from the manufacturer verifying the location and distance from the Project Site to the point of manufacture for each regional material
  - e. Manufacturer's product data, product literature, or a letter from the manufacturer verifying the location and distance from the Project Site to the point of extraction, harvest, or recovery for each regional material or product, including, at a minimum, gravel and fill, planting materials, concrete, masonry, and GWB
  - f. An electronic spreadsheet that tabulates the Project's total materials cost and regional materials value, expressed as a percentage of total materials cost. This spreadsheet shall be submitted every third month with the Contractor's Certificate and Application for Payment. It should indicate on an ongoing basis, line items for each material, including cost, location of manufacture, distance from manufacturing plant to the Project Site, location of raw material extraction, and distance from extraction point to the Project Site.
14. Outdoor Air Delivery Monitoring: Provide manufacturer's cut sheets highlighting the installed carbon dioxide monitoring system components and sequence of controls shop drawing documentation, including CO2 differential set-points and alarm capabilities.
15. Interior Adhesives and Sealants: Submittals for all field-applied adhesives and sealants, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content.

- a. Provide manufacturers' documentation verifying all adhesives used to apply laminates, whether shop-applied or field-applied, contain no urea-formaldehyde.
- 16. Interior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content
- 17. Exterior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on ambient air quality, must include manufacturer's MSDSs or other manufacturer's Product Data highlighting VOC content.
- 19. Composite Wood and Agrifiber Binders: Submittals for all composite wood and agrifiber products (including but not limited to particleboard, wheatboard, strawboard, agriboard products, engineered wood components, solid-core wood doors, OSB, MDF, and plywood products) must include manufacturer's product data verifying that these products contain no urea-formaldehyde resins.
- 20. Systems Furniture and Seating: Provide manufacturer's product data verifying that all systems furniture and seating products meet the requirements of one of the following:
  - a. Greenguard certification
  - b. SCS Indoor Advantage certification
  - c. SCS Indoor Advantage Gold certification
  - d. BIFMA Standard X7.1-2005, as tested to BIFMA method M7.1-2005 and as verified by an independent laboratory
  - d. Calculated indoor air concentration limits for furniture systems and seating determined by the U.S. EPA's Environmental Technology Verification Large Chamber Test Protocol for Measuring Emissions of VOCs and Aldehydes (September 1999) testing protocol as conducted in an independent air quality testing laboratory
- 21. Entryway Systems: Provide manufacturer's cut sheets for all walk-off systems installed to capture particulates, including permanently installed grates, grilles, slotted systems, direct glue-down walk-off mats, and non-permanent roll-out mats.
- 22. Air Filtration: Provide manufacturer's cut sheets and product data highlighting the following:

- a. Minimum Efficiency Reporting Value (MERV) for filtration media in all air handling units (AHUs) per ASHRAE HVAC Design Manual for Hospitals and Clinics.
  - b. Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed AHUs are used during construction. See above for requirements
23. Mercury in Lighting: Provide manufacturer's cut sheets or product data for all fluorescent or HID lamps highlighting mercury content.
24. Lighting Controls: Provide manufacturer's cut sheets and shop drawing documentation highlighting all lighting controls systems components.
25. Thermal Comfort Controls: Provide manufacturer's cut sheets and shop drawing documentation highlighting all thermal comfort-control systems components.
26. Blended Cement: It is the intent of this specification to reduce CO<sub>2</sub> emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace portland cement as specified in Section 03 30 00, CONCRETE typically included in conventional construction. Provide the following submittals:
- a. Copies of concrete design mixes for all installed concrete
  - b. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project
  - c. Quantities in cubic yards of each installed concrete mix
27. Gypsum Wall Board: Provide manufacturer's cut sheets or product data verifying that all gypsum wallboard products are moisture and mold-resistant.
28. Fiberglass Insulation: Provide manufacturer's cut sheets or product data verifying that fiberglass batt insulation contains no urea-formaldehyde.
29. Duct Acoustical Insulation: Provide manufacturer's cut sheets or product data verifying that mechanical sound insulation materials in air distribution ducts consists of an impervious, non-porous coatings that prevent dust from accumulating in the insulating materials.



30. Green Housekeeping: Provide documentation that all cleaning products and janitorial paper products meet the VOC limits and content requirements of this specification section.
- B. Project Materials Cost Data: Provide a spreadsheet in an electronic file indicating the total cost for the Project and the total cost of building materials used for the Project, as follows:
1. Not more than 60 days after the Preconstruction Meeting, the General Contractor shall provide to the Owner and Architect a preliminary schedule of materials costs for all materials used for the Project organized by specification section. Exclude labor costs and all mechanical, electrical, and plumbing (MEP) systems materials and labor costs. Include the following:
    - a. Identify each reused or salvaged material, its cost, and its replacement value.
    - b. Identify each recycled-content material, its post-consumer and pre-consumer recycled content as a percentage the product's weight, its cost, its combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value), and the total combined recycled content value for all materials as a percentage of total materials costs.
    - c. Identify each regional material, its cost, its manufacturing location, the distance of this location from the Project site, the source location for each raw material component of the material, the distance of these extraction locations from the Project site, and the total value of regional materials as a percentage of total materials costs.
    - d. Identify each biobased material, its source, its cost, and the total value of biobased materials as a percentage of total materials costs. Also provide the total value of rapidly renewable materials (materials made from plants that are harvested in less than a 10-year cycle) as a percentage of total materials costs.
    - e. Identify each wood-based material, its cost, the total wood-based materials cost, each FSC Certified wood material, its cost, and the total value of Certified wood as a percentage of total wood-based materials costs.

2. Provide final versions of the above spreadsheets to the Owner and Architect not more than 14 days after Substantial Completion.
- C. Construction Waste Management: See Section 01 74 19 "Construction Waste Management" for submittal requirements.
- D. Construction Indoor Air Quality (IAQ) Management: Submittals must include the following:
  1. Not more than 30 days after the Preconstruction Meeting, prepare and submit for the Architect and Owner's approval, an electronic copy of the draft Construction IAQ Management Plan in an electronic file including, but not limited to, descriptions of the following:
  2. Instruction procedures for meeting or exceeding the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995, Chapter 3, including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling
    - a. Instruction procedures for protecting absorptive materials stored on-site or installed from moisture damage
    - b. Schedule of submission to Architect of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials
    - c. Instruction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille
    - d. Instruction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit
  3. Not more than 30 days following receipt of the approved draft CIAQMP, submit an electronic copy of the approved CIAQMP in an electronic file, along with the following:
    - a. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for all filtration media to be installed at return air grilles during construction if permanently installed AHUs are used during construction.

- b. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media in all air handling units (AHUs).
- 4. Not more than 14 days after Substantial Completion provide the following:
  - a. Documentation verifying required replacement of air filtration media in all air handling units (AHUs) after the completion of construction and prior to occupancy and, if applicable, required installation of filtration during construction.
  - b. Minimum of 18 Construction photographs: Six photographs taken on three different occasions during construction of the SMACNA approaches employed, along with a brief description of each approach, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
- E. Commissioning: See Section 01 91 00 "General Commissioning Requirements" for submittal requirements.
- F. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports for the following:
  - 1. Construction Waste Management: Waste reduction progress reports and logs complying with the requirements of Section 01 74 19 "Construction Waste Management."
  - 2. Construction IAQ Management: See details below under Section 3.2 Construction Indoor Air Quality Management for Construction IAQ management progress report requirements.

#### **1.6 QUALITY ASSURANCE**

- A. Preconstruction Meeting: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner, Architect, and all Subcontractors to discuss the Construction Waste Management Plan, the required Construction Indoor Air Quality (IAQ) Management Plan, and all other Sustainable Design Requirements. The purpose of this meeting is to develop a mutual understanding of the Project's Sustainable Design Requirements and coordination of the Contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- B. Construction Job Conferences: The status of compliance with the Sustainable Design Requirements of these specifications will be an

agenda item at all regular job meetings conducted during the course of work at the site.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCT ENVIRONMENTAL REQUIREMENTS**

- A. Site Clearing: Topsoil shall be provided by the Contractor from on-site material which has been stockpiled for reuse. Off-site borrow should only be used when on-site sources are exhausted. Chip and/or compost on site all vegetated material identified for removal.
- B. Do not burn rubbish, organic matter, etc. or any material on the site. Dispose of legally in accordance with Specifications Sections 01 74 19.
- C. Roofing Materials: All roofing systems, other than vegetated roof systems, must comply with the following requirements:
  - 1. Low-Sloped roofing less than or equal to 2:12 slope must have an SRI of at least 78.
  - 2. Steep-Sloped roofing greater than 2:12 slope must have an SRI of at least 29.
  - 3. Roofing Materials: Light-colored, reflective, and high-emissivity roofing helps to reduce localized heat build-up from roof surfaces that contribute to the urban heat island effect.
- D. Exterior Lighting Fixtures:
  - 1. All exterior luminaires must emit 0% of the total initial designed fixture lumens at an angle above 90° from nadir and/or meet the requirements of the Dark Sky certification program.
  - 2. Exterior lighting cannot exceed 80% of the lighting power densities defined by ASHRAE/IESNA Standard 90.1-2004, Exterior Lighting Section, without amendments.
  - 3. No lighting of building facades or landscape features is permitted.
- E. Herbicides and Pest Control: Herbicides shall not be permitted, and pest control measures shall utilize EPA-registered biopesticides only.
- F. Landscape Irrigation: Use water-efficient landscape and irrigation strategies, including water reuse and recycling, to reduce outdoor potable water consumption by a minimum of 50 percent over that consumed by conventional means (plant species and plant densities).
- G. Water-Conserving Fixtures: Plumbing fixtures and fittings shall use in aggregate at least 20% less water than the water use baseline calculated for the building after meeting the Energy Policy Act of 1992

fixture performance requirements. Flow and flush rates shall not exceed the following:

1. Toilets: no more than 1.3 gallons per flush, otherwise be dual flush 1.6/0.8 gallons per flush, and have documented bowl evacuation capability per MaP testing of at least 400 grams
  2. Urinals: Waterless or Water sense rated with no more than 0.5 gallons per flush.
  3. Lavatory Faucets: 0.5 gpm with automatic faucet controls
  4. Kitchen Sink Lavatories: 2.2 gpm
  5. Showerheads: no more than 1.5gpm
- H. Process Water Use: Employ strategies that in aggregate result in 20% less water use than the process water use baseline for the building after meeting the commercial equipment and HVAC performance requirements as listed in the Table below. For equipment not addressed by EPACT 2005 or the list below, additional equipment performance requirements may be proposed provided documentation supporting the proposed benchmark or industry standard is submitted.
1. Clothes Washer: 7.5 gallons/cubic foot/cycle
  2. Dishwasher with Racks: 1.0 gallons/rack
  3. Ice Machine: 20 gallons/100 pounds ice for machines making over 175 pounds of ice per day; 30 gallons/100 pounds ice for machines making less than 175 ice per day. Avoid water-cooled machines.
  4. Food Steamer: 2 gallons/hour. Use only boilerless steamers.
  5. Pre-Rinse Spray Valves: 1.4 gallons/minute
  6. Kitchen Pot-Washing Sinks: 2.2 gallons/minute
  7. Cooling Towers: 2.3 gallons/ton-hr. water loss
- I. Elimination of CFCs AND HCFCs:
1. Ozone Protection and Greenhouse Gas Reduction: Base building cooling equipment shall contain no refrigerants other than the following: HCFC-123, HFC-134a, HFC-245fa, HFC-407c, or HFC 410a.
  2. Fire suppression systems may not contain ozone-depleting substances such as halon 1301 and 1211.
  3. Extruded polystyrene insulation (XPS) and closed-cell spray foam polyurethane insulation shall not be manufactured with hydrochlorofluorocarbon (HCFC) blowing agents.
- J. Appliances and Equipment: All materials and equipment being installed that falls under the Energy Star or FEMP programs must be Energy Star

or FEMP-rated. Eligible equipment includes refrigerators, motors, laundry equipment, office equipment and more. Refer to each program's website for a complete list.

K. HVAC Distribution Efficiency:

1. All duct systems shall be constructed of aluminum, stainless steel or galvanized sheet metal, as deemed appropriate based on the application requirements. No fiberglass duct board shall be permitted.
2. All medium- and high-pressure ductwork systems shall be pressure-tested in accordance with the current SMACNA standards.
3. All ductwork shall be externally insulated. No interior duct liner shall be permitted.
4. Where possible, all air terminal connections shall be hard-connected with sheet metal ductwork. If flexible ductwork is used, no flexible duct extension shall be more than six feet in length.
5. All HVAC equipment shall be isolated from the ductwork system with flexible duct connectors to minimize the transmittance of vibration.
6. All supply and return air branch ducts shall include the appropriate style of volume damper. Air terminal devices such as grilles, registers, and diffusers shall be balanced at duct branch dampers, not at terminal face.

L. Measurement and Verification: Install controls and monitoring devices as required by MEP divisions order to comply with International Performance Measurement & Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003, Option D.

1. The IPMVP provides guidance on situation-appropriate application of measurement and verification strategies.

M. Salvaged or Reused materials: There shall be no substitutions for specified salvaged and reused materials and products.

1. Salvaged materials: Use of salvaged materials reduces impacts of disposal and manufacturing of replacements.

N. Recycled Content of Materials:

1. Provide building materials with recycled content such that post-consumer recycled content value plus half the pre-consumer recycled content value constitutes a minimum of 30% of the cost of materials used for the Project, exclusive of all MEP equipment, labor, and

delivery costs. The Contractor shall make all attempts to maximize the procurement of materials with recycled content.

- a. The post-consumer recycled content value of a material shall be determined by dividing the weight of post-consumer recycled content by the total weight of the material and multiplying by the cost of the material.
- b. Do not include mechanical and electrical components in the calculations.
- c. Do not include labor and delivery costs in the calculations.
- d. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e).
- e. Utilize all on-site existing paving materials that are scheduled for demolition as granulated fill, and include the cost of this material had it been purchased in the calculations for recycled content value.
- f. The materials in the following list must contain the minimum recycled content indicated:

Category	Minimum Recycled Content
Compost/mulch	100% post-consumer
Asphaltic Concrete Paving	25% post-consumer
Cast-in-Place Concrete	6% pre-consumer
CMU: Gray Block	20% pre-consumer
Steel Reinforcing Bars	90% combined
Structural Steel Shapes	90% combined
Steel Joists	75% combined
Steel Deck	75% combined
Steel Fabrications	60% combined
Steel Studs	30% combined
Steel Roofing	30% post-consumer
Aluminum Fabrications	35% combined

Rigid Insulation	20% pre-consumer
Batt insulation	30% combined

O. Biobased Content:

1. For products designated by the USDA's BioPreferred program, provide products that meet or exceed USDA recommendations for biobased content, so long as products meet all other performance requirements in VA master specifications. For more information regarding the product categories covered by the BioPreferred program, visit <http://www.biopreferred.gov>

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**SECTION 02 41 00**  
**DEMOLITION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

**1.2 RELATED WORK:**

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.
- B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- F. Construction Waste Management: Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT.

**1.3 PROTECTION:**

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.
- E. In addition to previously listed fire and safety rules to be observed in performance of work, include following:

1. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
  2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- F. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Medical Center; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.
- G. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

**1.4 UTILITY SERVICES:**

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 DEMOLITION:**

- A. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Medical Center to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.
- B. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in

compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

- C. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

### **3.2 CLEAN-UP:**

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Medical Center disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

**1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:**

- A. Testing agency for the trial concrete mix design retained and reimbursed by the Contractor and approved by A/E. For all other testing, refer to Section 01 45 29 Testing Laboratory Services.
- B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology. Accompany request for approval of testing agency with a copy of Report of Latest Inspection of Laboratory Facilities by CCRL.
- C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

**1.4 TOLERANCES:**

- A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).
- B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.
- C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).
- D. Slab Finishes: ACI 117, Section 4.5.6, F-number method in accordance with ASTM E1155, except as follows:

1. Test entire slab surface, including those areas within 600 mm (2 feet) of construction joints and vertical elements that project through slab surface.
2. Maximum elevation change which shall occur within 600 mm (2 feet) of any column or wall element is 6 mm (0.25 inches).
3. Allow sample measurement lines that are perpendicular to construction joints to extend past joint into previous placement no further than 1500 mm (5 feet).

**1.5 REGULATORY REQUIREMENTS:**

- A. ACI SP-66 - ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.
- C. ACI 301 - Standard Specifications for Structural Concrete.

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Shop Drawings: Reinforcing steel: Complete shop drawings
- C. Mill Test Reports:
  1. Reinforcing Steel.
  2. Cement.
- D. Manufacturer's Certificates:
  1. Abrasive aggregate.
  2. Air-entraining admixture.
  3. Chemical admixtures, including chloride ion content.
  4. Waterproof paper for curing concrete.
  5. Liquid membrane-forming compounds for curing concrete.
  6. Non-shrinking grout.
  7. Liquid hardener.
  8. Waterstops.
  9. Expansion joint filler.
  10. Adhesive binder.
- E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology and copy of report of latest CCRL, Inspection of Laboratory.
- F. Test Report for Concrete Mix Designs: Trial mixes including water-cement fly ash ratio curves, concrete mix ingredients, and admixtures.

**1.7 DELIVERY, STORAGE, AND HANDLING:**

- A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.
- B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement in separate suitable bins.
- C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

**1.8 PRE-CONCRETE CONFERENCE:**

- A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.
- B. Agenda: Includes but is not limited to:
  - 1. Submittals.
  - 2. Coordination of work.
  - 3. Availability of material.
  - 4. Concrete mix design including admixtures.
  - 5. Methods of placing, finishing, and curing.
  - 6. Finish criteria required to obtain required flatness and levelness.
  - 7. Timing of floor finish measurements.
  - 8. Material inspection and testing.
- C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; admixture manufacturers; A/E; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.
- D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

**1.9 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
  - 117-10.....Specifications for Tolerances for Concrete Construction and Materials and Commentary

- 211.1-91(R2009).....Standard Practice for Selecting Proportions for  
Normal, Heavyweight, and Mass Concrete
- 211.2-98(R2004).....Standard Practice for Selecting Proportions for  
Structural Lightweight Concrete
- 214R-11.....Guide to Evaluation of Strength Test Results of  
Concrete
- 301-10.....Standard Practice for Structural Concrete
- 304R-00(R2009).....Guide for Measuring, Mixing, Transporting, and  
Placing Concrete
- 305.1-06.....Specification for Hot Weather Concreting
- 306.1-90(R2002).....Standard Specification for Cold Weather  
Concreting
- 308.1-11.....Specification for Curing Concrete
- 309R-05.....Guide for Consolidation of Concrete
- 318-11.....Building Code Requirements for Structural  
Concrete and Commentary
- 347-04.....Guide to Formwork for Concrete
- SP-66-04.....ACI Detailing Manual
- C. American National Standards Institute and American Hardboard Association  
(ANSI/AHA):
- A135.4-2004.....Basic Hardboard
- D. American Society for Testing and Materials (ASTM):
- A82/A82M-07.....Standard Specification for Steel Wire, Plain,  
for Concrete Reinforcement
- A185/185M-07.....Standard Specification for Steel Welded Wire  
Reinforcement, Plain, for Concrete
- A615/A615M-09.....Standard Specification for Deformed and Plain  
Carbon Steel Bars for Concrete Reinforcement
- A653/A653M-11.....Standard Specification for Steel Sheet, Zinc  
Coated (Galvanized) or Zinc Iron Alloy Coated  
(Galvannealed) by the Hot Dip Process
- A706/A706M-09.....Standard Specification for Low Alloy Steel  
Deformed and Plain Bars for Concrete  
Reinforcement
- A767/A767M-09.....Standard Specification for Zinc Coated  
(Galvanized) Steel Bars for Concrete  
Reinforcement
- A775/A775M-07.....Standard Specification for Epoxy Coated  
Reinforcing Steel Bars

A820-11.....Standard Specification for Steel Fibers for  
Fiber Reinforced Concrete

A996/A996M-09.....Standard Specification for Rail Steel and Axle  
Steel Deformed Bars for Concrete Reinforcement

C31/C31M-10.....Standard Practice for Making and Curing Concrete  
Test Specimens in the field

C33/C33M-11A.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength of  
Cylindrical Concrete Specimens

C94/C94M-12.....Standard Specification for Ready Mixed Concrete

C143/C143M-10.....Standard Test Method for Slump of Hydraulic  
Cement Concrete

C150-11.....Standard Specification for Portland Cement

C171-07.....Standard Specification for Sheet Materials for  
Curing Concrete

C172-10.....Standard Practice for Sampling Freshly Mixed  
Concrete

C173-10.....Standard Test Method for Air Content of Freshly  
Mixed Concrete by the Volumetric Method

C192/C192M-07.....Standard Practice for Making and Curing Concrete  
Test Specimens in the Laboratory

C231-10.....Standard Test Method for Air Content of Freshly  
Mixed Concrete by the Pressure Method

C260-10.....Standard Specification for Air Entraining  
Admixtures for Concrete

C309-11.....Standard Specification for Liquid Membrane  
Forming Compounds for Curing Concrete

C330-09.....Standard Specification for Lightweight  
Aggregates for Structural Concrete

C494/C494M-11.....Standard Specification for Chemical Admixtures  
for Concrete

C618-12.....Standard Specification for Coal Fly Ash and Raw  
or Calcined Natural Pozzolan for Use in Concrete

C666/C666M-03(R2008)....Standard Test Method for Resistance of Concrete  
to Rapid Freezing and Thawing

C881/C881M-10.....Standard Specification for Epoxy Resin Base  
Bonding Systems for Concrete

C1107/1107M-11.....Standard Specification for Packaged Dry,  
Hydraulic-Cement Grout (Non-shrink)



- C1315-11.....Standard Specification for Liquid Membrane  
Forming Compounds Having Special Properties for  
Curing and Sealing Concrete
- D6-95(R2011).....Standard Test Method for Loss on Heating of Oil  
and Asphaltic Compounds
- D297-93(R2006).....Standard Methods for Rubber Products Chemical  
Analysis
- D412-06AE2.....Standard Test Methods for Vulcanized Rubber and  
Thermoplastic Elastomers - Tension
- D1751-04(R2008).....Standard Specification for Preformed Expansion  
Joint Filler for Concrete Paving and Structural  
Construction (Non-extruding and Resilient  
Bituminous Types)
- D4263-83(2012).....Standard Test Method for Indicating Moisture in  
Concrete by the Plastic Sheet Method.
- D4397-10.....Standard Specification for Polyethylene Sheeting  
for Construction, Industrial and Agricultural  
Applications
- E1155-96(R2008).....Standard Test Method for Determining  $F_F$  Floor  
Flatness and  $F_L$  Floor Levelness Numbers
- F1869-11.....Standard Test Method for Measuring Moisture  
Vapor Emission Rate of Concrete Subfloor Using  
Anhydrous Calcium Chloride.
- E. American Welding Society (AWS):
- D1.4/D1.4M-11.....Structural Welding Code - Reinforcing Steel
- F. Concrete Reinforcing Steel Institute (CRSI):
- Handbook 2008
- G. National Cooperative Highway Research Program (NCHRP):
- Report On.....Concrete Sealers for the Protection of Bridge  
Structures
- H. U.S. Department of Commerce Product Standard (PS):
- PS 1.....Construction and Industrial Plywood
- PS 20.....American Softwood Lumber
- I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:
- CRD C513.....Rubber Waterstops
- CRD C572.....Polyvinyl Chloride Waterstops

**PART 2 - PRODUCTS:**

**2.1 FORMS:**

- A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.
- B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.
- C. Metal for Concrete Rib-Type Construction: Steel (removal type) of suitable weight and form to provide required rigidity.
- D. Permanent Steel Form for Concrete Slabs: Corrugated, ASTM A653, Grade E, and Galvanized, ASTM A653, G90. Provide venting where insulating concrete fill is used.
- E. Corrugated Fiberboard Void Boxes: Double faced, completely impregnated with paraffin and laminated with moisture resistant adhesive, size as shown. Design forms to support not less than 48 KPa (1000 psf) and not lose more than 15 percent of their original strength after being completely submerged in water for 24 hours and then air dried.
- F. Form Lining:
  - 1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
  - 2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.
  - 3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.
- G. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

**2.2 MATERIALS:**

- A. Portland Cement: ASTM C150 Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33.
  - 1. Size 67 or Size 467 shall be used for footings and walls over 300 mm (12 inches) thick.

2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.
3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.
- D. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150  $\mu$ m (No. 100) sieve.
- E. Mixing Water: Fresh, clean, and potable.
- F. Admixtures:
  1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
  2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
  3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
  4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer shall have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
  5. Air Entraining Admixture: ASTM C260.
  6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
  7. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.
- G. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.
- H. Welded Wire Fabric: ASTM A185.
- I. Reinforcing Bars to be Welded: ASTM A706.
- J. Galvanized Reinforcing Bars: ASTM A767.
- K. Epoxy Coated Reinforcing Bars: ASTM A775.
- L. Cold Drawn Steel Wire: ASTM A82.

- M. Reinforcement for Metal Pan Stair Fill: 50 mm (2 inch) wire mesh, either hexagonal mesh at .8Kg/m<sup>2</sup> (1.5 pounds per square yard), or square mesh at .6Kg/m<sup>2</sup> (1.17 pounds per square yard).
- N. Supports, Spacers, and Chairs: Types which shall hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.
- O. Expansion Joint Filler: ASTM D1751.
- P. Sheet Materials for Curing Concrete: ASTM C171.
- Q. Liquid Membrane-forming Compounds for Curing Concrete: ASTM C309, Type I, with fugitive dye, and shall meet the requirements of ASTM C1315. Compound shall be compatible with scheduled surface treatment, such as paint and resilient tile, and shall not discolor concrete surface.
- R. Abrasive Aggregate: Aluminum oxide grains or emery grits.
- S. Moisture Vapor Emissions & Alkalinity Control Sealer: 100% active colorless aqueous silicate solution concrete surface.
  - 1. ASTM C1315 Type 1 Class A, and ASTM C309 Type 1 Class A, penetrating product to have no less than 34% solid content, leaving no sheen, volatile organic compound (VOC) content rating as required to suite regulatory requirements. The product shall have at least a five (5) year documented history in controlling moisture vapor emission from damaging floor covering, compatible with all finish materials.
  - 2. MVE 15-Year Warranty:
    - a. When a floor covering is installed on a below grade, on grade, or above grade concrete slab treated with Moisture Vapor Emissions & Alkalinity Control Sealer according to manufacturer's instruction, sealer manufacturer shall warrant the floor covering system against failure due to moisture vapor migration or moisture-born contaminates for a period of fifteen (15) years from the date of original installation. The warranty shall cover all labor and materials needed to replace all floor covering that fails due to moisture vapor emission & moisture born contaminates.
- T. Penetrating Sealer: For use on parking garage ramps and decks. High penetration silane sealer providing minimum 95 percent screening per National Cooperative Highway Research Program (NCHRP) No. 244 standards for chloride ion penetration resistance. Requires moist (non-membrane) curing of slab.
- U. Non-Shrink Grout:

1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (5000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.
  2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.
- V. Adhesive Binder: ASTM C881.
- W. Waterstops:
1. Polyvinyl Chloride Waterstop: CRD C572.
  2. Rubber Waterstops: CRD C513.
  3. Bentonite Waterstop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 lbs. per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
  4. Non-Metallic Hydrophilic: Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in 70 deg water shall be 3 to 1 minimum.
- X. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).
- Y. Fibers:
1. Synthetic Fibers: Monofilament or fibrillated polypropylene fibers for secondary reinforcing of concrete members. Use appropriate length and 0.9 kg/m<sup>3</sup> (1.5 lb. per cubic yard). Product shall have a UL rating.
- Z. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
- AA. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.
- BB. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

### 2.3 CONCRETE MIXES:

- A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.
  - 1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
  - 2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m<sup>3</sup> (cubic yard) measured dry rodded and damp loose, specific gravity, fineness modulus, percentage of moisture, air content, water-cement-fly ash ratio, and consistency of each cylinder in terms of slump.
  - 3. Prepare a curve showing relationship between water-cement-fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
  - 4. If the field experience method is used, submit complete standard deviation analysis.
- B. Fly Ash Testing: Submit certificate verifying conformance with ASTM 618 initially with mix design and for each truck load of fly ash delivered from source. Submit test results performed within 6 months of submittal date. Notify A/E immediately when change in source is anticipated.
  - 1. Testing Laboratory used for fly ash certification/testing shall participate in the Cement and Concrete Reference Laboratory (CCRL) program. Submit most recent CCRL inspection report.
- C. After approval of mixes no substitution in material or change in proportions of approval mixes shall be made without additional tests and approval of A/E or as specified. Making and testing of preliminary test cylinders shall be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. A/E shall allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.
- D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Use Fly Ash as an admixture with 20% replacement by weight in all structural work. Increase this replacement to 40% for mass concrete, and reduce it to 10% for drilled piers and caissons. Fly ash shall not be used in high-early mix design.

**TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE**

Concrete Strength		Non-Air- Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m <sup>3</sup> (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) <sup>1,3</sup>	375 (630)	0.45	385 (650)	0.40
30 (4000) <sup>1,3</sup>	325 (550)	0.55	340 (570)	0.50
25 (3000) <sup>1,3</sup>	280 (470)	0.65	290 (490)	0.55
25 (3000) <sup>1,2</sup>	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
  2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
  3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

**TABLE II - MAXIMUM SLUMP, MM (INCHES)\***

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

- F. Slump shall be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture shall have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This shall

be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

- G. Air-Entrainment: Air-entrainment of normal weight concrete shall conform with Table III. Air-entrainment of lightweight structural concrete shall conform with Table IV. Determine air content by either ASTM C173 or ASTM C231.

**TABLE III - TOTAL AIR CONTENT  
FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Total Air Content	Coarse Aggregate, mm (Inches) Percentage by Volume
10 mm (3/8 in).6 to 10	13 mm (1/2 in).5 to 9
20 mm (3/4 in).4 to 8	25 mm (1 in).3-1/2 to 6-1/2
40 mm (1 1/2 in).3 to 6	

**TABLE IV  
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE**

Nominal Maximum size of Total Air Content	Coarse Aggregate, mm's (Inches) Percentage by Volume
Greater than 10 mm (3/8 in) 4 to 8	10 mm (3/8 in) or less 5 to 9

- H. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.
- I. Concrete slabs placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).
- J. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. For air content requirements see Table III or Table IV.
- K. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests shall be used as indicators of 28-day strength. Average of any



three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Shall strengths shown by test specimens fall below required values, A/E shall require any one or any combination of the following corrective actions, at no additional cost to the Government:

1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
2. Require additional curing and protection.
3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, A/E shall direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, A/E shall order load tests, made by Contractor retained testing agency, on portions of building so affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.
5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the A/E.

#### **2.4 BATCHING AND MIXING:**

- A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment shall be approved by A/E. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38<sup>0</sup>C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the A/E for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services shall be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise A/E.

### **PART 3 - EXECUTION**

#### **3.1 FORMWORK:**

- A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.
  1. Form boards and plywood forms shall be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and A/E approves their reuse.
  2. Provide forms for concrete footings unless A/E determines forms are not necessary.
  3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.
- B. Treating and Wetting: Treat or wet contact forms as follows:
  1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
  2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
  3. Use sealer on reused plywood forms as specified for new material.
- C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind

of lumber used nor to develop deflection greater than  $1/270$  of free span of member.

- D. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 150 mm (6 inches) apart.
- E. Lined Forms: Shall be used in lieu of unlined plywood forms. Back up form lining solidly with square edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing shall coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 200 mm (8 inches) on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.
- F. Architectural Liner: Attach liner as recommended by the manufacturer with tight joints to prevent leakage.
- G. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (18 inches) on center.
  - 1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
  - 2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.
- H. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.

1. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.
2. Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
3. Do not install sleeves in beams, joists or columns except where shown or permitted by A/E. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the A/E, and require no structural changes, at no additional cost to the Government.
4. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.

I. Construction Tolerances:

1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They shall be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

**3.2 PLACING REINFORCEMENT:**

- A. General: Details of concrete reinforcement in accordance with ACI 318 unless otherwise shown.
- B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
  1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Use epoxy-coated tie wire with epoxy-coated reinforcing. Secure reinforcing

- bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that shall be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 318. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports shall not be permitted.
2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.
  3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.
- C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.
- D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.
  2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength ( $f_y$ ) for the bars. Welding conform to the requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
    - a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
    - b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
    - c. Contractor retained testing agency shall test a minimum of three splices, for compliance, locations selected by A/E.
  3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength ( $f_y$ ) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and

threaded sleeve. Exposed threads and swaging in the field not permitted.

- a. Initial qualification: In the presence of A/E, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory shall perform load test.
- b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory shall perform the load test.
- E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by A/E.
- F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that shall reduce bond.
- G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

### **3.3 VAPOR BARRIER:**

- A. Except where membrane waterproofing is required, interior concrete slab on grade shall be placed on a continuous vapor barrier.
  - 1. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
  - 2. Vapor barrier joints lapped 150 mm (6 inches) and sealed with compatible waterproof pressure-sensitive tape.
  - 3. Patch punctures and tears.

### **3.4 SLABS RECEIVING RESILIENT COVERING**

- A. Slab shall be allowed to cure for 6 weeks minimum prior to placing resilient covering. After curing, slab shall be tested by the Contractor for moisture in accordance with ASTM D4263 or ASTM F1869. Moisture content shall be less than 3 pounds per 1000 sf prior to placing covering.
- B. In lieu of curing for 6 weeks, Contractor has the option, at his own cost, to utilize the Moisture Vapor Emissions & Alkalinity Control Sealer as follows:
  - 1. Sealer is applied on the day of the concrete pour or as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade or above grade receiving resilient

flooring, such as, sheet vinyl, vinyl composition tile, rubber, wood flooring, epoxy coatings and overlays.

2. Manufacturer's representative shall be on the site the day of concrete pour to install or train its application and document. He shall return on every application thereafter to verify that proper procedures are followed.
  - a. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
  - b. Spray apply Sealer at the rate of 20 m<sup>2</sup> (200 square feet) per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
  - c. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply Sealer product to these areas as soon as weather condition permits.

### **3.5 CONSTRUCTION JOINTS:**

- A. Unless otherwise shown, location of construction joints to limit individual placement shall not exceed 24,000 mm (80 feet) in any horizontal direction, except slabs on grade which shall have construction joints shown. Allow 48 hours to elapse between pouring adjacent sections unless this requirement is waived by A/E.
- B. Locate construction joints in suspended floors near the quarter-point of spans for slabs, beams or girders, unless a beam intersects a girder at center, in which case joint in girder shall be offset a distance equal to twice width of beam. Provide keys and inclined dowels as shown. Provide longitudinal keys as shown.
- C. Place concrete for columns slowly and in one operation between joints. Install joints in concrete columns at underside of deepest beam or girder framing into column.
- D. Allow 2 hours to elapse after column is cast before concrete of supported beam, girder or slab is placed. Place girders, beams, grade beams, column capitals, brackets, and haunches at the same time as slab unless otherwise shown.

### **3.6 EXPANSION JOINTS AND CONTRACTION JOINTS:**

- A. Clean expansion joint surfaces before installing premolded filler and placing adjacent concrete.
- B. Provide contraction (control) joints in floor slabs as indicated on the contract drawings. Joints shall be either formed or saw cut, to the

indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

### **3.7 PLACING CONCRETE:**

#### **A. Preparation:**

1. Remove hardened concrete, wood chips, shavings and other debris from forms.
2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
3. Have forms and reinforcement inspected and approved by A/E before depositing concrete.
4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

#### **B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.**

##### **1. Preparing surface for applied topping:**

- a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
- b. Broom clean and keep base slab wet for at least four hours before topping is applied.
- c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

#### **C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which shall prevent segregation. Method of conveying concrete is subject to approval of A/E.**

#### **D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD hours.**

2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.



3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) WEATHER.
  1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
  2. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
  3. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints shall be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
  4. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts shall be a continuation of this concrete or concrete with a conventional slump.
  5. Concrete on metal deck:
    - a. Concrete on metal deck shall be minimum thickness shown. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
      - 1) The Contractor shall become familiar with deflection characteristics of structural frame to include proper amount of additional concrete due to beam/deck deflection.
- E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.

1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

**3.8 HOT WEATHER:**

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by A/E.

**3.9 COLD WEATHER:**

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by A/E.

**3.10 PROTECTION AND CURING:**

- A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods shall be used if approved by A/E.
  1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer's instructions. Apply immediately after finishing. Maximum coverage 10m<sup>2</sup>/L (400 square feet per gallon) on steel troweled surfaces and 7.5m<sup>2</sup>/L (300 square feet per gallon) on floated or broomed surfaces for the curing/sealing compound.
  2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and

overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.

3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

### **3.11 REMOVAL OF FORMS:**

- A. Remove in a manner to assure complete safety of structure after the following conditions have been met.
  1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members shall be removed after 24 hours, provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
  2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.
- B. Control Test: Use to determine if the concrete has attained sufficient strength and curing to permit removal of supporting forms. Cylinders required for control tests taken in accordance with ASTM C172, molded in accordance with ASTM C31, and tested in accordance with ASTM C39. Control cylinders cured and protected in the same manner as the structure they represent. Supporting forms or shoring not removed until strength of control test cylinders have attained at least 70 percent of minimum 28-day compressive strength specified. For post-tensioned systems supporting forms and shoring not removed until stressing is completed. Exercise care to assure that newly unsupported portions of structure are not subjected to heavy construction or material loading.

### **3.12 CONCRETE SURFACE PREPARATION:**

- A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.
- B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate

with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

- C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

### **3.13 CONCRETE FINISHES:**

A. Vertical and Overhead Surface Finishes:

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas shall not require additional finishing.
2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical means approved by A/E, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
  - a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
  - b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600  $\mu$ m (No. 30) sieve. Work grout into

surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.

- c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
  - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
4. Textured: Finish as specified. Maximum quantity of patched area 0.2 m<sup>2</sup> (2 square feet) in each 93 m<sup>2</sup> (1000 square feet) of textured surface.

B. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to A/E and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds shall be used to establish initial grade during strike-off, unless A/E determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.

4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
5. Immediately following screeding, and before any bleed water appears, use a 3000 mm (10 foot) wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying shall be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete shall sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys shall be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.
8. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 3000 mm (10 foot) highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall

- be smooth, free of trowel marks, and uniform in texture and appearance.
10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by A/E from sample panel.
11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
- a. Areas not specified otherwise in b. below:
    - 1) Slab on Grade:
      - a) Specified overall value  $F_F$  25/ $F_L$  20
      - b) Minimum local value  $F_F$  20/ $F_L$  15
    - 2) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
  - b. Areas that shall be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:
    - 1) Slab on grade:
      - a) Specified overall value  $FF$  36/ $FL$  20
      - b) Minimum local value  $FF$  24/ $FL$  15
    - 2) Level tolerance such that 80 percent of all points fall within a 20 mm (3/4 inch) envelope +10 mm, -10 mm (+3/8 inch, -3/8 inch) from the design elevation.
  - c. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
  - d. "Minimum local value" (MLV) describes the flatness or levelness below which repair or replacement is required. MLV is based on the results of an individual placement and applies to a minimum local area. Minimum local area boundaries shall not cross a construction joint or expansion joint. A minimum local area shall be bounded by construction and/or control joints, or by column lines and/or half-column lines, whichever is smaller.
12. Measurements
- a. Contractor retained testing laboratory shall take measurements as directed by A/E, to verify compliance with FF, FL, and other finish requirements. Measurements shall occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Make measurements before shores or forms are removed to

insure the "as-built" levelness is accurately assessed. Profile data for above characteristics shall be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by contractor retained testing laboratory.

- b. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses, finishing techniques, and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.
13. Acceptance/ Rejection:
- a. If individual slab section measures less than either of specified minimum local  $F_F/F_L$  numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries shall be set at construction and contraction (control) joints, and not smaller than one-half bay.
  - b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall  $F_F/F_L$  numbers, then whole slab shall be rejected and remedial measures shall be required.
14. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by A/E, until a slab finish constructed within specified tolerances is accepted.

#### **3.14 SURFACE TREATMENTS:**

- A. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Broadcast aggregate uniformly over concrete surface at rate of application of 8% per 1/10th  $m^2$  (7.5 percent per square foot) of area. Trowel concrete surface to smooth dense finish. After curing, rub treated surface with abrasive brick and water to slightly expose abrasive aggregate.

#### **3.17 RETAINING WALLS:**

- A. Use air-entrained concrete.



- B. Expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves installed and constructed as shown.
- C. Exposed surfaces finished to match adjacent concrete surfaces, new or existing.
- D. Place porous backfill as shown.

**3.18 PRECAST CONCRETE ITEMS:**

Precast concrete items, not specified elsewhere. Cast using 25 MPa (3000 psi) air-entrained concrete to shapes and dimensions shown. Finish to match corresponding adjacent concrete surfaces. Reinforce with steel for safe handling and erection.

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**SECTION 03 41 13**  
**PRECAST CONCRETE HOLLOW CORE PLANKS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies precast concrete roof and floor planks.

**1.2 MANUFACTURER'S QUALIFICATIONS**

Products of one manufacturer regularly engaged in making precast concrete planks of type specified.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Roof and floor plank framing layout, anchorage, and installation details.
- C. Manufacturers Certificates: Stating plank conforms to specification requirements.

**1.5 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A36/A36M-08.....Carbon Structural Steel
  - A185/A185M-07.....Steel Welded Wire, Reinforcement, Plain, for Concrete
  - A615/A615M-09.....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - A653/A653M-10.....Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
  - A996/A996M-09.....Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
  - C150/C150M-09.....Portland Cement
  - C494/C494M-10.....Chemical Admixtures for Concrete
  - C881/C881M-02.....Epoxy-Resin-Base Bonding Systems for Concrete

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Portland Cement: ASTM C150, Type I or III.

B. Reinforcing:

1. Welded wire Fabric: ASTM A185, galvanized size as required by plank manufacturers.
2. Bars: ASTM A615 or A996, deformed. Grade as required by plank manufacturer.

C. Chemical Admixtures: ASTM C494, Type as required by plank manufacturer.

D. Bonding Adhesive: ASTM C881.

E. Steel Clips:

1. ASTM A653.
2. Designed to anchor planks to steel framing.

F. Grout:

1. Cement Grout: One part portland cement and two parts fine sand.
2. Epoxy Grout: ASTM C881.

G. Steel Angles: ASTM A36.

**2.2 FABRICATION**

A. Planks:

1. Shapes: channel tongue and grooved flat plank tongue and grooved steel edge flat plank as shown.
2. Manufacture: Reinforced concrete, composed of regular weight mineral aggregate, portland cement and water, resulting in a unit having a minimum compressive strength of 27500 MPa // (4000 psi) for structural slabs.

B. Allowable Tolerances:

1. Thickness and depth 3 mm, (1/8 inch).
2. Length and width 6 mm (1/4 inch).
3. Camber or Sweep:
  - a. Plus or minus 6 mm (1/4-inch).
  - b. Variation in camber between adjacent and abutting members, 3 mm (1/8 inch).
4. Inserts, bolts and pipe sleeves: Deviation from location shown - not more than 10 mm (3/8 inch).

C. Exposed concrete surfaces natural cement color free of honeycomb, pit holes, or other defects.

D. Not acceptable: Warped, cracked or broken units.

E. Flat Plank:

1. Fabricate to thickness shown with tongue and groove edges at abutting edges, square edges at exposed roof ends and sides.
2. Reinforce with wire fabric in both top and bottom of slab.

F. Channel Plank:

1. Fabricate to thickness shown.
2. Provide plank with square edges and closed ends and sides at roof edges except where concealed in finished work.
3. Reinforce channel plank with wire fabric in the web section, and steel reinforcement bars in flanges.

G. Steel Clips:

1. Provide zinc-coated steel clips for plank to secure plank to framing.
2. For inclines exceeding 1 in 6 (2-inches per foot), provide an angle clip to support planks at lower purlin.

H. Structural Steel Headers:

1. ASTM A36.
2. Angle sizes as shown.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install slabs in accordance with manufacturer's instructions.
- B. Before erection of slabs, clean bearing surfaces free from dirt, mortar particles, and trash.
- C. Erect slabs to prevent chipping and cracking and to provide a level deck surface.
  1. Stagger end joints
  2. Locate end joints on centerline of support.
  3. After erection, fill joints on upper side of channel slabs with epoxy grout cement and joints on upper side of flat slabs with epoxy grout or portland cement grout.
  4. Finish grout joint flush.
- D. Erect steel edged tongue and groove plank so that planks have one structural support.
  1. Form tight and closed joints at sides and ends of slabs.
  2. Clip slabs to structural support.
- E. Do not make cutouts without approval of A/E.
  1. Form openings or carefully saw cut; do not punch openings.
  2. Locate openings less than 150 mm (6-inches) wide in sections of plank between reinforcing bars.
  3. Frame openings larger than 150 mm (6-inches) wide with structural steel headers.

**3.2 REPLACEMENT AND REPAIR**

- A. Replace broken, cracked, and warped plank, and planks exceeding allowable tolerances.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

B. Plank having defects, not affecting serviceability of deck, shall be  
repaired with epoxy grout if approved by A/E.

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**SECTION 03 41 33**  
**PRECAST STRUCTURAL PRETENSIONED CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section specifies precast prestressed concrete construction including design not shown, fabrication, erection, and other related items including bearing pads and anchorage.
- B. Precast prestressed concrete includes: single tees, double tees, hollow- core slabs, slabs, beams and spandrels, columns, I beams/box beams, tee/keystone joists, step units, and ribbed wall panels.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Sealants and Caulking: Section 07 92 00, JOINT SEALANTS.
- D. Architectural Precast Concrete Panels: Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
- E. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer Qualifications: Precast concrete manufacturing plant shall be certified by Prestressed Concrete Institute, Plant Certification Program, prior to start of production.
- B. In lieu of above qualification, contractor shall meet and pay for following requirements:
  - 1. Retain an independent testing or consulting firm approved by A/E.
  - 2. This firm shall inspect precast plant at two-week intervals during production and issue a report, certified by a registered Professional Engineer verifying that materials, methods, products and quality control meet all requirements of specifications and drawings. When report indicates to the contrary, A/E shall reject any or all products produced during period of noncompliance with above requirements.
- C. Precast concrete work shall be performed by firms that have demonstrated capability, subject to approval, to produce and erect type of work specified.

- D. Precast concrete manufacturer shall have on staff or shall retain a qualified registered Professional Structural Engineer to certify precast concrete conforms in all aspects to requirements of ACI 318.
- E. Erector Qualifications: Regularly engaged for at least 5 years in erection of precast structural concrete similar to requirements of this project.
- F. Requirements of Regulatory Agencies: Local codes plus applicable specifications, standards and codes are a part of these specifications.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
  - 1. Erection Drawings:
    - a. Plans and/or elevations locating and defining material furnished by manufacturer.
    - b. Sections and details showing connections, cast-in items and their relation to structure.
    - c. Description of all loose, cast-in and field hardware.
    - d. Field installed anchor location drawings.
    - e. Erection sequences and handling requirements.
    - f. Dead, live and other applicable loads used in design.
  - 2. Production drawings:
    - a. Elevation view of each member.
    - b. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, and essential embedded hardware.
    - c. Lifting and erection inserts.
    - d. Dimensions and finishes.
    - e. Prestress for strand and concrete strengths.
    - f. Estimated cambers.
    - g. Method of transportation.
- C. Product Design Criteria:
  - 1. Loadings for design:
    - a. Initial handling and erection stresses.
    - b. Dead and live loads as specified on contract drawings.
    - c. Other loads specified for member where they are applicable.
    - d. Deflection of precast members shall be limited as follows:
      - 1) Vertical Live Load -  $\text{Span}/360$
      - 2) Wind Load -  $0.0025 \times \text{Floor to Floor Height}$

- e. Design shall provide for thermal movements of completed structure.
- 2. Design calculations of products shall be performed by a registered Professional Engineer experienced in precast prestressed concrete design.
- 3. Design shall be in accordance with applicable codes, ACI 318 and the PCI Design Handbook.
- 4. Details for waterproof joints between precast members.
- D. Mix Designs: Submit proposed concrete mix designs and appropriate test data as specified in Part 2 of this section.
- E. Permissible Design Deviations:
  - 1. Design connections according to the conceptual details shown in the contract documents.
  - 2. Design deviations shall be permitted only after A/E's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
  - 3. Design deviations shall provide an installation equivalent to basic intent without incurring additional cost to the Government.
- F. Test Reports: Concrete and other material.

**1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Delivery and Handling:
  - 1. Lift and support precast concrete members during manufacturing, stockpiling, transporting and erection operations only at lifting or supporting points, or both, as shown on contract and shop drawings, and with approved lifting devices. Lifting devices shall have a minimum safety factor of 4. Exterior lifting hardware shall have a minimum safety factor of 5.
  - 2. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.
- B. Storage:
  - 1. Store all units off ground.
  - 2. Place stored units so that identification marks are discernible.
  - 3. Separate stacked members by battens across full width of each bearing point.
  - 4. Stack so that lifting devices are accessible and undamaged.
  - 5. Do not use upper members of stacked tier as storage area for shorter member or heavy equipment.



**1.6 APPLICABLE PUBLICATIONS:**

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

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

A36/A36M-08.....Standard Specifications for Carbon Structural Steel

A82-07.....Standard Specifications for Steel Wire, Plain, for Concrete Reinforcement

A123/A123M-09.....Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-09.....Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A185-07.....Standard Specifications for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement

A307-10.....Standard Specifications for Carbon Steel Bolts and Studs

A325-10.....Standard Specifications for Structural Bolts, Steel, Heat Treated

A416/A416M-10.....Standard Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A615/A615M-09.....Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A706/A706M-09.....Standard Specifications for Low-Allow Steel Deformed and Plain Bars for Concrete Reinforcement

A767/A767M-09.....Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

A775/A775M-03(R2008)....Standard Specifications for Epoxy-Coated Reinforcing Steel Bars

C33-03.....Standard Specifications for Concrete Aggregates

C88-05.....Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C150-07.....Standard Specifications for Portland Cement

C260-10.....Standard Specifications for Air-Entraining Admixtures for Concrete

- C330-05.....Standard Specifications for Lightweight  
Aggregates for Structural Concrete
- C494/C494M-10.....Standard Specification for Chemical Admixtures  
for Concrete
- C. American Concrete Institute (ACI):
  - 117-10.....Standard Specifications for Tolerances for  
Concrete Construction and Materials
  - 318-08.....Building Code Requirements for Structural  
Concrete and Commentary
- D. Prestressed Concrete Institute (PCI):
  - MNL-116-99.....Manual for Quality Control for Plants and  
Production of Precast Concrete Products Fourth  
Edition
  - MNL-127-99.....Erector's Manual: Standards and Guidelines for  
the Erection of Precast Concrete Products
- F. American Welding Society (AWS):
  - D1.1/D1.1M-10.....Structural Welding Code - Steel
  - D1.4-11.....Structural Welding Code - Reinforcing Steel

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. Portland Cement: ASTM C150, Type I or III.
- B. Aggregates: ASTM C33, Coarse and Fine.
- C. Lightweight Coarse Aggregate: ASTM C330, maximum size 19mm (3/4 inch), maximum 15 percent loss when tested in accordance with ASTM C88.
- D. Air-entraining Admixture: ASTM C260.
- E. Chemical Admixtures: ASTM C494.
- F. Mixing Water: Fresh, clean, and potable.
- G. Reinforcing Steel: ASTM A615M, Grade 400 MPa (ASTM A615, Grade 60), deformed.
- H. Weldable Reinforcing Steel: ASTM A706M, Grade 400 MPa, (ASTM A706 Grade 60).
- I. Galvanized Reinforcing Steel: ASTM A767M, Grade 400 MPa, (ASTM A767, Grade 60) Class II, hot-dipped galvanized after fabrication and bending.
- J. Epoxy-Coated Reinforcing Steel: ASTM A775M, Grade 400 MPa, (ASTM A775, Grade 60).
- K. Anchor Bolts: ASTM A307, low-carbon steel bolts, regular hexagon nuts and carbon steel washers, galvanized.

- L. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon bolts, and hardened washers complying with ASTM A325, galvanized.
- M. Welded Wire Fabric: ASTM A185.
- N. Wire Reinforcement: ASTM A82.
- O. Prestressing Steel: ASTM A416, Grade 250K or 270K, uncoated, 7-wire, stress-relieved strand.
- P. Anchors and Inserts: ASTM A36 structural steel plates and shapes, ASTM A153 or ASTM A123 hot dipped galvanized finish.
- Q. Non-metallic Shrinkage-Resistant Grout: Proprietary pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C-621. Minimum cube strength of 62 MPa (9000 psi) at 28 days when placed at flowable consistency.
- R. Bearing Pads:
  - 1. Elastomeric Pads: Vulcanized, chloroprene elastomeric compound, molded to size or cut from a molded sheet, 50-60 shore A durometer.
  - 2. Laminated Fabric-Rubber Pads: Preformed, unused synthetic fibers and new, unvulcanized rubber. Surface hardness of 70-80 shore A durometer.
  - 4. Sliding Pads: Manufactured assembly with Polyetrafluoroethylene (PTFE) surface, with glass fiber reinforcing as required for service load bearing stress. Combine with elastomeric base where required for full contact bearing.
  - 5. Plastic: Multi-monomer plastic strips, non-leaching and able to support construction loads with no visible overall expansion.
- S. Welded Studs: AWS D1.1.
- T. Welded Rebar: AWS D1.4.
- U. Caulking and Sealants: Specified under Section 07 92 00, JOINT SEALANTS.
- V. Accessories: Provide clips, hangers, and other accessories required for installation of project units and for support of subsequent construction or finishes.

## **2.2 CONCRETE MIXES:**

- A. Normal-Weight Concrete:
  - 1. Compressive Strength: 35 MPa (5000 psi) minimum at 28 days.
  - 2. Release Strength: 25 MPa (3500 psi) minimum at transfer of prestress.
- B. Lightweight Concrete:
  - 1. Compressive Strength: 35 MPa (5000 psi) minimum at 28 days.
  - 2. Release Strength: 25 MPa (3500 psi) minimum at transfer of prestress.

3. Air-Dry Density: Not less than 1440 kg per cubic meter (90 pounds per cubic foot) nor more than 1840 kg per cubic meter (115 pounds per cubic foot).

4. Drying Shrinkage (ASTM C330): Maximum 0.035 percent at 28 days.

C. Do not use calcium chloride, chloride ions or other salts.

**2.3 FABRICATION:**

A. Fabrication Procedures: PCI MNL-116.

B. Fabrication Tolerances: PC MNL-116 and ACI 117 for reinforcing steel placement.

C. Finishes:

1. Standard Underside: Resulting from casting against approved forms using good industry practice in cleaning of forms, design of concrete mix, placing and curing. Small surface holes caused by air bubbles, normal color variations, normal form joint marks, and minor chips and spalls shall be tolerated, but no major or unsightly imperfections, honeycomb, or other defects shall be permitted.

2. Standard Top: Result of vibrating screed and additional hand finishing at projections. Normal color variations, minor indentations, minor chips and spalls shall be permitted. No major imperfections, honeycomb, or defects shall be permitted.

3. Exposed Vertical Ends: Strands shall be recessed and the ends of member shall receive sacked finish.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations. For exposed-to-view concrete surfaces, shear legs of supports are in contact with forms, provide supports with legs that are plastic protected or stainless steel protected.

E. Use epoxy coated reinforcing whenever concrete cover is less than 50 mm (2 inches) for top surfaces exposed to deicing salts, brackish water or salt spray, such as in parking garage decks.

F. Openings: Primarily on thin sections, factory fabricate those openings 250 mm (10 inches) round or square or larger as shown on drawings. Locate and field drill or cut other openings where no contact is made with prestressing or reinforcing steel after precast prestressed products have been erected. Opening shall be approved by A/E before drilling or cutting.

G. Patching: Patching shall be acceptable providing structural adequacy of product and appearance are not impaired.

- H. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be removed and replaced with precast concrete units that meet the requirements of this section. Contractor is also responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.
- I. Fasteners: Cast in galvanized hardware such structural inserts, bolts and plates as required by drawings.

### **PART 3 - EXECUTION**

#### **3.1 ERECTION:**

- A. Site Access: Provide suitable access to building, proper drainage, and firm, level bearing for hauling and erection equipment to operate under their own power.
- B. Preparation:
1. Provide true, level surfaces on field placed bearing walls and other field placed supporting members.
  2. Place and accurate align anchor bolts, plates or dowels in column footings, grade beams and other field placed support members.
  3. Shoring required for composite beams and slab shall have a minimum load factor of 1.5 times (dead load plus construction loads).
- C. Installation: Installation of precast prestressed concrete shall be performed by the fabricator or a competent erector in accordance with PCI MNL-127. Lift members with suitable lifting devices at points provided by manufacturer. Temporary shoring and bracing, when necessary, shall comply with manufacturer's recommendations.
- D. Alignment: Align and level precast members as required by the approved shop drawings. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to A/E. Individual pieces are considered plumb, level, and aligned if the error does not exceed 1:500 excluding structural deformation caused by loads.

#### **3.2 FIELD WELDING:**

- A. Field welding is to be done by qualified welders using equipment and materials compatible to base material in accordance with AWS D1.1 and AWS D1.4.
- B. Field coat with galvanized paint specified under Section 09 91 00, PAINTING all welded connections.

**3.3 ATTACHMENTS:**

Do not use powder-actuated or air-driven fasteners or drill the precast units for surface attachment of accessory items unless otherwise accepted by the precast manufacturer.

**3.4 INSPECTION AND ACCEPTANCE:**

Final inspection and acceptance of erected precast prestressed concrete shall be made by A/E to verify conformance with drawings and specifications.

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**SECTION 03 45 00**  
**PRECAST ARCHITECTURAL CONCRETE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section includes the performance criteria, materials, production, and erection of architectural precast concrete cladding and load bearing units. The work performed under this section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the architectural precast concrete work shown on the contract drawings.

**1.2 RELATED WORK**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Mortar: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING
- E. Masonry Facing: Section 04 20 00, UNIT MASONRY.
- H. Sealants: Section 07 92 00, JOINT SEALANTS.
- I. Size, type and color of aggregate for exposed aggregate finish and matrix color: Section 09 06 00, SCHEDULE FOR FINISHES.
- K. Repair of abraded galvanized and painted surfaces: Section 09 91 00, PAINTING.

**1.3 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm that complies with PCI MNL 117 and the following requirements and is experienced in producing units similar to those indicated for this Project and with a record of successful in-service performance:
  - 1. Assumes responsibility for engineering units to comply with performance requirements. A Comprehensive Engineering Analysis shall be performed by a qualified professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.
  - 2. Participates in PCI's Plant Certification program at the time of bidding and is designated a PCI-certified plant for Group A, Category A1- Architectural Cladding and Load Bearing Units.
  - 3. Has sufficient production capacity to produce required units without delaying the work.

B. Erector Qualifications:

1. A precast concrete erector Qualified by the Precast/Prestressed Concrete Institute (PCI) prior to beginning work at the project site. Submit a current Certificate of Compliance furnished by PCI designating qualification in Category A (Architectural Systems) for non-load-bearing members Category S2 (Complex Structural Systems) for load-bearing members.
2. An erector with a minimum of 2 years of experience who has completed architectural precast concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117.

D. Sample Panels: After sample approval and before fabricating units, produce a minimum of two sample panels a minimum of (.75 sq. m) 8 sq. ft. in size for review by A/E. Incorporate full scale details of architectural features, finishes, textures, and transitions in the sample panels.

Approved sample panel may be used for mockup and range sample.

1. Locate panels where indicated or, if not indicated, as directed by A/E (Contracting Officer's Representative).
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After acceptance of repair technique, maintain one sample panel at the manufacturer's plant and one at the project site in an undisturbed condition as a standard for judging the completed work.
4. When back face of precast concrete unit is to be exposed, show samples of the workmanship, color, and texture of the backup concrete as well as the facing.
5. Demolish and remove sample panels only when directed.

E. Range Samples: After sample panel approval and before production of units, produce a minimum of three samples, approximately 1 sq. ft. in size and 2" thick, representing anticipated range of color and texture on project's units. Following range sample acceptance by the A/E, maintain samples at the manufacturer's plant as color and texture acceptability reference.

F. Mockups: After sample approval but before production of units, construct full sized mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mockup to be representative of the finished work in all respects including



glass, aluminum framing, sealants and architectural precast concrete complete with all anchors, connections, imbed bricks, flashings, and joint fillers as accepted on the final shop drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by A/E.
  2. Notify A/E in advance of dates and times when mockups will be constructed.
  3. Obtain A/E's approval of mockups before starting fabrication.
  4. Mockup may be incorporated into finished work when approved by A/E.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01, GENERAL REQUIREMENTS.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide units and connections capable of withstanding: the design criteria specified on the drawings, self weights and weights of materials supported or attached, for the conditions indicated, specifically in meeting the required vehicle impact loads where panels are to be installed without cable barriers.
1. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, applicable to types of units indicated.
  2. Limit deflection of precast members as follows:  
Vertical live load -  $\text{Span} / 360$ .  
Wind load - Floor to floor height times 0.0025.
  3. Design for handling, transportation and erection stresses.
  4. Parking Garage Vehicular Impact Loads: Design spandrel units acting as vehicular barrier for passenger cars to resist a single load of 26.7 kN (6,000 lbs) service load and 44.5 kN (10,000 lbs) ultimate load applied horizontally in any direction, with anchorages or attachments capable of transferring this load to the structure. For design of these units, assume the load to act at a height of 460 mm (18 inches) above the floor or ramp surface on an area not to exceed 0.09 sq. m. (1 sq. ft.).
- B. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live load deflection, shrinkage and creep of primary building structure, and other building movements.
- C. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 27 deg C (80 deg F). Use other values, greater or smaller, whenever justified by climatic conditions at the project site as approved by A/E.

### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years or period of warranty, whichever is greater.
- B. Design Mixes: For each concrete mix along with compressive strength and water-absorption tests.
- C. Shop (Erection) Drawings: Detail fabrication and installation of units.
  - 1. Indicate member locations with distinctive marks that match marks placed on the panels. Provide plans, elevations, dimensions, corner details, shapes, cross sections and relationships to adjacent materials.
  - 2. Indicate aesthetic intent including joints, reveals, and extent and location of each surface finish.
  - 3. Indicate separate face and backup mix locations, and thicknesses. Indicate locations, extent and treatment of dry joints if two-stage casting is proposed.
  - 4. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, and connections.
  - 5. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
  - 6. Indicate sequence of erection.
  - 7. Indicate locations and details of facing materials, anchors, and joint widths.
  - 8. Design Modifications:
    - If design modifications are necessary to meet the performance requirements and field conditions, submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units when modifying details or materials and maintain the general design concept.
- D. Comprehensive Engineering Analysis: Provide calculations signed and sealed by the qualified professional engineer responsible for the product design. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate design criteria and loads. Indicate the location, type, magnitude and direction of all imposed loadings from the precast system to the building structural frame.
- E. Samples: As described under Section 1.3 QUALITY ASSURANCE, showing the full range of color and texture expected. Supply sketch of each corner or special shape with dimensions. Supply sample showing color and texture of joint treatment.

- F. Welding Certificates: Copies of certificates for welding procedure specifications (WPS) and personnel.
- G. Qualification Data for fabricator and professional engineer: List of completed projects with project names and addresses, names, email, phone number, and addresses of CORs/Owner's Representative and owners, and other information specified.
- I. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
  - 1. Concrete strengths and mix designs.
- J. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.
  - 1. Concrete materials.
  - 2. Reinforcing materials and prestressing tendons.
  - 3. Admixtures.
  - 4. Bearing pads.
  - 5. Structural-steel shapes and hollow structural sections.
  - 6. Insulation
  - 7. Facing units.
  - 8. Anchors.

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

- A. Product handling requirements of PCI MNL 117 shall be followed at the plant and project site.
- B. Deliver all units to the project site in such quantities and at such times to assure compliance with the agreed project schedule and proper setting sequence so as to limit unloading units temporarily on the ground.
- C. Lift and support units only at designated points shown on the Shop Drawings.
- D. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

#### **1.7 WARRANTY**

- A. Warranty of precast concrete work, including anchorage, joint treatment and related components to be free from defects in materials and workmanship, including cracking and spalling.
- B. After erection, completed work will be weathertight, subject to terms of Article "Warranty of Construction" FAR clause 52.246-21.

## 1.8 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

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

A27/A27M-10.....Steel Castings, Carbon, for General Application  
A36/A36M-08.....Carbon Structural Steel  
A47/A47M-99(R2009)...Ferritic Malleable Iron Castings  
A82-07.....Steel Wire, Plain, for Concrete Reinforcement  
A108-07.....Steel Bar, Carbon and Alloy, Cold-Finished  
A123/A123M-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and  
Steel Products  
A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel Hardware  
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel  
Plate, Sheet, and Strip  
A184/A184M-06.....Fabricated Deformed Steel Bar Mats for Concrete  
Reinforcement  
A185-07.....Steel Welded Wire Fabric, Plain, for Concrete  
Reinforcement  
A276-10.....Stainless Steel Bars and Shapes  
A283/A283M-03(R2007).Low and Intermediate Tensile Strength Carbon Steel  
Plates  
A307-10.....Carbon Steel Bolts and Studs, 60 000 PSI Tensile  
Strength  
A325/A325M-10.....Structural Bolts, Steel, Heat Treated, 120/105 ksi  
Minimum Tensile Strength  
A416/A416M-10.....Steel strand, Uncoated Seven-Wire for Prestressed  
Concrete  
A490/A490M-10.....Structural Bolts, Alloy Steel, Heat Treated, 150  
ksi Minimum Tensile Strength  
A496-07.....Steel Wire, Deformed, for Concrete Reinforcement  
A497-07.....Steel Welded Wire Reinforcement, Deformed, for  
Concrete  
A500-10.....Cold-Formed Welded and Seamless Carbon Steel  
Structural Tubing in Rounds and Shapes  
A563/A563M-07.....Carbon and Alloy Steel Nuts  
A572/A572M-07.....High-Strength Low-Alloy Columbium-Vanadium  
Structural Steel  
A615/A615M-09.....Deformed and Plain Billet-Steel Bars for Concrete  
Reinforcement

A666-10.....Annealed or Cold-Worked Austenitic Stainless Steel  
Sheet, Strip, Plate, and Flat Bar  
A675/A675M-03(R2009).Steel Bars, Carbon, Hot-Wrought, Special Quality,  
Mechanical Properties  
A706/A706M-09.....Low-Alloy Steel Deformed and Plain Bars for  
Concrete Reinforcement  
A767/A767M-09.....Zinc-Coated (Galvanized) Steel Bars for Concrete  
Reinforcement  
A775/A775M-07.....Epoxy-Coated Steel Reinforcing Bars  
A780-09.....Repair of Damaged and Uncoated Areas of Hot-Dip  
Galvanized Coatings  
A884/A884M-06.....Epoxy-Coated Steel Wire and Welded Wire Fabric for  
Reinforcement  
A934/A934M-07.....Epoxy-Coated Prefabricated Steel Reinforcing Bars  
B227-10.....Hard-Drawn Copper-Clad Steel Wire  
B633-07.....Electrodeposited Coatings of Zinc on Iron and  
Steel  
C33-11.....Concrete Aggregates  
C40-04.....Organic Impurities in Fine Aggregate for Concrete  
C150-09.....Portland Cement  
C260-10.....Air-Entraining Admixtures for Concrete  
C330-09.....Lightweight Aggregates for Structural Concrete  
C373-88(R2006).....Test Method for Water Absorption, Bulk Density,  
Apparent Porosity, and Apparent Specific Gravity  
of Fired Whiteware Products  
C494/C494M-10.....Chemical Admixtures for Concrete  
C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan  
for Use as a Mineral Admixture in Concrete  
C881/C881M-10.....for Epoxy-Resin-Base Bonding Systems for Concrete  
C979-10.....Pigments for Integrally Colored Concrete  
C989-10.....Ground Granulated Blast-Furnace Slag for Use in  
Concrete and Mortars  
C1017/C1017M-07.....Chemical Admixtures for Use in Producing Flowing  
Concrete  
C1107-08.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)  
C1218/C1218M-99(R2008)Test Method for Water-Soluble Chloride in Mortar  
and Concrete  
C1240-10.....Silica Fume Used in Cementitious Mixtures  
D412-06.....Test Methods for Vulcanized Rubber and  
Thermoplastic Elastomers—Tension

- D2240-05(R2010).....Test Method for Rubber Property-Durometer Hardness  
F436/F436M-10.....Hardened Steel Washers  
F568M-07.....Carbon and Alloy Steel Externally Threaded Metric  
Fasteners  
F593-02(R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs  
F844-07.....Washers, Steel, Plain (Flat), Unhardened for  
General Use
- C. American Concrete Institute (ACI):  
ACI 211.1-91(R2009)..Selecting Proportions for Normal, Heavyweight and  
Mass Concrete (Reapproved 2002)  
ACI 318-11.....Building Code Requirements for Structural Concrete
- D. American Association of State Highway and Transportation Officials  
AASHTO LFRD-2010.....LRFD Bridge Design Specifications, U.S., 3rd  
Edition  
AASHTO M251-06.....Elastomeric Bearings
- E. Precast/Prestressed Concrete Institute (PCI):  
MNL-117-96.....Quality Control for Plants and Production of  
Architectural Precast Concrete Products  
MNL-120-04.....Design Handbook - Precast and Prestressed Concrete  
MNL-124-08.....Design for Fire Resistance of Precast Prestressed  
Concrete.  
MNL-127-99.....Erector's Manual - Standards and Guidelines for  
the Erection of Precast Concrete Products  
MNL-135-00.....Tolerance Manual for Precast and Prestressed  
Concrete Construction  
TR-6-03.....Interim Guidelines for the Use of Self-  
Consolidating Concrete
- F. Military Specifications (MIL. Spec):  
MIL-C882E-89.....Cloth, Duck, Cotton or Cotton-Polyester Blend  
Synthetic Rubber, Impregnated, and Laminated, Oil  
Resistant.
- G. Structural Steel Painting Council (SSPC):  
SSPC-Paint 20 (2002).Zinc-Rich Primers (Type I, Inorganic, and Type II,  
Organic).

## **PART 2 - PRODUCTS**

### **2.1 MOLD MATERIALS**

- A. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and  
buckle free, that will provide continuous and true precast concrete

surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes:

1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration to produce the indicated shapes. Provide solid backing and form supports to ensure that form liners remain in place during concrete placement. Use with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

## **2.2 REINFORCING MATERIALS**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Weldable Reinforcing Bars: ASTM A706/A706M, deformed.
  1. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized and chromate wash treated after fabrication and bending.
  2. Steel Bar Mats: ASTM A184/A184M, assembled with clips.
    - a. Plain-Steel Welded Wire Reinforcement: ASTM A185, fabricated from galvanized and chromate wash treated steel wire into flat sheets.
    - b. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.
- D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## **2.3 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150, Type I or III.
  1. For surfaces exposed to view in finished structure, use white or gray, as indicated on the finish schedule, same type, brand, and mill source throughout the precast concrete production.
  2. Standard gray Portland cement may be used for non-exposed backup concrete.
- B. Supplementary Cementitious Materials for unexposed surfaces (backup concrete) only.
  1. Fly Ash Admixture: ASTM C618, Class C or F with maximum loss on ignition of 3 percent.
  2. Metakaolin Admixture: ASTM C618, Class N.

3. Silica Fume Admixture: ASTM C1240 with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33, with coarse aggregates complying with Class 5S. Provide and stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for entire project.
  1. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected PCI design guide finish and selected finish sample.
    - a. Gradation: Uniformly graded.
    - b. Hard durable quartz, limestone, or feldspar aggregate carefully graded from coarse to fine in proportions required to match selected PCI design guide finish and selected finish sample.
  2. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by A/E.
    - a. Test sand for color value in accordance with ASTM C40. Sand producing darker than specified color standard is unacceptable.
    - b. Clean washed white sand.
    - c. Hard durable quartz, limestone, or feldspar aggregate carefully graded from coarse to fine in proportions required to match selected PCI design guide finish and selected finish sample.
- D. Lightweight Coarse Aggregate: Except as modified by PCI MNL 117, ASTM C 330, with absorption less than 11 percent and free from expanded clay.
- E. Unexposed Surface (Backup) Concrete Aggregates: ASTM C33.
- F. Admixtures: Admixtures containing calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture are not permitted.
  1. Coloring Admixture: ASTM C979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable and non-fading.
  2. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
  3. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  4. Retarding Admixture: ASTM C494/C494M, Type B.
  5. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
  6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  7. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
  8. Plasticizing Admixture for Flowable Concrete: ASTM C1017/C1017M.



- G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

#### **2.4 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A36/A36M except silicon (Si) content in the range of 0 to 0.03% or 0.15 to 0.25% for materials to be galvanized. Steel with chemistry conforming to the formula  $Si + 2.5P \leq 0.09$  is also acceptable.
- B. Carbon-Steel Headed Studs: ASTM A108, Grades 1018 through 1020, cold finished and bearing the minimum mechanical properties for studs as indicated under PCI MNL 117, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.
- C. Carbon-Steel Plate: ASTM A283/A283M.
- D. Malleable Iron Castings: ASTM A47/A47M. Grade 32510.
- E. Carbon-Steel Castings: ASTM A27/A27M, Grade U-60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M except silicon (Si) content in the range of 0 to 0.03% or 0.15 to 0.25% for materials to be galvanized. Steel with chemistry conforming to the formula  $Si + 2.5P \leq 0.09$  is also acceptable.
- G. Carbon-Steel Structural Tubing: ASTM A500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706/A706M.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A (ASTM F568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A563/A563M, Grade A); and flat, unhardened steel washers (ASTM F844).
- K. High-Strength Bolts and Nuts: ASTM A325/A325M or ASTM A490/A490M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, (ASTM A563/A563M) and hardened carbon-steel washers (ASTM F436/F436M).
- L. Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M, after fabrication, or ASTM A153/A153M, as applicable.
1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- M. Welding Electrodes: Comply with AWS standards.

#### **2.5 STAINLESS-STEEL CONNECTION MATERIALS**

- A. Stainless-Steel Plate: ASTM A666, Type 304, of grade suitable for application.

- B. Stainless-Steel Bolts and Studs: ASTM F593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless steel washers. Lubricate threaded parts of stainless steel bolts with an anti-seize thread lubricant during assembly.
- C. Stainless-Steel Headed Studs: ASTM A276 and bearing the minimum mechanical properties for studs as indicated under PCI MNL 117, Table 3.2.3.

## **2.6 BEARING PADS AND OTHER ACCESSORIES**

- A. Provide bearing pads for units as follows:
  - 1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D2240, minimum tensile strength 15.5 MPa (2250 psi) per ASTM D412.
  - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 20.7 MPa (3000 psi) with no cracking, splitting or delaminating in the internal portions of the pad. Test one specimen for each 200 pads used in the project.
  - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer according to ASTM D2240. Conforming to Division II, Section 18.10.2 of AASHTO LFRD, or MIL-C-882E.
  - 4. Frictionless Pads: Tetrafluoroethylene (teflon), glass-fiber reinforced, bonded to stainless or mild-steel plates, of type required for in-service stress.
  - 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.
- B. Reglets: Stainless steel, ASTM A167, Type 302 felt or fiber filled or cover face opening of slots.
- C. Vents and Weeps: Polyvinyl chloride plastic tubing, 9.5 mm (3/8-inch) inside diameter.
- D. Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install units.

## **2.7 GROUT MATERIALS**

- A. Sand-Cement Grout: Portland Cement, ASTM C150, Type I, and clean, natural sand, ASTM C144, or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement,

shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, Grade A for drypack and Grades B and C for flowable grout and of a consistency suitable for application within a 30-minute working time.

- C. Epoxy-resin grout: Two-component mineral-filled epoxy-resin: ASTM C881 of type, grade, and class to suit requirements.

## **2.8 FACING UNITS AND ACCESSORIES**

- A. Refer to the related specification for facing units and facing accessories.
- B. Epoxy Anchor Hole Filler: ASTM C881, 100 percent solids, sand-filled non-shrinking, non-staining of type, class, and grade to suit application.

## **2.9 CONCRETE MIXES**

- A. Prepare design mixes to match A/E's sample for each type of concrete required.
1. Limit use of fly ash and granulated blast-furnace slag to 40 percent replacement of Portland cement by weight; metakaolin and silica fume to 10 percent of Portland cement by weight.
- B. Design mixes shall be prepared by a qualified independent testing agency or by qualified precast plant personnel at fabricator's option.
- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- D. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
  2. Maximum Water-Cementitious Materials Ratio: 0.45.
  3. Release Strength at Transfer of Prestress: 24.1 MPa (3500 psi).
- E. Lightweight Concrete Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
  2. Unit Weight: Calculated equilibrium unit weight of 1842 kg/cu.m (115 lb/cu.ft.), plus or minus 48 kg/cu.m (3 lb/cu.ft.), according to ASTM C567.
- F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- H. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

#### **2.11 MOLD FABRICATION**

- A. Molds: Accurately construct and maintain molds, mortar tight, within fabrication tolerances and of sufficient strength to withstand pressures due to concrete-placement and vibration operations and temperature changes and for prestressing and detensioning operations.
  - 1. Form joints are not permitted on faces exposed to view in the finished work.
  - 2. Edge and Corner Treatment: Uniformly chamfered.
  - 3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during placing of concrete.
  - 4. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

#### **2.12 SETTING FACING UNITS**

- A. Place form liner templates accurately to provide grid for brick facings. Provide solid backing and supports to maintain stability of liners while placing bricks and during placing of concrete.
- B. Securely place brick units face down into form liner pockets and place precast concrete backing mix.
  - 1a. For Base Bid: Provide brick units inserts continuous to edge of panel and wrap exposed corners. Brick shall be continuous pattern on three sides of precast concrete unit.
  - 1b. For Deduct Alternate #6: Provide brick units inserts held back 120 mm (5") from the corners of panels or walls. Hold inset brick 60 mm (2 1/2") from joints or edge between panels within the same wall. Brick shall be continuous pattern on the Primary Control Surface of Panel/Precast concrete unit.
- C. Clean faces and joints of brick facing.

#### **2.13 FABRICATION**

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of

loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

Weld headed studs and deformed bar anchors used for anchorage.

- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in units as indicated.
- D. Cast-in openings larger than 250 mm (10 inches) in any dimension. Do not drill or cut openings or reinforcing without approval of A/E.
- E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabrication, placing, and supporting reinforcement.
  - 1. Place reinforcing steel and prestressing strand to maintain at least 19 mm (3/4 inch) . Increase cover requirements for reinforcing steel to 38 mm (1-1/2 inches) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.
  - 2. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.
  - 1. At the fabricator's option either of the following mix design/casting techniques may be used:
    - a. A single design mix throughout the entire thickness of panel.
    - b. Design mixes for facing and backup; using cement and aggregates for each type as indicated, for consecutive placement in the mold. Use cement and aggregate specified for facing mix, use cement and aggregate for backup mix complying with criteria specified as selected by the fabricator.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117.
  - 1. Place backup concrete to ensure bond with face mix concrete.
  - 2. Place self-consolidating concrete without vibration in accordance with PCI TR-6.
- H. Identify pickup points of units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings.

Imprint or permanently mark casting date on each unit on a surface that will not show in finished structure.

- I. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam.
- J. Repair damaged units to meet acceptability requirements of PCI MNL 117 and the A/E.

#### **2.14 FABRICATION TOLERANCES**

- A. Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
  - 1. Additional Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
    - a. Location of Bearing Surface from End of Member: Plus or Minus 6 mm (1/4 inch).
    - b. Position of Sleeve: Plus or Minus 13 mm (1/2 inch).
    - c. Location of Window Washer Track or Buttons: Plus or Minus 3 mm (1/8 inch).
- B. Fabricate architectural trim units such as sills, lintels, coping, cornices, quoins, medallions, bollards, benches, planters, and pavers, with tolerances meeting PCI MNL 135.
- C. Brick-Faced Architectural Precast Concrete Units.
  - 1. Alignment of mortar joints:
    - a. Jog in Alignment: 3 mm (1/8 inch) max.
    - b. Alignment with Panel Centerline: Plus or Minus 3 mm (1/8 inch).
  - 2. Variation in Width of Exposed Mortar Joints: Plus or Minus 6 mm (1/4 inch).
  - 3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus 1.5 mm (1/16 inch); Minus 6 mm (1/4 inch) depth of form liner joint.
  - 4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus 6 mm (1/4 inch); Minus 3 mm (1/8 inch).
  - 5a. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus 1.5 mm (1/16 inch); Minus 6 mm (1/4 inch) depth of form liner joint.
  - 5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus 1.5 mm (1/16 inch); Minus 6 mm (1/4 inch) depth of form liner joint.

- 6a. Base Bid: Provide brick units inserts continuous to edge of panel and wrap exposed corners. Brick shall be continuous pattern on three sides of precast concrete unit.
- 6b. Deduct Alternate #6: Provide brick units inserts held back 120 mm (5") from the corners of panels or walls. Hold inset brick 60 mm (2 1/2") from joints or edge between panels within the same wall. Brick shall be continuous pattern on the Primary Control Surface of Panel/Precast concrete unit.

## **2.15 FINISHES**

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight and sharp. Finish exposed-face surfaces of units to match approved design reference sample, and mockups and as follows:
  - 1. PCI's "Architectural Precast Concrete -Color and Texture Selection Guide," with indicated guide finishes selected and highlighted..
  - 2. Bushhammer Finish: Use power and hand tools to remove matrix and fracture coarse aggregates.
  - 3. Exposed Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
  - 4. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
- B. Finish exposed top, bottom, back, and side surfaces of units to match face-surface finish.
- C. Finish unexposed surfaces of units by float finish.

## **2.16 SOURCE QUALITY CONTROL**

- A. Quality-Control Testing: Test and inspect precast concrete according to Section 01 45 29, TESTING LABORATORY SERVICES and PCI MNL 117 requirements respectively. If using self-consolidating concrete also test and inspect according to PCI TR-6.
- B. Testing: If there is evidence that the concrete strength of precast concrete units may be deficient, Precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to PCI MNL 117:
  - 1. Test results will be made in writing on the same day that tests are performed, with copies to A/E, Contractor, and precast concrete fabricator. Test reports will include the information required in Section TESTING LABORATORY SERVICES and the following:

- a. Identification mark and type of precast concrete units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- C. Defective or Damaged Work: Units that do not comply with acceptability requirements, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cored units may be repaired, if repaired units match the visual mock-up. The A/E reserves the right to reject any unit if it does not match the accepted samples and visual mock-up. Replace unacceptable units with precast concrete units that comply with requirements.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Deliver anchorage devices that are embedded in or attached to the building structural frame or foundation before start of such work. Provide locations, setting diagrams, and templates for the proper installation of each anchorage device.
- B. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install units until supporting structure is structurally ready to receive loads from precast.

#### **3.2 ERECTION**

- A. Erect level, plumb and square within the specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
  - 1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack-weld steel shims to each other to prevent shims from separating.
  - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 3. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.



4. Unless otherwise shown provide for uniform joint widths of 19mm (3/4 inch).
- B. Connect units in position by bolting, welding, grouting, or as otherwise indicated on approved Erection Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
  1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.
  2. Welding: Comply with applicable requirements for welding.
    - a. Protect units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
    - b. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
    - c. Clean weld affected metal surfaces and apply a minimum 100 µm (0.004 inch) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780.
    - d. Visually inspect all welds critical to precast connections. Visually check all welds for completion and remove, reweld or repair all defective welds.
  3. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.
    - a. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connection apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
  4. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- C. Attachments: Upon approval of A/E, precast pre-stressed products may be drilled or "shot" for fasteners or small openings. Provided reinforcing or pre-stressing steel is not damaged or cut.
  1. Should spalling occur, repair according to this specification section.
- D. Setting: Where shown, fill joints with cement mortar specified in Section 04 05 13, MASONRY MORTARING.

1. Clean surfaces forming beds and other joints for precast concrete panels of dust, dirt, and other foreign matter, and wet thoroughly to prevent suction before precast concrete elements are set.
  2. Set precast element level and true to line with uniform joints filled completely with mortar.  
Rake out joints 25 mm (1-inch) deep for pointing or sealants.  
Joints required to have only sealant: Kept free of mortar for full depth.
  3. Keep exposed faces of precast concrete elements free of mortar.
  4. Remove wedges, spacers, or other appliances which are likely to cause staining from joints.
  5. Where parging is shown, parge back of elements solid with mortar.  
Apply parging without skips or holidays.
- F. Pointing: Wash and brush clean, leaving joints free from loose mortar, dust and other foreign material.
1. Carefully point with a slightly concave joint.
  2. Mortar for pointing as specified in Section 04 05 13, MASONRY MORTARING  
Use same material and color sand used in fabrication of precast concrete elements when specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- G. Sealing of Joints: Where shown and where required to make work watertight: clean, dry and seal joints between precast concrete elements and between precast elements and adjoining materials as specified in Section 07 92 00, JOINT SEALANTS.
- H. Mortaring at welded connections: provide masonry grout matching existing concrete to cover all welded connections for precast to concrete structure in accordance with Section 04 05 13, MASONRY MORTARING.

### **3.3 ERECTION TOLERANCES**

- A. Erect units level, plumb, square, true, and in alignment without exceeding the erection tolerances of PCI MNL 117, Appendix I.

### **3.4 FIELD QUALITY CONTROL**

- A. Refer to Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Testing agency will report test results promptly and in writing to Contractor and A/E.
- C. Repair or remove and replace work that does not comply with specified requirements.

- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

### **3.5 REPAIRS**

- A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 6 m (20 feet).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.
- D. Remove and replace damaged units when repairs do not meet requirements.

### **3.6 CLEANING**

- A. Clean all surfaces of precast concrete to be exposed to view, as necessary, prior to shipping.
- B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

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**SECTION 04 05 13**  
**MASONRY MORTARING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section specifies mortar materials and mixes.

**1.2 RELATED WORK:**

- A. Mortar used in Section:
  - 1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
  - 2. Section 04 05 16, MASONRY GROUTING.
  - 3. Section 04 20 00, UNIT MASONRY.
- B. Mortar Color: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 TESTING LABORATORY-CONTRACTOR RETAINED**

- A. Engage a commercial testing laboratory approved by A/E to perform tests specified below.
- B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to A/E.

**1.4 TESTS**

- A. Test mortar and materials specified.
- B. Certified test reports.
- C. Identify materials by type, brand name and manufacturer or by origin.
- D. Do not use materials until laboratory test reports are approved by A/E.
- E. After tests have been made and materials approved, do not change without additional test and approval of A/E.
- F. Testing:
  - 1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
  - 2. Mortar:
    - a. Test for compressive strength and water retention; ASTM C270.
    - b. Mortar compressive strengths 28 days as follows:
      - Type M: Minimum 17230 kPa (2500 psi) at 28 days.
      - Type S: Minimum 12400 kPa (1800 psi) at 28 days.
      - Type N: Minimum 5170 kPa (750 psi) at 28 days.
  - 3. Cement:
    - a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
    - b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.

4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

- G. During progress of work, testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES, takes and tests samples as specified in that section. Testing procedures and test methods in ASTM C780.

#### **1.5 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
  2. Indicating that following items meet specifications:
    - a. Portland cement.
    - b. Masonry cement.
    - c. Mortar cement.
    - d. Hydrated lime.
    - e. Fine aggregate (sand).
    - g. Color admixture.
- C. Laboratory Test Reports:
  1. Mortar, each type.
  2. Admixtures.
- D. Manufacturer's Literature and Data:
  1. Cement, each kind.
  2. Hydrated lime.
  3. Admixtures.
  4. Liquid acrylic resin.

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

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking 4" clear of ground, and protect damage from handling, dirt, stain, water and wind.

#### **1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - C40-04.....Organic Impurities in Fine Aggregates for Concrete
  - C91-05.....Masonry Cement
  - C109-08.....Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-MM Cube Specimens)
  - C144-04.....Aggregate for Masonry Mortar

C150-09.....Portland Cement  
C207-06.....Hydrated Lime for Masonry Purposes  
C270-10.....Mortar for Unit Masonry  
C307-03(R2008).....Tensile Strength of Chemical - Resistant Mortar,  
Grouts, and Monolithic Surfacing  
C321-00(R2005).....Bond Strength of Chemical-Resistant Mortars  
C348-08.....Flexural Strength of Hydraulic Cement Mortars  
C595-10.....Blended Hydraulic Cement  
C780-10.....Preconstruction and Construction Evaluation of  
Mortars for Plain and Reinforced Unit Masonry  
C979-10.....Pigments for Integrally Colored Concrete  
C1329-05.....Mortar Cement

## **PART 2 - PRODUCTS**

### **2.1 HYDRATED LIME**

ASTM C207, Type S.

### **2.2 AGGREGATE FOR MASONRY MORTAR**

A. ASTM C144 and as follows:

1. Light colored sand for mortar for laying face brick.
2. White plastering sand meeting sieve analysis for mortar joints for pointing

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

### **2.3 BLENDED HYDRAULIC CEMENT**

ASTM C595, Type IS, IP.

### **2.4 MASONRY CEMENT**

A. ASTM C91. Type N, S, or M.

B. Use white masonry cement whenever white mortar is specified.

### **2.5 MORTAR CEMENT**

ASTM C1329, Type N, S or M.

### **2.6 PORTLAND CEMENT**

A. ASTM C150, Type I.

B. Use white Portland cement wherever white mortar is specified.

### **2.7 LIQUID ACRYLIC RESIN**

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

### **2.8 WATER**

Potable, free of substances that are detrimental to mortar, masonry, and metal.

## **2.9 POINTING MORTAR**

- A. For Precast Concrete: Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.
- B. Pointing Mortar for Glazed Structural Facing Tile:
  - 1. Proportion by volume: One part white Portland cement, two parts of graded white sand passing Number 50 sieve, and 1/8 part hydrated lime.

## **2.10 MASONRY MORTAR**

- A. Conform to ASTM C270.
- B. Admixtures:
  - 1. Do not use mortar admixtures, except for color admixtures unless approved by A/E.
  - 2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
  - 3. Do not use antifreeze compounds.
- C. Colored Mortar:
  - 1. Maintain uniform mortar color for exposed work throughout.
  - 2. Match mortar color in approved sample or mock-up.
  - 3. Color of mortar for exposed work in alteration work to match color of existing mortar unless specified otherwise in section 09 06 00, SCHEDULE FOR FINISHES.
- D. Color Admixtures:
  - 1. Proportion as specified by manufacturer.
  - 2. For color, see Section 09 06 00, SCHEDULE FOR FINISHES.

## **2.11 HIGH BOND MORTAR**

- A. Mixture by volume, one-part Portland cement, 1/4-part hydrated lime, three-parts sand, water, and liquid acrylic resin.
- B. Mortar properties when tested in accordance with referenced specifications.
  - 1. Compressive Strength, ASTM C109: Minimum 19,305 kPa (2800 psi), using 50 mm (2 inch) cubes.
  - 2. Tensile Strength, ASTM C307: 3861 kPa Minimum (560 psi), using the 25mm (1 inch) briquettes.
  - 3. Flexural Strength, ASTM C348: Minimum 6067 kPa (880 psi), using flexural bar.
  - 4. Bond Strength, ASTM C321: Minimum 2965 kPa (430 psi), using crossed brick.

## **2.12 COLOR ADMIXTURE**

- A. Pigments: ASTM C979.

- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

### **PART 3 - EXECUTION**

#### **3.1 MIXING**

- A. Mix in a mechanically operated mortar mixer.
  - 1. Mix mortar for at least three minutes but not more than five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
  - 1. Re-tempered by adding water to restore to proper consistency and workability.
  - 2. Discard mortar that has reached its initial set or has not been used within two hours.
- E. Pointing Mortar:
  - 1. Mix dry ingredients with enough water to produce a damp mixture of workable consistency which will retain its shape when formed into a ball.
  - 2. Allow mortar to stand in dampened condition for one to 1-1/2 hours.
  - 3. Add water to bring mortar to a workable consistency prior to application.

#### **3.2 MORTAR USE LOCATION**

- A. Use Type M mortar for precast concrete panels, and waterproof parging below grade.
- B. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered), masonry below grade setting cast stone, and engineered reinforced unit masonry work .
- C. Use Type N mortar for other masonry work, except as otherwise specified.

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**SECTION 04 05 16**  
**MASONRY GROUTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section specifies grout materials and mixes.

**1.2 RELATED WORK:**

A. Grout used in Section:

1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 20 00, UNIT MASONRY.

B. Grout Color: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 TESTS:**

A. Test grout and materials specified.

B. Certified test reports.

C. Identify materials by type, brand name and manufacturer or by origin.

D. Do not use materials until laboratory test reports are approved by A/E.

E. After tests have been made and materials approved, do not change without additional test and approval of A/E.

F. Testing:

1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:

2. Grout:

- a. Test for compressive strength; ASTM C1019.
- b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.

3. Cement:

- a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
- b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.

4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

**1.4 SUBMITTALS:**

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

B. Certificates:

1. Indicating that following items meet specifications:
  - a. Portland cement.
  - b. Masonry cement.

- c. Grout.
- d. Hydrated lime.
- e. Fine aggregate (sand).
- f. Coarse aggregate for grout.
- g. Color admixture.
- C. Laboratory Test Reports:
  - 1. Grout, each type.
  - 2. Admixtures.
- D. Manufacturer's Literature and Data:
  - 1. Cement, each kind.
  - 2. Hydrated lime.
  - 3. Admixtures.
  - 4. Liquid acrylic resin.

**1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

**1.6 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - C40-04.....Organic Impurities in Fine Aggregates for  
Concrete
  - C91-05.....Masonry Cement
  - C150-09.....Portland Cement
  - C207-06.....Hydrated Lime for Masonry Purposes
  - C404-07.....Aggregate for Masonry Grout
  - C476-10.....Grout for Masonry
  - C595-10.....Blended Hydraulic Cement
  - C979-10.....Pigments for Integrally Colored Concrete
  - C1019-11.....Sampling and Testing Grout

**PART 2 - PRODUCTS**

**2.1 HYDRATED LIME:**

ASTM C207, Type S.

**2.2 AGGREGATE FOR MASONRY GROUT:**

ASTM C404, Size 8.

**2.3 BLENDED HYDRAULIC CEMENT:**

ASTM C595, Type IS, IP.

**2.4 MASONRY CEMENT:**

- A. ASTM C91. Type N, S, or M.
- B. Use white masonry cement whenever white mortar is specified.

**2.5 PORTLAND CEMENT:**

- A. ASTM C150, Type I.
- B. Use white Portland cement wherever white mortar is specified.

**2.6 LIQUID ACRYLIC RESIN:**

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

**2.7 WATER:**

Potable, free of substances that are detrimental to grout, masonry, and metal.

**2.8 GROUT:**

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
  - 1. Fine Grout:
    - a. Portland cement or blended hydraulic cement: one part.
    - b. Hydrated lime: 0 to 1/10 part.
    - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
  - 2. Coarse Grout:
    - a. Portland cement or blended hydraulic cement: one part.
    - b. Hydrated lime: 0 to 1/10 part.
    - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
    - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
  - 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

**2.9 COLOR ADMIXTURE:**

- A. Pigments: ASTM C979.
- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

**PART 3 - EXECUTION**

**3.1 MIXING:**

- A. Mix in a mechanically operated grout mixer.
  - 1. Mix grout for at least five minutes.

- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

**3.2 GROUT USE LOCATIONS:**

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.
- B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).
- C. Do not use grout for filling bond beam or lintel units.

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**SECTION 04 20 00**  
**UNIT MASONRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies requirements for construction of masonry unit walls.

**1.2 RELATED WORK**

- A. ARCHITECTURAL PRECAST: Section 03 45 00
- B. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- C. Steel lintels and shelf angles: Section 05 50 00, METAL FABRICATIONS.
- D. Flashing: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.
- F. Color and texture of masonry units: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
  - 1. Inset Thin-brick, sample panel, 200 mm by 400 mm (8 inches by 16 inches,) showing full color range and texture of bricks, bond, and proposed "mortar joints" in precast Concrete Sample.
  - 2. Concrete masonry units, when exposed in finish work.
  - 3. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
- C. Shop Drawings:
  - 1. Special masonry shapes.
  - 2. Drawings, showing reinforcement, applicable dimensions and methods of hanging soffit or lintel masonry and reinforcing masonry for embedment of anchors for hung fixtures.
  - 3. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
- D. Certificates:
  - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.

2. Indicating that the following items meet specification requirements:
    - a. Thin-brick.
    - b. Solid and load-bearing concrete masonry units, including fire-resistant rated units.
    - c. Structural clay tile units.
  3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
- E. Laboratory Test Reports:
1. Brick for pre-built masonry panels.
- F. Manufacturer's Literature and Data:
1. Anchors, ties, and reinforcement.
  2. Shear keys.
  3. Reinforcing bars.

#### **1.4 SAMPLE PANEL**

- A. Coordinate sample panel in accordance with Masonry Standards Joint Committee (MSJC) and Brick Industry Association (BIA) with Architectural Precast sample panel and precast concrete samples.
1. Use masonry units from random cubes of units delivered on site.
  2. Include reinforcing, ties, and anchors.
- B. Use sample panels approved by COR for standard of workmanship of new masonry work.
- C. Use precast concrete Mock-up panel to test cleaning methods.

#### **1.5 WARRANTY**

Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A951-06.....Steel Wire for Masonry Joint Reinforcement.
- A615/A615M-09.....Deformed and Plain Billet-Steel Bars for  
Concrete Reinforcement.
- A675/A675M-03(R2009)....Standard Specification for Steel Bars, Carbon,  
Hot-Wrought, Special Quality, Mechanical  
Properties C34-03 Structural Clay Load-Bearing  
Wall Tile
- C55-09.....Concrete Building Brick
- C56-10.....Structural Clay Non-Load-Bearing Tile

- C62-10.....Building Brick (Solid Masonry Units Made From  
Clay or Shale)
- C67-09.....Sampling and Testing Brick and Structural Clay  
Tile
- C90-11.....Load-Bearing Concrete Masonry Units
- C126-10.....Ceramic Glazed Structural Clay Facing Tile,  
Facing Brick, and Solid Masonry Units
- C216-10.....Facing Brick (Solid Masonry Units Made From Clay  
or Shale)
- C476-10.....Standard Specification for Grout for Masonry
- C612-10.....Mineral Fiber Block and Board Thermal Insulation
- C744-11.....Prefaced Concrete and Calcium Silicate Masonry  
Units.
- D1056-07.....Flexible Cellular Materials - Sponge or Expanded  
Rubber
- D2000-08.....Rubber Products in Automotive Applications
- D2240-05(R2010).....Rubber Property - Durometer Hardness
- D3574-08.....Flexible Cellular Materials-Slab, Bonded, and  
Molded Urethane Foams
- F1667-11.....Fasteners: Nails, Spikes and Staples
- C. Masonry Industry Council:  
Hot and Cold Weather Masonry Construction Manual-98 (R2000).
- D. American Welding Society (AWS):  
D1.4-11 Structural Welding Code - Reinforcing Steel.
- E. Federal Specifications (FS):  
FF-S-107C-00.....Screws, Tapping and Drive
- F. Brick Industry Association - Technical Notes on Brick Construction  
(BIA):  
11-2001.....Guide Specifications for Brick Masonry, Part I  
11A-1988.....Guide Specifications for Brick Masonry, Part II  
11B-1988.....Guide Specifications for Brick Masonry, Part III  
Execution  
11C-1998.....Guide Specification for Brick Masonry Engineered  
Brick Masonry, Part IV  
11D-1988.....Guide Specifications for Brick Masonry  
Engineered Brick Masonry, Part IV continued
- G. Masonry Standards Joint Committee; Specifications for Masonry Structures  
TMS 602-08/ACI 530.1-08/ASCE 6-08 (2008 MSJC Book Version TMS-0402-08).

**PART 2 - PRODUCTS**

## **2.1 BRICK**

### **A. Face Brick or Thin Brick:**

1. ASTM C216, Grade SW, Type FBS.
2. Brick when tested in accordance with ASTM C67: Classified slightly efflorescent or better.
3. Size:
  - a. Utility (3 5/8" x 7 5/8" Face)
  - b. Thin Brick: 13 mm (1/2 inch) thick with angle shapes for corners.

### **B. Ceramic Glazed Facing Brick: ASTM C126; Grade S, Type I (single-faced units) where only one face is exposed; Grade S, Type II (two-faced units) where two opposite finished faces are exposed.**

## **2.2 CONCRETE MASONRY UNITS**

### **A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.**

1. Unit Weight: Normal weight.
2. Sizes: Modular.
3. For molded faces used as a finished surface, use concrete masonry units with uniform fine to medium surface texture unless specified otherwise.
4. Use bullnose concrete masonry units at corners exposed in finished work with 25 mm (one inch) minimum radius rounded vertical exterior corners (bullnose units).

### **B. Concrete Brick: ASTM C55.**

## **2.3 SHEAR KEYS**

- A. ASTM D2000, solid extruded cross-shaped section of rubber, neoprene, or polyvinyl chloride, with a durometer hardness of approximately 80 when tested in accordance with ASTM D2240, and a minimum shear strength of 3.5 MPa (500 psi).
- B. Shear key dimensions: Approximately 70 mm by 8 mm for long flange and 38 mm by 16 mm for short flange (2-3/4 inches by 5/16 inch for long flange, and 1-1/2 inches by 5/8 inch for short flange).

## **2.4 ANCHORS, TIES, AND REINFORCEMENT**

### **A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.**

### **B. Joint Reinforcement:**

1. Form from wire complying with ASTM A951.
2. Galvanized after fabrication.
3. Width of joint reinforcement 40 mm (0.16 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement at least 3000 mm (10 feet) in length.



6. Joint reinforcement in rolls is not acceptable.
  7. Joint reinforcement that is crimped to form drip is not acceptable.
  8. Maximum spacing of cross wires 400 mm (16 inch) to longitudinal wires.
  9. Ladder Design:
    - a. Longitudinal wires deformed 5 mm (0.20 inch) diameter wire.
    - b. Cross wires 4 mm (0.16 inch) diameter.
  10. Trussed Design:
    - a. Longitudinal and cross wires not less than 4 mm (0.16 inch nominal) diameter.
    - b. Longitudinal wires deformed.
  11. Multiple Wythes and Cavity wall ties:
    - a. Longitudinal wires 4 mm (0.16 inch), two in each wythe with ladder truss wires 4 mm (0.16 inch) overlay, welded to each longitudinal wire.
    - b. Longitudinal wires 4 mm (0.16 inch) with U shape 4 mm (0.16 inch) rectangular ties extending into other wythe not less than 75 mm (3 inches) spaced 400 mm o.c. (16 inches). Adjustable type with U shape tie designed to receive 4 mm (0.16 inch) pintle projecting into other wythe 75 mm (3 inches min.).
- C. Dovetail Anchors:
1. Triangular wire dovetail anchor 100 mm (4 inch) wide formed of 4 mm (9 gage) steel wire with galvanized steel dovetail insert. Anchor length to extend at least 75 mm (3 inches) into masonry, 25 mm (1 inch) into 40 mm (1-1/2 inch) thick units.
  2. Form dovetail anchor slots from 0.6 mm (0.0239 inch) thick galvanized steel (with felt or fiber filler).
- D. Individual ties:
1. Rectangular ties: Form from 5 mm (3/16 inch) diameter galvanized steel rod to a rectangular shape not less than 50 mm (2 inches) wide by sufficient length for ends of ties to extend within 25 mm (1 inch) of each face of wall. Ties that are crimped to form drip are not permitted.
- E. Wall Ties, (Mesh or Wire):
1. Mesh wall ties formed of ASTM A82, W0.5, 2 mm, (16 gage) galvanized steel wire 13 mm by 13 mm (1/2 inch by 1/2 inch) mesh, 75 mm (3 inches) wide by 200 mm (8 inches) long.
  2. Rectangular wire wall ties formed of W1.4, 3 mm, (9 gage) galvanized steel wire 50 mm (2 inches) wide by 200 mm (8 inches) long.

## **2.5 PREFORMED COMPRESSIBLE JOINT FILLER**

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
- C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

## **2.6 ACCESSORIES**

- A. Weep Hole Inserts:, 10 mm (3/8 inch) minimum width, 50 mm (2 inches) minimum height, 300 mm (12 inches) long.
- B. Box Board:
  - 1. Mineral Fiber Board: ASTM C612, Class 1.
  - 2. 25 mm (1 inch) thickness.
  - 3. Other spacing material having similar characteristics may be used subject to the COR's approval.
- C. Masonry Cleaner:
  - 1. Detergent type cleaner selected for each type masonry used.
  - 2. Acid cleaners are not acceptable.
  - 3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.
- D. Fasteners:
  - 1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
  - 2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
  - 3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

## **2.7 PRE-BUILT MASONRY PANELS**

- A. Shop fabricated under a controlled environment, in a plant capable of manufacturing, transporting, and storing the finished panels.
- B. Fabricate panels to size and configuration shown, conforming to approved shop drawing.
- C. Fabricate panels in jigs.
- D. Reject panels failing to meet these requirements.
  - 1. Plumb head joints.
  - 2. Panel dimensions tolerances: Accurate to plus 0 mm (0 inch) and minus 6 mm (1/4 inch) in 3600 mm (12 feet).
  - 3. Panels true, free of warp or rack, and plumb on base.

## **PART 3 - EXECUTION**

### **3.1 JOB CONDITIONS**

- A. Protection:
  - 1. Cover tops of walls with nonstaining waterproof covering, when work is not in progress. Secure to prevent wind blow off.

2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.

B. Cold Weather Protection:

1. Masonry may be laid in freezing weather when methods of protection are utilized.
2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

**3.2 CONSTRUCTION TOLERANCES**

- A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:
- B. Maximum variation from plumb:
  1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
  2. In 6000 mm (20 feet) - 10 mm (3/8 inch).
  3. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).
- C. Maximum variation from level:
  1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
  2. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).
- D. Maximum variation from linear building lines:
  1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
  2. In 12 000 mm (40 feet) or more - 19 mm (3/4 inch).
- E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
  1. Minus 6 mm (1/4 inch).
  2. Plus 13 mm (1/2 inch).
- F. Maximum variation in prepared opening dimensions:
  1. Accurate to minus 0 mm (0 inch).
  2. Plus 6 mm (1/4 inch).

**3.3 INSTALLATION GENERAL**

- A. Keep finish work free from mortar smears or spatters, and leave neat and clean.
- B. Anchor masonry as specified in Paragraph, ANCHORAGE.
- C. Wall Openings:
  1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.
  2. If items are not available when walls are built, prepare openings for subsequent installation.
- D. Tooling Joints:
  1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.

2. Tool while mortar is soft enough to be compressed into joints and not raked out.
3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
4. Tool Exposed interior joints in finish work concave unless specified otherwise.

E. Lintels:

1. Lintels are not required for openings less than 1000 mm (3 feet 4 inches) wide that have hollow metal frames.
  2. Openings 1025 mm (3 feet 5 inches) wide to 1600 mm (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
  3. Precast lintels of 25 Mpa (3000 psi) concrete, of same thickness as partition, and with one Number 5 deformed bar top and bottom for each 100 mm (4 inches) of nominal thickness, may be used in lieu of reinforced CMU masonry lintels.
  4. Use steel lintels, for openings over 1600 mm (5 feet 4 inches) wide, brick masonry, and elevator openings unless shown otherwise.
  5. Doors having overhead concealed door closers require a steel lintel, and a pocket for closer box.
  6. Length for minimum bearing of 100 mm (4 inches) at ends.
  7. Build masonry openings or arches over wood or metal centering and supports when steel lintels are not used.
- f. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

H. Structural Steel Encased in Masonry:

1. Where structural steel is encased in masonry and the voids between the steel and masonry are filled with mortar, provide a minimum 25 mm (1 inch) mortar free expansion space between the masonry and the steel by applying a box board material to the steel before the masonry is laid.
2. Do not place spacing material where steel is bearing on masonry or masonry is bearing on steel.

I. Wetting and Wetting Test:

1. Test and wet brick or clay tile in accordance with BIA 11B.

2. Do not wet concrete masonry units or glazed structural facing tile before laying.
- J. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
- K. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.
- L. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.
- M. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.
  1. 10 days for girders and beams.
  2. 7 days for slabs.
  3. 7 days for reinforced masonry soffits.

### **3.4 ANCHORAGE**

- A. Veneer to Concrete Walls:
  1. Install dovetail slots in concrete vertically at 600 mm (2 feet) on centers.
  2. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals.
- B. Anchorage of Abutting Masonry:
  1. Anchor interior 100 mm (4 inch) thick masonry partitions to exterior masonry walls with wall ties. Space ties at 600 mm (2 foot) maximum vertical intervals. Extend ties 100 mm (4 inches) minimum into masonry.
  2. Anchor interior masonry bearing walls or interior masonry partitions over 100 mm (4 inches) thick to masonry walls with rigid wall anchors spaced at 400 mm (16 inch) maximum vertical intervals.
  3. Anchor abutting masonry walls and partitions to concrete with dovetail anchors. Install dovetail slots vertically in concrete at centerline of abutting wall or partition. Locate dovetail anchors at 400 mm (16 inch) maximum vertical intervals. Secure anchors to existing wall with two 9 mm (3/8 inch) by 75 mm (3 inch) expansion bolts or two power-driven fasteners.
  4. Anchor abutting interior masonry partitions to existing concrete and existing masonry construction, with wall ties. Extend ties at least 100 mm (4 inches) into joints of new masonry. Fastened to existing

concrete and masonry construction, with powder actuated drive pins, nail or other means that provides rigid anchorage. Install anchors at 400 mm (16 inch) maximum vertical intervals.

### **3.5 REINFORCEMENT**

#### **A. Joint Reinforcement:**

1. Use as joint reinforcement in CMU wythe of combination brick and CMU, cavity walls, and single wythe concrete masonry unit walls or partitions.
2. Reinforcing may be used in lieu of individual ties for anchoring brick facing to CMU backup in exterior masonry walls.
3. Brick veneer over frame backing walls does not require joint reinforcement.
4. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
5. Additional joint reinforcement is required in mortar joints at both 200 mm (8 inches) and 400 (16 inches) above and below windows, doors, louvers and similar openings in masonry, except where other type anchors are required for anchorage of masonry to concrete structure.
6. Joint reinforcement is required in every other course of stack bond CMU masonry.
7. Wherever brick masonry is backed up with stacked bond masonry, joint reinforcement is required in every other course of CMU backup, and in corresponding joint of facing brick.

#### **B. Steel Reinforcing Bars:**

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.
2. Use grade 60 bars if not specified otherwise.
3. Bond Beams:
  - a. Form Bond beams of load-bearing concrete masonry units filled with ASTM C476 grout and reinforced with 2-#15m (#5) reinforcing steel unless shown otherwise. Do not cut reinforcement.
  - b. Brake bond beams only at expansion joints and at control joints, if shown.
4. Stack Bond:
  - a. Locate additional joint reinforcement in vertical and horizontal joints as shown.
  - b. Anchor vertical reinforcement into the foundation or wall or bond beam below and hold in place.

- c. Provide temporary bracing for walls over 8 ft. tall until permanent horizontal bracing is completed.

5. Grout openings:

- a. Leave cleanout holes in double wythe walls during construction by omitting units at the base of one side of the wall.
- b. Locate 75 mm x 75 mm (3 in. x 3 in.) min. clean-out holes at location of vertical reinforcement.
- c. Keep grout space clean of mortar accumulation and sand debris. Clean the grout space every day using a high pressure jet stream of water, or compressed air, or industrial vacuum, or by laying wood strips on the metal ties as the wall is built. If wood strips are used, lift strips with wires as the wall progresses and before placing each succeeding course of wall ties.

**3.6 BRICK EXPANSION AND CMU CONTROL JOINTS.**

- A. Provide brick expansion (BEJ) and CMU control (CJ) joints where shown on drawings or in any section of wall greater than 30 feet. Coordinate location with designer.
- B. Keep joint free of mortar and other debris.
- C. Where joints occur in masonry walls.
  - 1. Install preformed compressible joint filler in brick wythe.
  - 2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key unless otherwise specified.
  - 3. Install filler, backer rod, and sealant on exposed faces.
- D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint. E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.
- F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

**3.7 BUILDING EXPANSION AND SEISMIC JOINTS**

- A. Keep joint free of mortar. Remove mortar and other debris.
- B. Install non-combustible, compressible type joint filler to fill space completely except where sealant is shown on joints in exposed finish work.
- C. Where joints are on exposed faces, provide depth for backer rod and sealant as specified in Section 07 92 00, JOINT SEALANTS, unless shown otherwise.

### 3.8 ISOLATION SEAL

- A. Where full height walls or partitions lie parallel or perpendicular to and under structural beams or shelf angles, provide a separation between walls or partitions and bottom of beams or shelf angles not less than the masonry joint thickness unless shown otherwise.
- B. Insert in the separation, a continuous full width strip of non-combustible type compressible joint filler.
- C. Where exposed in finish work, cut back filler material in the joint enough to allow for the joint to be filled with sealant material specified in Section 07 92 00, JOINT SEALANTS.

### 3.9 BRICKWORK

- A. See Section 034500 ARCHITECTURAL PRECAST
- B. Laying:
  - 1. Lay brick in running bond with course of masonry bonded at corners unless shown otherwise to match main campus building.
  - 2. Maintain bond pattern throughout.
  - 3. Do not use brick smaller than half-brick at any angle, corner, break or jamb.
  - 4. Where length of cut brick is greater than one half but less than a whole brick, maintain the vertical joint location of such units.
  - 5. Lay clay brick in accordance with BIA Technical Note 11 series.
  - 6. Build solid brickwork as required for anchorage of items.
- C. Solid Exterior Walls:
  - 1. Build with 10 mm (1/2 inches) of thin-brick inserts, backed up with cast-in-place concrete.
  - 2. Construct solid brick jambs not less than 20 mm (.8 inches) wide at exterior wall openings and at recesses, except where exposed concrete unit backup is shown.
  - 3. Do not use full bonding headers.
  - 4. Parging:
    - a. For solid masonry walls, lay backup to height of six brick courses, parge backup with 13 mm (1/2 inch) of mortar troweled smooth; then lay exterior wythe to height of backup.
    - b. Make parging continuous over backup, and extend 150 mm (six inches) onto adjacent concrete or masonry.
    - c. Parge, with mortar, the ends and backs for recesses in exterior walls to a thickness of 13 mm (1/2 inch).
    - d. Parge with mortar to true even surface the inside surface of exterior walls to receive insulation.



### **3.9 CONCRETE MASONRY**

#### **A. Kind and Users:**

1. Provide special concrete masonry shapes as required, including lintel and bond beam units, sash units, and bull-nose corner units. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
3. Provide rounded corner (bullnose) shapes at opening jambs in exposed work and at exterior corners.
4. Do not use brick jambs in exposed finish work.
5. Use concrete building brick only as filler in backup material where not exposed.

#### **B. Laying:**

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Provide a 6 mm (1/4 inch) open joint for caulking between exterior walls, concrete work, and abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes shown.
12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
13. Steel reinforcement in place before grouting.
14. Minimum clear distance between parallel bars: One bar diameter.

15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
17. Reinforcement shall be fully encased by grout or concrete.
18. Splice reinforcement or attach reinforcement to dowels by placing in contact and secured or by placing the reinforcement within 1/5 of the required bar splice length.
19. Stagger splices in adjacent horizontal reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
21. Cavity and joint horizontal reinforcement may be placed as the masonry work progresses.

### **3.10 POINTING OF GLAZED UNITS**

- A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.
- B. Wipe off excess mortar from joints of glazed masonry units with dry cloth.
- C. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise.

### **3.11 GROUTING**

- A. Preparation:
  1. Clean grout space of mortar droppings before placing grout.
  2. Close cleanouts.
  3. Install vertical solid masonry dams across grout space for full height of wall at intervals of not more than 9000 mm (30 feet). Do not bond dam units into wythes as masonry headers.
  4. Verify reinforcing bars are in cells of units or between wythes as shown.
- B. Placing:
  1. Place grout by hand bucket, concrete hopper, or grout pump.
  2. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
  3. Do not slush with mortar or use mortar with grout.
  4. Interruptions:
    - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.

- b. Grout from dam to dam on high lift method.
  - c. A longitudinal run of masonry may be stopped off only by raking back one-half a masonry unit length in each course and stopping grout 100 mm (4 inches) back of rake on low lift method.
- C. Puddling Method:
- 1. Double wythe masonry constructed grouted in lifts not to exceed 300 mm (12 inches) or less than 50 mm (2 inches) wide.
  - 2. Consolidate by puddling with a grout stick during and immediately after placing.
  - 3. Grout the cores of concrete masonry units containing the reinforcing bars solid as the masonry work progresses.
- D. Low Lift Method:
- 1. Construct masonry to a height of 1.5 m (5 ft) maximum before grouting.
  - 2. Grout in one continuous operation and consolidate grout by mechanical vibration and reconsolidate after initial water loss and settlement has occurred.
- E. High Lift Method:
- 1. Do not pour grout until masonry wall has properly cured a minimum of 4 hours.
  - 2. Place grout in lifts not exceeding 1.5 m (5 ft).
  - 3. Exception:  
Where the following conditions are met, place grout in lifts not exceeding 3.86 m (12.67 ft).
    - a. The masonry has cured for at least 4 hours.
    - b. The grout slump is maintained between 254 and 279 mm (10 and 11 in).
    - c. No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.
  - 4. When vibrating succeeding lifts, extend vibrator 300 to 450 mm (12 to 18 inches) into the preceding lift to close any shrinkage cracks or separation from the masonry units.

### **3.12 PLACING REINFORCEMENT**

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may

be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.

- D. Splice reinforcement bars where shown; do not splice at other places unless accepted by the COR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- E. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- F. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- G. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- H. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.
- I. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

### **3.13 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY**

- A. Limit wetting of concrete masonry units (CMU).
- B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 10 mm (3/8 inch) joints.
- C. Where solid CMU units are shown, lay with full mortar head and bed joints.
- D. Walls:
  - 1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners

and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

E. Grouting:

1. Use "Fine Grout" per ASTM C476 for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
2. Use "Coarse Grout" per ASTM C476 for filling 100 mm (4 inch) spaces or larger in both horizontal directions.
3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

F. Low-Lift Grouting:

1. Provide minimum clear dimension of 50 mm (2 inches) and clear area of 5160 mm<sup>2</sup> (8 square inches) in vertical cores to be grouted.
2. Place vertical reinforcement prior to grouting of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 3 m (10 feet).
3. Lay CMU to maximum pour height. Do not exceed 1.5 m (5 foot) height, or if bond beam occurs below 1.5 m (5 foot) height, stop pour 38 mm (1-1/2 in) below top of bond beam.
4. Pour grout using chute container with spout or pump hose. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 38 mm (1-1/2 inches) below top course of pour.
5. Bond Beams: Stop grout in vertical cells 38 mm (1-1/2 inches) below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

G. High-Lift Grouting:

1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 75 mm (3 inches) and 6450 mm<sup>2</sup> (10 square inches), respectively.
2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
4. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
5. Limit grout lifts to a maximum height of 1.5 m (5 feet) and grout pour to a maximum height of 7.3 m (24 feet), for single wythe hollow concrete masonry walls, unless otherwise indicated.
6. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 3 m (10 feet).
7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosed before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
8. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
9. Place horizontal beam reinforcement as the masonry units are laid.
10. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
11. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.
12. Place grout by pumping into grout spaces unless alternate methods are acceptable to the COR.

13. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed 1.5 m (5 feet). Allow not less than 30 minutes, nor more than one hour between lifts of a given pour. Mechanically consolidate each grout lift during pouring operation.
14. Place grout in lintels or beams over openings in one continuous pour.
15. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 25 mm (1 inch) of vertically reinforced cavities, during construction of masonry.
16. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 38 mm (1-1/2 inches) of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

### **3.14 CLEANING AND REPAIR**

#### **A. General:**

1. Clean exposed masonry surfaces on completion.
2. Protect adjoining construction materials and landscaping during cleaning operations.
3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
4. Remove mortar droppings and other foreign substances from wall surfaces.

#### **B. Concrete Masonry Units:**

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
2. Allow mud to dry before brushing.

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**SECTION 05 12 00**  
**STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies structural steel shown and classified by Section 2, Code of Standard Practice for Steel Buildings and Bridges.

**1.2 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Painting: Section 09 91 00, PAINTING.
- C. Steel Decking: Section 05 31 00, STEEL DECKING.
- D. Composite Steel Deck: Section 05 36 00, COMPOSITE METAL DECKING.
- E. Fireproofing: Section 07 81 00, APPLIED FIREPROOFING.

**1.3 QUALITY ASSURANCE:**

- A. Fabricator and erector shall maintain a program of quality assurance in conformance with Section 8, Code of Standard Practice for Steel Buildings and Bridges. Work shall be fabricated in an AISC certified Category Std fabrication plant.
- B. Before authorizing the commencement of steel erection, the controlling contractor shall ensure that the steel erector is provided with the written notification required by 29 CFR 1926.752. Provide copy of this notification to the A/E.

**1.4 TOLERANCES:**

Fabrication tolerances for structural steel shall be held within limits established by ASTM A6, by AISC 303, Sections 6 and 7, Code of Standard Practice for Buildings and Bridges, except as follows:

- A. Elevation tolerance for closure plates at the building perimeter and at slab openings prior to concrete placement is 6 mm (1/4 inch).

**1.5 DESIGN:**

- A. Connections: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with the details shown on the Drawings, supplementing where necessary. The details shown on the Drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the A/E of any location where the



connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the A/E. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.

**1.6 REGULATORY REQUIREMENTS:**

- A. AISC 360: Specification for Structural Steel Buildings
- B. AISC 303: Code of Standard Practice for Steel Buildings and Bridges.

**1.7 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop and Erection Drawings: Complete
- C. Certificates:
  - 1. Structural steel.
  - 2. Steel for all connections.
  - 3. Welding materials.
  - 4. Shop coat primer paint.
- D. Test Reports:
  - 1. Welders' qualifying tests.
- E. Design Calculations and Drawings:
  - 1. Connection calculations, if required.
- F. Record Surveys.

**1.8 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Institute of Steel Construction (AISC):
  - 1. AISC 360-10 Specification for Structural Steel Buildings
  - 3. AISC 303-10 Code of Standard Practice for Steel Buildings and Bridges
- C. American National Standards Institute (ANSI):
  - B18.22.1-65(R2008).....Plain Washers
  - B18.22M-81(R2000).....Metric Plain Washers
- D. American Society for Testing and Materials (ASTM):
  - A6/A6M-11.....Standard Specification for General Requirements  
for Rolled Structural Steel Bars, Plates,  
Shapes, and Sheet Piling
  - A36/A36M-08.....Standard Specification for Carbon Structural  
Steel

- A53/A53M-10.....Standard Specification for Pipe, Steel, Black  
and Hot-Dipped, Zinc-Coated Welded and Seamless
- A123/A123M-09.....Standard Specification for Zinc (Hot-Dip  
Galvanized) Coatings on Iron and Steel Products
- A242/A242M-04(R2009)....Standard Specification for High-Strength Low-  
Alloy Structural Steel
- A283/A283M-03(R2007)....Standard Specification for Low and Intermediate  
Tensile Strength Carbon Steel Plates
- A307-10.....Standard Specification for Carbon Steel Bolts  
and Studs, 60,000 psi Tensile Strength
- A325-10.....Standard Specification for Structural Bolts,  
Steel, Heat Treated, 120/105 ksi Minimum Tensile  
Strength
- A490-12.....Standard Specification for Heat-Treated Steel  
Structural Bolts 150 ksi Minimum Tensile  
Strength
- A500/A500M-10a.....Standard Specification for Cold Formed Welded  
and Seamless Carbon Steel Structural Tubing in  
Rounds and Shapes
- A501-07.....Standard Specification for Hot-Formed Welded and  
Seamless Carbon Steel Structural Tubing
- A572/A572M-07.....Standard Specification for High-Strength  
Low-Alloy Columbium-Vanadium Structural Steel
- A992/A992M-11.....Standard Specification for Structural Steel  
Shapes
- E. American Welding Society (AWS):  
D1.1/D1.1M-10.....Structural Welding Code-Steel
- F. Research Council on Structural Connections (RCSC) of The Engineering  
Foundation:  
Specification for Structural Joints Using ASTM A325 or A490 Bolts
- G. Military Specifications (Mil. Spec.):  
MIL-P-21035.....Paint, High Zinc Dust Content, Galvanizing,  
Repair
- H. Occupational Safety and Health Administration (OSHA):  
29 CFR Part 1926-2001...Safety Standards for Steel Erection

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. Structural Steel: ASTM A36, A242, A283, A572, Grade 50 A992.
- B. Structural Tubing: ASTM A500, Grade B.

- C. Structural Tubing: ASTM A501.
- D. Steel Pipe: ASTM A53, Grade B.
- E. Bolts, Nuts and Washers:
  - 1. High-strength bolts, including nuts and washers: ASTM A325 or A490.
  - 2. Bolts and nuts, other than high-strength: ASTM A307, Grade A.
  - 3. Plain washers, other than those in contact with high-strength bolt heads and nuts: ANSI Standard B18.22.1.
- F. Zinc Coating: ASTM A123.
- G. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035.

### **PART 3 - EXECUTION**

#### **3.1 CONNECTIONS (SHOP AND FIELD):**

- A. Welding: Welding in accordance with AWS D1.1. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in AWS D1.1 to perform type of work required.
- B. High-Strength Bolts: High-strength bolts tightened to a bolt tension not less than 70% of their minimum tensile strength. Tightening done with properly calibrated wrenches, by turn-of-nut method or by use of direct tension indicators (bolts or washers). Tighten bolts in connections identified as slip-critical using Direct Tension Indicators. Twist-off torque bolts are not an acceptable alternate fastener for slip critical connections.

#### **3.2 FABRICATION:**

Fabrication in accordance with Chapter M, AISC 360. .

#### **3.3 SHOP PAINTING:**

- A. General: Shop paint steel with primer in accordance with AISC 303, Section 6.
- B. Shop paint for steel surfaces is specified in Section 09 91 00, PAINTING.
- C. Do not apply paint to following:
  - 1. Surfaces within 50 mm (2 inches) of joints to be welded in field.
  - 2. Surfaces which shall be encased in concrete.
  - 3. Surfaces which shall receive sprayed on fireproofing.
  - 4. Top flange of members which shall have shear connector studs applied.
- D. Zinc Coated (Hot Dip Galvanized) per ASTM A123 (after fabrication):  
Touch-up after erection: Clean and wire brush any abraded and other spots worn through zinc coating, including threaded portions of bolts and welds and touch-up with galvanizing repair paint.

**3.4 ERECTION:**

- A. General: Erection in accordance with AISC 303, Section 7B. Temporary Supports: Temporary support of structural steel frames during erection in accordance with AISC 303, Section 7

**3.5 FIELD PAINTING:**

- A. After erection, touch-up steel surfaces specified to be shop painted. After welding is completed, clean and prime areas not painted due to field welding.
- B. Finish painting of steel surfaces is specified in Section 09 91 00, PAINTING.

**3.6 SURVEY:**

Upon completion of finish bolting or welding on any part of the work, and prior to start of work by other trades that shall be supported, attached, or applied to the structural steel work, submit a certified report of survey to A/E for approval. Reports shall be prepared by Registered Land Surveyor or Registered Civil Engineer as specified in Section 01 00 00, GENERAL REQUIREMENTS. Report shall specify that location of structural steel is acceptable for plumbness, level and alignment within specified tolerances specified in the AISC Manual.

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**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies items and assemblies fabricated from structural steel shapes and other materials as shown and specified.
- B. Items specified.
  - 1. Support for Wall and Ceiling Mounted Items: (12, 14A, 14C)
  - 2. Frames: (24E)
  - 3. Guards
  - 4. Gratings
  - 5. Loose Lintels
  - 6. Shelf Angles
  - 7. Plate Door Sill
  - 8. Safety Nosings
  - 9. Railings: (10)
  - 10. Ladders

**1.2 RELATED WORK**

- A. Railings attached to precast stairs: Section 03 45 00, ARCHITECTURAL PRECAST.
- B. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Prime and finish painting: Section 09 91 00, PAINTING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:

Grating, each type	Floor plate
	Wheel guards
Manhole Covers	Safety nosing

- C. Shop Drawings:
  - 1. Each item specified, showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors.
  - 2. Mark items requiring field assembly for erection identification and furnish erection drawings and instructions.
  - 3. Provide templates and rough-in measurements as required.

D. Manufacturer's Certificates:

1. Anodized finish as specified.
2. Live load designs as specified.

E. Installer's Certificates:

1. Provide current welding certificate for installers.

F. Design Calculations for specified live loads including dead loads.

G. Furnish setting drawings and instructions for installation of anchors to be preset into concrete and masonry work, and for the positioning of items having anchors to be built into concrete or masonry construction.

**1.4 QUALITY ASSURANCE**

A. Each manufactured product shall meet, as a minimum, the requirements specified, and shall be a standard commercial product of a manufacturer regularly presently manufacturing items of type specified.

B. Each product type shall be the same and be made by the same manufacturer.

C. Assembled product to the greatest extent possible before delivery to the site.

D. Include additional features, which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

**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 (ASME):

B18.6.1-97.....Wood Screws

B18.2.2-87(R2005).....Square and Hex Nuts

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

A36/A36M-08.....Structural Steel

A47-99(R2009).....Malleable Iron Castings

A48-03(R2008).....Gray Iron Castings

A53-12.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated  
Welded and Seamless

- A123-12.....Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- A240/A240M-14.....Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
- A269-10.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A307-10.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- A312/A312M-09.....Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A391/A391M-07(R2012)....Grade 80 Alloy Steel Chain
- A653/A653M-10.....Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
- A786/A786M-09.....Rolled Steel Floor Plate
- B221-13.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- B456-11.....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
- B632-08.....Aluminum-Alloy Rolled Tread Plate
- C1107-13.....Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- D3656-13.....Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
- F436-11.....Hardened Steel Washers
- F468-06(R2012).....Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws and Studs for General Use
- F593-13.....Stainless Steel Bolts, Hex Cap Screws, and Studs
- F1667-11.....Driven Fasteners: Nails, Spikes and Staples
- D. American Welding Society (AWS):
- D1.1-10.....Structural Welding Code Steel
- D1.2-08.....Structural Welding Code Aluminum
- D1.3-08.....Structural Welding Code Sheet Steel
- E. National Association of Architectural Metal Manufacturers (NAAMM)
- AMP 521-01.....Pipe Railing Manual
- AMP 500-06.....Metal Finishes Manual
- MBG 531-09.....Metal Bar Grating Manual
- MBG 532-09.....Heavy Duty Metal Bar Grating Manual
- F. Structural Steel Painting Council (SSPC)/Society of Protective Coatings:

- SP 1-04.....No. 1, Solvent Cleaning
- SP 2-04.....No. 2, Hand Tool Cleaning
- SP 3-04.....No. 3, Power Tool Cleaning

G. Federal Specifications (Fed. Spec):

- RR-T-650E.....Treads, Metallic and Nonmetallic, Nonskid

**PART 2 - PRODUCTS**

**2.1 DESIGN CRITERIA**

- A. In addition to the dead loads, design fabrications to support the following live loads unless otherwise specified.
- B. Railings and Handrails: 900 N (200 pounds) in any direction at any point.
- C. Floor Plates, Gratings, Covers, Trap Doors, Catwalks, and Platforms: 500 kg/m<sup>2</sup> (100 pounds per square foot). Use 300 pounds for concentrated loads. Use 40 pounds per square foot for vehicle loads in the following areas : Parking Deck on level 1-4.  
Use 100 pounds per square foot for live loads in the following areas :  
Stair and elevator towers/lobbies on level 1-4.
- D. Manhole Covers: (250 pounds per square foot).

**2.2 MATERIALS**

- A. Structural Steel: ASTM A36.
- B. Stainless Steel: ASTM A240, Type 302 or 304.
- C. Aluminum, Extruded: ASTM B221, Alloy 6063-T5 unless otherwise specified.  
For structural shapes use alloy 6061-T6 and alloy 6061-T4511.
- D. Floor Plate:
  - 1. Steel ASTM A786.
  - 2. Aluminum: ASTM B632.
- E. Steel Pipe: ASTM A53.
  - 1. Galvanized for exterior locations.
  - 2. Type S, Grade A unless specified otherwise.
  - 3. NPS (inside diameter) as shown.
- F. Cast-Iron: ASTM A48, Class 30, commercial pattern.
- G. Malleable Iron Castings: A47.
- H. Primer Paint: As specified in Section 09 91 00, PAINTING.
- I. Stainless Steel Tubing: ASTM A269, type 302 or 304.
- J. Modular Channel Units:
  - 1. Factory fabricated, channel shaped, cold formed sheet steel shapes, complete with fittings bolts and nuts required for assembly.
  - 2. Form channel with in turned pyramid shaped clamping ridges on each side.



3. Provide case hardened steel nuts with serrated grooves in the top edges designed to be inserted in the channel at any point and be given a quarter turn so as to engage the channel clamping ridges. Provide each nut with a spring designed to hold the nut in place.
4. Factory finish channels and parts with oven baked primer when exposed to view. Channels fabricated of ASTM A525, G90 galvanized steel may have primer omitted in concealed locations. Finish screws and nuts with zinc coating.
5. Fabricate snap-in closure plates to fit and close exposed channel openings of not more than 0.3 mm (0.0125 inch) thick stainless steel.

K. Grout: ASTM C1107, pourable type.

L. Insect Screening: ASTM D3656.

## **2.3 HARDWARE**

### **A. Rough Hardware:**

1. Furnish rough hardware with a standard plating, applied after punching, forming and assembly of parts; galvanized, cadmium plated, or zinc-coated by electro-galvanizing process. Galvanized G-90 where specified.
2. Use G90 galvanized coating on ferrous metal for exterior work unless non-ferrous metal or stainless is used.

### **B. Fasteners:**

1. Bolts with Nuts:
  - a. ASME B18.2.2.
  - b. ASTM A307 for 415 MPa (60,000 psi) tensile strength bolts.
  - c. ASTM F468 for nonferrous bolts.
  - d. ASTM F593 for stainless steel.
2. Screws: ASME B18.6.1.
3. Washers: ASTM F436, type to suit material and anchorage.
4. Nails: ASTM F1667, Type I, style 6 or 14 for finish work.

## **2.4 FABRICATION GENERAL**

### **A. Material**

1. Use material as specified. Use material of commercial quality and suitable for intended purpose for material that is not named or its standard of quality not specified.
2. Use material free of defects which could affect the appearance or service ability of the finished product.

### **B. Size:**

1. Size and thickness of members as shown.
2. When size and thickness is not specified or shown for an individual part, use size and thickness not less than that used for the same

component on similar standard commercial items or in accordance with established shop methods.

C. Connections

1. Except as otherwise specified, connections may be made by welding, riveting or bolting.
2. Field riveting will not be approved.
3. Design size, number and placement of fasteners, to develop a joint strength of not less than the design value.
4. Holes, for rivets and bolts: Accurately punched or drilled and burrs removed.
5. Size and shape welds to develop the full design strength of the parts connected by welds and to transmit imposed stresses without permanent deformation or failure when subject to service loadings.
6. Use Rivets and bolts of material selected to prevent corrosion (electrolysis) at bimetallic contacts. Plated or coated material will not be approved.
7. Use stainless steel connectors for removable members machine screws or bolts.

D. Fasteners and Anchors

1. Use methods for fastening or anchoring metal fabrications to building construction as shown or specified.
2. Where fasteners and anchors are not shown, design the type, size, location and spacing to resist the loads imposed without deformation of the members or causing failure of the anchor or fastener, and suit the sequence of installation.
3. Use material and finish of the fasteners compatible with the kinds of materials which are fastened together and their location in the finished work.
4. Fasteners for securing metal fabrications to new construction only, may be by use of threaded or wedge type inserts or by anchors for welding to the metal fabrication for installation before the concrete is placed or as masonry is laid.
5. Fasteners for securing metal fabrication to existing construction or new construction may be expansion bolts, toggle bolts, power actuated drive pins, welding, self drilling and tapping screws or bolts.

E. Workmanship

1. General:
  - a. Fabricate items to design shown.
  - b. Furnish members in longest lengths commercially available within the limits shown and specified.

- c. Fabricate straight, true, free from warp and twist, and where applicable square and in same plane.
  - d. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
  - e. Provide openings, cut-outs, and tapped holes for attachment and clearances required for work of other trades.
  - f. Prepare members for the installation and fitting of hardware.
  - g. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
  - h. Fabricate surfaces and edges free from sharp edges, burrs and projections which may cause injury.
2. Welding:
- a. Weld in accordance with AWS.
  - b. Welds shall show good fusion, be free from cracks and porosity and accomplish secure and rigid joints in proper alignment.
  - c. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
  - d. Finish welded joints to match finish of adjacent surface.
3. Joining:
- a. Miter or butt members at corners.
  - b. Where frames members are butted at corners, cut leg of frame member perpendicular to surface, as required for clearance.
4. Anchors:
- a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3 mm (1-1/4 by 1/8 inch) steel strap anchors, 150 mm (6 inches) long with 25 mm (one inch) hooked end, to back of member at 600 mm (2 feet) on center, unless otherwise shown.
5. Cutting and Fitting:
- a. Accurately cut, machine and fit joints, corners, copes, and miters.
  - b. Fit removable members to be easily removed.
  - c. Design and construct field connections in the most practical place for appearance and ease of installation.
  - d. Fit pieces together as required.
  - e. Fabricate connections for ease of assembly and disassembly without use of special tools.
  - f. Joints firm when assembled.

- g. Conceal joining, fitting and welding on exposed work as far as practical.
  - h. Do not show rivets and screws prominently on the exposed face.
  - i. The fit of components and the alignment of holes shall eliminate the need to modify component or to use exceptional force in the assembly of item and eliminate the need to use other than common tools.
- F. Finish:
- 1. Finish exposed surfaces in accordance with NAAMM Metal Finishes Manual.
  - 2. Aluminum: NAAMM AMP 501.
    - a. Clear anodic coating, AA-C22A41, chemically etched medium matte, with Architectural Class 1, 0.7 mils or thicker.
  - 3. Steel and Iron: NAAMM AMP 504.
    - a. Zinc coated (Galvanized): ASTM A123, G90 unless noted otherwise.
    - b. Shop Prime Painting:
      - 1) Surfaces of Ferrous metal:
        - a) Items not specified to have other coatings.
        - b) Galvanized surfaces specified to have prime paint.
        - c) Remove all loose mill scale, rust, and paint, by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
        - d) Clean of oil, grease, soil and other detrimental matter by use of solvents or cleaning compounds as defined in SSPC-SP1.
        - e) After cleaning and finishing apply one coat of primer as specified in Section 09 91 00, PAINTING.
      - 2) Non ferrous metals: Comply with MAAMM-500 series.
- G. Protection:
- 1. Insulate aluminum surfaces that will come in contact with concrete, masonry, plaster, or metals other than stainless steel, zinc or white bronze by giving a coat of heavy-bodied alkali resisting bituminous paint or other approved paint in shop.
  - 2. Spot prime all abraded and damaged areas of zinc coating which expose the bare metal, using zinc rich paint on hot-dip zinc coat items and zinc dust primer on all other zinc coated items.

## 2.5 SUPPORTS

- A. General:
- 1. Fabricate ASTM A36 structural steel shapes as shown.
  - 2. Use clip angles or make provisions for welding hangers and braces to overhead construction.

3. Field connections may be welded or bolted.

C. Supports for Items at Various Conditions at Suspended Ceilings:

1. Fabricate of structural steel shapes as shown.
2. Drill for anchor bolts of suspended item.

**2.6 FRAMES**

A. Elevator Entrance Wall Opening.

1. Fabricate of channel shapes, plates, and angles as shown.
2. Weld or bolt head to jamb as shown.
3. Weld clip angles to bottom of frame and top of jamb members extended to structure above for framed construction.
  - a. Provide holes for anchors.
  - b. Weld head to jamb members.

**2.7 GUARDS**

A. Wall Corner Guards:

1. Fabricate from steel angles and furnish with anchors as shown.
2. Continuously weld anchor to angle.

B. Guard Angles for Overhead Doors:

1. Cut away top portion of outstanding leg of angle and extend remaining portion of angle up wall.
2. Weld filler piece across head of opening to jamb angles.
3. Make provisions for fasteners and anchorage.

C. Edge Guard Angles for Openings in slabs.

1. Fabricate from steel angles of sizes and with anchorage shown.
2. Where size of angle is not shown, provide 50 x 50 x 6 mm (2 x 2 x 1/4 inch) steel angle with 32 x 5 mm (1-1/4 x 3/16 inch) strap anchors, welded to back.
3. Miter or butt angles at corners and weld.
4. Use one anchor near end and three feet on centers between end anchors.

D. Wheel Guards:

1. Construct wheel guards of not less than 16 mm (5/8 inch) thick cast iron.
2. Provide corner type, with flanges for bolting to walls.

**2.8 GRATINGS**

- A. Fabricate gratings to support live loads specified and a concentrated load as specified.
- B. Provide clearance at all sides to permit easy removal of grating.

- C. Make cutouts in gratings with 6 mm (1/4 inch) minimum to 25 mm (one inch) maximum clearance for penetrations or passage of pipes and ducts. Edge band cutouts.
- D. Fabricate in sections not to exceed 2.3 m<sup>2</sup> (25 square feet) in area and 90 kg (200 pounds) in weight.
- E. Fabricate sections of grating with end-banding bars.
- F. Fabricate angle frames and supports, including anchorage as shown.
  - 1. Fabricate intermediate supporting members from "T's" or angles.
  - 2. Locate intermediate supports to support grating section edges.
  - 3. Fabricate frame to finish flush with top of grating.
  - 4. Locate anchors at ends and not over 600 mm (24 inches) o.c.
  - 5. Butt or miter, and weld angle frame at corners.
- G. Steel Bar Gratings:
  - 1. Fabricate grating using steel bars, frames, supports and other members shown in accordance with Metal Bar Grating Manual.
  - 2. Galvanize steel members after fabrication in accordance with ASTM A123, G-90 for exterior gratings, gratings in concrete floors, and interior grating where specified.
  - 3. Interior gratings: Prime paint unless specified galvanized.
  - 4. Use serrated bars for exterior gratings and interior gratings.

## **2.9 LOOSE LINTELS**

- A. Furnish lintels of sizes shown. Where size of lintels is not shown, provide the sizes specified.
- B. Fabricate lintels with not less than 150 mm (6 inch) bearing at each end for nonbearing masonry walls, and 200 mm (8 inch) bearing at each end for bearing walls.
- C. Provide one angle lintel for each 100 mm (4 inches) of masonry thickness as follows except as otherwise specified or shown.
  - 1. Openings 750 mm to 1800 mm (2-1/2 feet to 6 feet) - 100 x 90 x 8 mm (4 x 3-1/2 x 5/16 inch).
  - 2. Openings 1800 mm to 3000 mm (6 feet to 10 feet) - 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- D. For 150 mm (6 inch) thick masonry openings 750 mm to 3000 mm (2-1/2 feet to 10 feet) use one angle 150 x 90 x 9 mm (6 x 3-1/2 x 3/8 inch).
- E. Provide bearing plates for lintels where shown.
- F. Weld or bolt upstanding legs of double angle lintels together with 19 mm (3/4 inch bolts) spaced at 300 mm (12 inches) on centers.

- G. Insert spreaders at bolt points to separate the angles for insertion of metal windows, louver, and other anchorage.
- H. Where shown or specified, punch upstanding legs of single lintels to suit size and spacing of anchor bolts.
- I. Elevator Entrance:
  - 1. Fabricate lintel from plate bent to channel shape, and provide a minimum of 100 mm (4 inch) bearing each end.
  - 2. Cut away the front leg of the channel at each end to allow for concealment behind elevator hoistway entrance frame.

#### **2.10 SHELF ANGLES**

- A. Fabricate from steel angles of size shown.
- B. Fabricate angles with horizontal slotted holes for 19 mm (3/4 inch) bolts spaced at not over 900 mm (3 feet) on centers and within 300 mm (12 inches) of ends.
- C. Provide adjustable malleable iron inserts for embedded in concrete framing.

#### **2.11 PLATE DOOR SILL**

- A. Fabricate of checkered plate as detailed.
  - 1. Aluminum Plate: ASTM B632, 3 mm (0.125 inch) thick.
  - 2. Steel Plate: ASTM A786, 3 mm (0.125 inch thick), galvanized G90.
- B. Fabricate for anchorage with flat head countersunk bolts at each end and not over 300 mm (12 inches), o.c.

#### **2.12 SAFETY NOSINGS**

- A. Fed. Spec. RR-T-650, Type C.
  - 1. Aluminum: Class 2, Style 2.
  - 2. Cast iron: Class 4.
- B. Fabricate nosings for exterior use from cast aluminum, and nosings for interior use from either cast aluminum or cast iron. Use one Class throughout.
- C. Fabricate nosings approximately 100 mm (4 inches) wide with not more than 9 mm (3/8 inch) nose.
- D. Provide nosings with integral type anchors spaced not more than 100 mm (4 inches) from each end and intermediate anchors spaced approximately 375 mm (15 inches) on center.
- E. Fabricate nosings to extend within 100 mm (4 inches) of ends of concrete stair treads except where shown to extend full width.
- F. Fabricate nosings to extend full width between stringers of metal stairs and full width of door openings.
- G. On curved steps fabricate to terminate at point of curvature of steps having short radius curved ends.

## **2.13 LADDERS**

### **A. Steel Ladders:**

1. Fixed-rail type with steel rungs shouldered and headed into and welded to rails.
2. Fabricate angle brackets of 50 mm (2 inch) wide by 13 mm (1/2 inch) thick steel; brackets spaced maximum of 1200 mm (4 feet) apart and of length to hold ladder 175 mm (7 inches) from wall to center of rungs. Provide turned ends or clips for anchoring.
3. Provide threaded holes in imbed plates for anchoring with expansion bolts through turned ends and brackets.
4. Where shown, fabricate side rails curved, twisted and formed into a gooseneck.
5. Galvanize exterior ladders after fabrication, ASTM A123, G-90.

### **B. Ladder Rungs:**

1. Fabricate from 25 mm (one inch) diameter steel bars.
2. Fabricate so that rungs will extend at least 100 mm (4 inches) into wall with ends turned 50 mm (2 inches), project out from wall 175 mm (7 inches), be 400 mm (16 inches) wide and be designed so that foot cannot slide off end.
3. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

## **2.14 RAILINGS**

- ### **A. In addition to the dead load design railing assembly to support live load specified.**

### **B. Fabrication General:**

1. Provide continuous welded joints, dressed smooth and flush.
2. Standard flush fittings, designed to be welded, may be used.
3. Exposed threads will not be approved.
4. Form handrail brackets to size and design shown.
5. Exterior Post Anchors.
  - a. Fabricate tube or pipe sleeves with closed ends or plates as shown.
  - b. Where inserts interfere with reinforcing bars, provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts.
  - c. Provide heavy pattern sliding flange base plate with set screws at base of pipe or tube posts.
6. Interior Post Anchors:
  - a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise.



- b. Weld or thread flanged fitting to posts at base.
  - c. For securing removable posts to floor, provide close fitting sleeve insert or inverted flange base plate with stud bolts or rivets concrete anchor welded to the base plate.
  - d. Provide sliding flange base plate on posts secured with set screws.
  - e. Weld flange base plate to removable posts set in sleeves.
- C. Handrails:
- 1. Close free ends of rail with flush metal caps welded in place except where flanges for securing to walls with bolts are shown.
  - 2. Make provisions for attaching handrail brackets to wall, posts, and handrail as shown.
- D. Steel Pipe Railings:
- 1. Fabricate of steel pipe with welded joints.
  - 2. Number and space of rails as shown.
  - 3. Space posts for railings not over 1800 mm (6 feet) on centers between end posts.
  - 4. Form handrail brackets from malleable iron.
  - 5. Fabricate removable sections with posts at end of section.
  - 6. Removable Rails:
    - a. Provide "U" shape brackets at each end to hold removable rail as shown. Use for top and bottom horizontal rail when rails are joined together with vertical members.
    - b. Secure rail to brackets with 9 mm (3/8 inch) stainless steel through bolts and nuts at top rail only when rails joined with vertical members.
    - c. Continuously weld brackets to post.
    - d. Provide slotted bolt holes in rail bracket.
    - e. Weld bolt heads flush with top of rail.
    - f. Weld flanged fitting to post where posts are installed in sleeves.
  - 7. Opening Guard Rails:
    - a. Fabricate rails with flanged fitting at each end to fit between wall opening jambs.
    - b. Design flange fittings for fastening with machine screws to steel plate anchored to jambs.
    - c. Fabricate rails for floor openings for anchorage in sleeves.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, GENERAL**

- A. Set work accurately, in alignment and where shown, plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.
- B. Items set into concrete or masonry.
  - 1. Provide temporary bracing for such items until concrete or masonry is set.
  - 2. Place in accordance with setting drawings and instructions.
  - 3. Build strap anchors, into masonry as work progresses.
- C. Set frames of gratings, covers, corner guards, trap doors and similar items flush with finish floor or wall surface and, where applicable, flush with side of opening.
- D. Field weld in accordance with AWS.
  - 1. Design and finish as specified for shop welding.
  - 2. Use continuous weld unless specified otherwise.
- E. Install anchoring devices and fasteners as shown and as necessary for securing metal fabrications to building construction as specified. Power actuated drive pins may be used except for removable items and where members would be deformed or substrate damaged by their use.
- F. Spot prime all abraded and damaged areas of zinc coating as specified and all abraded and damaged areas of shop prime coat with same kind of paint used for shop priming.
- G. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- H. Secure escutcheon plate with set screw.

**3.2 INSTALLATION OF SUPPORTS**

- A. Anchorage to structure.
  - 1. Secure angles or channels and clips to overhead structural steel by continuous welding unless bolting is shown.
  - 2. Secure supports to concrete inserts by bolting or continuous welding as shown.
  - 3. Secure supports to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs, with expansion bolts. unless shown otherwise.
  - 4. Secure steel plate or hat channels to studs as detailed.
- B. Supports for Wall Mounted items:
  - 1. Locate center of support at anchorage point of supported item.
  - 2. Locate support at top and bottom of wall hung cabinets.

3. Locate support at top of floor cabinets and shelving installed against walls.

4. Locate supports where required for items shown.

### **3.3 DOOR FRAMES**

- A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.
- B. Level and plumb frame; brace in position required.
- C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.
- D. Set frames in formwork for frames cast into concrete.
- E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.

### **3.4 OTHER FRAMES**

- A. Set frame flush with surface unless shown otherwise.
- B. Anchor frames at ends and not over 450 mm (18 inches) on centers unless shown otherwise.
- C. Set in formwork before concrete is placed.

### **3.5 GUARDS**

- A. Steel Angle Corner Guards:
  1. Build into masonry as the work progress.
  2. Set into formwork before concrete is placed.
  3. Set angles flush with edge of opening and finish floor or wall or as shown.
  4. At existing construction fasten angle and filler piece to adjoining construction with 16 mm (5/8 inch) diameter by 75 mm (3 inch) long expansion bolts 450 mm (18 inches) on center.
  5. Install Guard Angles at Edges of Trench, Stairwell where shown.
- B. Channel Guard at Top Edge of Concrete Platforms:
  1. Install in formwork before concrete is placed.
  2. Set channel flush with top of the platform.
- C. Wheel Guards:
  1. Set flanges of wheel guard at least 50 mm (2 inches) into pavement.
  2. Anchor to walls as shown, expansion bolt if not shown.

### **3.6 GRATINGS**

- A. Set grating flush with finish floor; top of curb, or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.
- B. Set frame in formwork before concrete is placed.
- C. Where grating terminates at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.

- D. Secure removable supporting members in place with stainless steel bolts.
- E. Bolt gratings to supports.

### **3.7 STEEL LINTELS**

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding, except for openings in 150 mm (6 inch) masonry walls install lintels with longest leg horizontal.
- C. Install lintels to have not less than 150 mm (6 inch) bearing at each end for nonbearing walls, and 200 mm (8 inch) bearing at each end for bearing walls.

### **3.8 SHELF ANGLES**

- A. Anchor shelf angles with 19 mm (3/4 inch) bolts unless shown otherwise in adjustable malleable iron inserts, set level at elevation shown.
- B. Provide expansion space at end of members.

### **3.9 PLATE DOOR SILL**

- A. Install after roofing base flashing and counter flashing work is completed.
- B. Set in sealant and bolt to curb.

### **3.10 SAFETY NOSINGS**

- A. Except as specified and where preformed rubber treads are shown or specified install safety nosings at the following:
  - 1. Exterior concrete steps.
  - 2. Door sills of areaway entrances curbs.
  - 3. Exposed edges of curbs of door sills at transformer and service rooms.
  - 4. Interior concrete steps, including concrete filled treads of metal stairs of service stairs.
- B. Install flush with horizontal and vertical surfaces.
- C. Install nosing to within 100 mm (4 inches) of ends of concrete stair treads, except where shown to extend full width.
- D. Extend nosings full width of door openings.
- E. Extend nosings, full width between stringers of metal stairs, and terminate at point of curvature of steps having short radius curved ends.

### **3.11 RAILINGS**

- A. Steel Posts:
  - 1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
  - 2. Install sleeves in concrete formwork.

3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting as specified in Section 07 92 00, JOINT SEALANTS—on exterior posts.
4. Secure removable posts to concrete with either machine screws through flanged fittings which are secured to inverted flanges embedded in and set flush with finished floor, or set posts in close fitting pipe sleeves without grout.
5. Secure sliding flanged fittings to posts at base with set screws.
6. Secure fixed flanged fittings to concrete with expansion bolts.
7. Secure posts to steel with welds.

C. Anchor to Walls:

1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate.
  - a. Anchor steel plate to concrete or solid masonry with expansion bolts.
  - b. Anchor steel plate to hollow masonry with toggle bolts.
2. Anchor flanged fitting with toggle bolt to steel support in frame walls.

D. Removable Rails:

1. Rest rails in brackets at each end and secure to bracket with stainless steel bolts and nuts where part of a continuous railing.
2. Rest rail posts in sleeves where not part of a continuous railing. Do not grout posts.

E. Handrails:

1. Anchor brackets for metal handrails as detailed, per manufacturer's standard details with precast imbed plates as anchorage.
2. Install brackets within 300 mm (12 inches) of return of walls, and at evenly spaced intermediate points not exceeding 1200 mm (4 feet) on centers unless shown otherwise.
3. Expansion bolt to concrete, imbed plate, or solid masonry.
4. Toggle bolt to installed supporting frame wall and to hollow masonry unless shown otherwise.

**3.12 CLEAN AND ADJUSTING**

- A. Adjust movable parts including hardware to operate as designed without binding or deformation of the members centered in the opening or frame and, where applicable, contact surfaces fit tight and even without forcing or warping the components.
- B. Clean after installation exposed prefinished and plated items and items fabricated from stainless steel, aluminum and copper alloys, as

H.H. McGuire VAMC  
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Bid Documents  
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recommended by the metal manufacture and protected from damage until  
completion of the project.

- - - E N D - - -

**SECTION 05 70 00  
DECORATIVE METAL**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Decorative metal mesh with aluminum "U" frame.
  - 2. Aluminum framing members, structural design and connection details.

**1.3 COORDINATION**

- A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Fabricator and Installer to coordinate with Contractor and Precast Concrete provider for attachments, imbed plates and installation. Coordinated figures, products and details shall be exhibited in Action Submittals and structural engineering design.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal mesh and tube frame support.
  - 1. Include plans, elevations, component details, and attachment details.
  - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
  - 3. Provide structural engineered design and connections of aluminum tube frame supporting the metal mesh. Include anchor points and connection details.

- C. Samples for Initial Selection: For products involving selection of color, texture, or design
- D. Samples for Verification: For each type of exposed finish.
  - 1. Samples of welded joints showing quality of workmanship

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fabricator and Structural Engineer.
- B. Welding certificates.

**1.7 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Installer Qualifications: An installer with three years of experience in welded wire, woven wire, or metal mesh products indicated for this Project and with a record of successful performance with the submitted manufactures products.
- C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
  - 4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
- F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups for the following types of decorative metal:
    - a. Metal Mesh: Corner showing the metal mesh and metal U edge to be used and the connections.



2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

#### **1.9 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

### **PART 2 - PRODUCTS**

#### **2.1 DECORATIVE METALS**

- A. Subject to compliance with requirements, provide decorative metal and associated support system with appearance equivalent to the basis of design product:
  1. Manufacturer:
    - a. GKD: woven wire fabric 'OMEGA 1520'
    - b. CI Banker Wire + Iron Works: 'M12Z-16'
    - c. CAMBRIDGE : woven wire fabric 'MATTE'
    - d. MCNICHOLS METAL; Metal Mesh "Airline"
  2. Finish: STAINLESS STEEL.

#### **2.2 METALS, GENERAL**

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

#### **2.3 ALUMINUM**

- A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Pipe and "U" Shapes: ASTM B 429/B 429M, Alloy 6063-T6.
- D. Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.

- E. Plate and Sheet: ASTM B 209 (ASTM B 209M).
- F. Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

#### **2.4 STEEL AND IRON**

- A. Tubing: ASTM A 500/A 500M (cold formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M unless otherwise indicated.
- E. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.

#### **2.5 FASTENERS**

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Items: Aluminum fasteners.
  - 2. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
  - 3. Galvanized-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
  - 4. Dissimilar Metals: Use Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.
  - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group **1 (A1)** stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

## **2.6 MISCELLANEOUS MATERIALS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal items shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer complying with MPI#26.
- I. Epoxy Intermediate Coat for Steel: Complying with MPI#77 and compatible with primer and topcoat.
- J. Polyurethane Topcoat for Steel: Complying with MPI#72 and compatible with undercoat.
- K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

**2.7 FABRICATION, GENERAL**

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Make up wire-ropes assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- C. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- E. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- G. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- H. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- I. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- J. Comply with AWS for recommended practices in shop welding behind finished surfaces without distorting or discoloring exposed side.

Clean exposed welded joints of flux, and dress exposed and contact surfaces.

1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 Welds: completely sanded joint, some undercutting and pinholes okay.

- K. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

## **2.8 FINISHES, GENERAL**

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

## **2.9 ALUMINUM FINISHES**

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## **2.10 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M.
  1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
  2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. Preparing Galvanized Items for Shop Priming: After galvanizing, thoroughly clean decorative metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION, GENERAL**

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
  - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article.

Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

- H. Field Brazing: Comply with requirements for brazing and for finishing brazed connections in "Fabrication, General" Article. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.
- I. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### **3.3 CLEANING AND PROTECTION**

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint in accordance with manufacturer's recommendations.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- E. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- F. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

--END--

**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section specifies wood blocking, framing, sheathing, furring, nailers, and rough hardware construction.

**1.2 RELATED WORK:**

- A. Metal Wall Panels: Section 07 40 00 ROOFING AND SIDING PANELS.
- B. Gypsum sheathing: Section 09 29 00, GYPSUM BOARD.
- C. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Protect lumber and other products from dampness both during and after delivery at site.
- B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.
- C. Stack plywood and other board products so as to prevent warping.
- D. Locate stacks on well drained areas, supported at least 150 mm (6 inches) above grade and cover with well ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

**1.5 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Forest and Paper Association (AFPA):  
National Design Specification for Wood Construction  
NDS-05.....Conventional Wood Frame Construction
- C. American Institute of Timber Construction (AITC):  
A190.1-07.....Structural Glued Laminated Timber
- D. American Society of Mechanical Engineers (ASME):  
B18.2.1-96(R2005).....Square and Hex Bolts and Screws  
B18.2.2-87.....Square and Hex Nuts  
B18.6.1-97.....Wood Screws  
B18.6.4-98(R2005).....Thread Forming and Thread Cutting Tapping Screws  
and Metallic Drive Screws



E. American Plywood Association (APA):

E30-07.....Engineered Wood Construction Guide

F. American Society for Testing And Materials (ASTM):

A47-99(R2009).....Ferritic Malleable Iron Castings

A48-03(R2008).....Gray Iron Castings

A653/A653M-10.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-10.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness

C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D143-09.....Small Clear Specimens of Timber, Method of Testing

D1760-01.....Pressure Treatment of Timber Products

D2559-10.....Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions

D3498-11.....Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

F844-07.....Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-08.....Nails, Spikes, and Staples

G. Federal Specifications (Fed. Spec.):

MM-L-736C.....Lumber; Hardwood

H. Commercial Item Description (CID):

A-A-55615.....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Military Specification (Mil. Spec.):

MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated

J. Truss Plate Institute (TPI):

TPI-85.....Metal Plate Connected Wood Trusses

K. U.S. Department of Commerce Product Standard (PS)

PS 1-95.....Construction and Industrial Plywood

PS 20-05.....American Softwood Lumber Standard

**PART 2 - PRODUCTS**

**2.1 LUMBER:**

- A. Unless otherwise specified, each piece of lumber bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
  - 1. Identifying marks in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
  - 2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.
- B. Lumber Other Than Structural:
  - 1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
  - 2. Framing lumber: Minimum extreme fiber stress in bending of 1100.
  - 3. Furring, blocking, nailers and similar items 100 mm (4 inches) and narrower Standard Grade; and, members 150 mm (6 inches) and wider, Number 2 Grade.
- C. Sizes:
  - 1. Conforming to Prod. Std., PS20.
  - 2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.
- D. Moisture Content:
  - 1. At time of delivery and maintained at the site.
  - 2. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.
  - 3. Lumber over 50 mm (2 inches) thick: 25 percent or less.
- E. Fire Retardant Treatment:
  - 1. Mil Spec. MIL-L-19140 with piece of treated material bearing identification of testing agency and showing performance rating.
  - 2. Treatment and performance inspection, by an independent and qualified testing agency that establishes performance ratings.
- F. Preservative Treatment:
  - 1. Do not treat Heart Redwood and Western Red Cedar.
  - 2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 600 mm (24 inches) from ground; nailers, edge strips, blocking,

crickets, curbs, cant, vent strips and other members used in connection with roofing and flashing materials.

3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with ASTM D1760, except any process involving the use of Chromated Copper arsenate (CCA) for pressure treating wood is not permitted.

## **2.2 ROUGH HARDWARE AND ADHESIVES:**

### **A. Anchor Bolts:**

1. ASME B18.2.1 and ANSI B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
2. Extend at least 200 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

### **B. Miscellaneous Bolts: Expansion Bolts: C1D, A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Use 13 mm (1/2 inch) bolt unless shown otherwise.**

### **C. Washers**

1. ASTM F844.
2. Use zinc or cadmium coated steel or cast iron for washers exposed to weather.

### **D. Screws:**

1. Wood to Wood: ANSI B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

### **E. Nails:**

1. Size and type best suited for purpose unless noted otherwise. Use aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
2. ASTM F1667:
  - a. Common: Type I, Style 10.
  - b. Concrete: Type I, Style 11.
  - c. Barbed: Type I, Style 26.
  - d. Underlayment: Type I, Style 25.
  - e. Masonry: Type I, Style 27.
  - f. Use special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.

### **F. Adhesives:**

1. For field-gluing plywood to lumber framing floor or roof systems: ASTM D3498.

2. For structural laminated Wood: ASTM D2559.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS:**

- A. Conform to applicable requirements of the following:
  1. AFPA National Design Specification for Wood Construction for timber connectors.
  2. AITC Timber Construction Manual for heavy timber construction.
  3. AFPA WCD-number 1, Manual for House Framing for nailing and framing unless specified otherwise.
  4. APA for installation of plywood or structural use panels.
  5. ASTM F 499 for wood underlayment.
  6. TPI for metal plate connected wood trusses.
- B. Fasteners:
  1. Nails.
    - a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA Manual for House Framing where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
    - b. Use special nails with framing connectors.
    - c. For sheathing and subflooring, select length of nails sufficient to extend 25 mm (1 inch) into supports.
    - d. Use eight penny or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
    - e. Use 16 penny or larger nails for nailing through 50 mm (2 inch) thick lumber.
    - f. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.
    - g. Nailing Schedule; Using Common Nails:
      - 1) Joist bearing on sill or girder, toe nail three-8d or framing anchor
      - 2) Bridging to joist, toe nail each end two-8d
      - 3) Ledger strip to beam or girder three-16d under each joint.
      - 4) Subflooring or Sheathing:
        - a) 150 mm (6 inch) wide or less to each joist face nail two-8d.
        - b) Subflooring, more than 150 mm (6 inches) wide, to each stud or joint, face nail three-8d.
        - c) Plywood or structural use panel to each stud or joist face nail 8d, at supported edges 150 mm (6 inches) on center and at intermediate supports 250 mm (10 inches) on center. When

gluing plywood to joint framing increase nail spacing to 300 mm (12 inches) at supported edges and 500 mm (20 inches) o.c. at intermediate supports.

- 5) Sole plate to joist or blocking, through sub floor face nail 20d nails, 400 mm (16 inches) on center.

2. Bolts:

- a. Fit bolt heads and nuts bearing on wood with washers.
- b. Countersink bolt heads flush with the surface of nailers.
- c. Embed in concrete and solid masonry or use expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
- d. Use toggle bolts to hollow masonry or sheet metal.
- e. Use bolts to steel over 2.84 mm (0.112 inch, 11 gage) in thickness. Secure wood nailers to vertical structural steel members with bolts, placed one at ends of nailer and 600 mm (24 inch) intervals between end bolts. Use clips to beam flanges.

3. Drill Screws to steel less than 2.84 mm (0.112 inch) thick.

- a. ASTM C1002 for steel less than 0.84 mm (0.033 inch) thick.
- b. ASTM C 954 for steel over 0.84 mm (0.033 inch) thick.

4. Power actuated drive pins may be used where practical to anchor to solid masonry, concrete, or steel.

5. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Use metal plugs, inserts or similar fastening.

6. Screws to Join Wood:

- a. Where shown or option to nails.
- b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.
- c. Spaced same as nails.

7. Installation of Timber Connectors:

- a. Conform to applicable requirements of the NFPA National Design Specification for Wood Construction.
- b. Fit wood to connectors and drill holes for fasteners so wood is not split.

C. Set sills or plates level in full bed of mortar on masonry or concrete walls.

1. Space anchor bolts 1200 mm (4 feet) on centers between ends and within 150 mm (6 inches) of end. Stagger bolts from side to side on plates over 175 mm (7 inches) in width.

2. Use shims of slate, tile or similar approved material to level wood members resting on concrete or masonry. Do not use wood shims or wedges.
3. Closely fit, and set to required lines.
- D. Cut notch, or bore in accordance with NFPA Manual for House-Framing for passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.
- E. Blocking Nailers, and Furring:
  1. Install furring, blocking, nailers, and grounds where shown.
  2. Use longest lengths practicable.
  3. Use fire retardant treated wood blocking where shown at openings and where shown or specified.
  4. Layers of Blocking or Plates:
    - a. Stagger end joints between upper and lower pieces.
    - b. Nail at ends and not over 600 mm (24 inches) between ends.
    - c. Stagger nails from side to side of wood member over 125 mm (5 inches) in width.
- F. Bridging:
  1. Use 25 mm by 75 mm (1 inch by 3 inch) lumber with ends beveled for slope. Option: Metal bridging may be used for wood bridging.
  2. Install one row of bridging for joist spans over 2400 mm (8 feet), but less than 4800 mm (16 feet) long; install two rows for spans over 4800 mm (16 feet) long.
  3. Install an extra row of bridging between trimmer and next two joists if header is more than 600 mm (2 feet) from end of trimmer or from regular row of bridging.
  4. Secure with two nails at ends.
  5. Leave bottom ends loose until after subflooring or roof sheathing is installed.
  6. Install single row of bridging at centerline of span and two rows at the third points of span unless otherwise shown.
- G. Rough Bucks:
  1. Install rough wood bucks at opening in masonry or concrete where wood frames or trim occur.
  2. Brace and maintain bucks plumb and true until masonry has been built around them or concrete cast in place.
  3. Cut rough bucks from 50 mm (2 inch) thick stock, of same width as partitions in which they occur and of width shown in exterior walls.
  4. Extend bucks full height of openings and across head of openings; fasten securely with anchors specified.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

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**SECTION 07 13 52**  
**MODIFIED BITUMINOUS SHEET WATERPROOFING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies modified bituminous sheet material used for exterior below grade waterproofing located on the exterior of the elevator shaft walls.

**1.2 MANUFACTURER'S QUALIFICATIONS:**

- A. Approval by Architect/Engineer (A/E) as indicated in Div 01 is required of products and services of proposed manufacturers, and installers, and will be based upon submission by Contractor that:
  - 1. Manufacturer regularly and presently manufactures bituminous sheet waterproofing as one of its principal products.
  - 2. Installer has technical qualifications, experience, trained personnel and facilities to install specified items.
  - 3. Manufacturer's product submitted has been in satisfactory and efficient operation on three similar installations for at least three years.
  - 4. Submit list of installations, include name and location of project and name of owner.

**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. Bituminous sheet.
  - 2. Primer.
  - 3. Mastic.
  - 4. Protection material, temporary and permanent.
  - 5. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 6. Printed installation instructions for conditions specified.
- C. Certificates:
  - 1. Indicating bituminous sheet manufacturer's approval of primer, and roof cement.
  - 2. Indicating bituminous sheet waterproofing manufacturer's qualifications as specified.
  - 3. Approval of installer by bituminous sheet manufacturers.



4. Water test report.

- D. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING:**

- A. Deliver materials to job in manufacturer's original unopened container.
- B. Do not store material in areas where temperature is lower than 10 degrees C (50 degrees F,) or where prolonged temperature is above 32 degrees C (90 degrees F).

**1.5 ENVIRONMENTAL REQUIREMENTS:**

Ambient Surface and Material Temperature: Not less than 4 degrees C (40 degrees F), during application of waterproofing.

**1.6 WARRANTY:**

Warrant bituminous sheet waterproofing installation against moisture leaks and subject to terms of "Warranty of Construction".

**1.7 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- UU-B-790A.....Building Paper, Vegetable Fiber: (Kraft, Water-INT AMD 1 Proof, Water Repellent and Fire Resistant)
- C. American Society for Testing and Materials (ASTM):
- C578-10.....Rigid Cellular Polystyrene Thermal Insulation
- D41-11.....Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
- D2822-05.....Asphalt Roof Cement
- D6380-03(R2009).....Asphalt Roll Roofing (Organic Felt)
- D. American Hardboard Association (AHA):
- A135.4-1995.....Basic Hardboard

**PART 2 - PRODUCTS**

**2.1 BITUMINOUS SHEET:**

- A. Cold applied waterproofing membrane composed primarily of modified bituminous material prefabricated in sheet form designed for below grade exterior and split slab waterproofing. Sheet reinforced with fibers at manufacturer's option.

- B. Thickness of Bituminous Sheet: 1.5 mm (60 mils), plus or minus 0.13 mm (5 mils), and bonded to a 0.1 mm (4 mil) thick plastic sheet.
- C. Provide with a release sheet to prevent bonding of bituminous sheet to itself.

## **2.2 PRIMER AND ROOF CEMENT:**

- A. Furnished by manufacturer of bituminous sheet as required for particular application in accordance with sheet manufacturer's instructions.
- B. Primer: ASTM D41.
- C. Roof Cement: ASTM D4586.

## **2.3 PROTECTION MATERIAL:**

- A. Polystyrene: ASTM C578, Type I or VIII, 13 mm (1/2-inch) minimum thickness.
- B. Hardboard: PS-58, Service Type, 6 mm (1/4-inch) thick.

## **2.4 PATCHING COMPOUND:**

A factory prepared, non-shrinking, fast setting, cementitious adhesive compound containing no ferrous metal or oxide.

# **PART 3 - EXECUTION**

## **3.1 PREPARATION:**

- A. Surface Condition:
  - 1. Before applying waterproofing materials, ensure concrete and masonry surfaces are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion.
  - 2. Fill voids, joints, and cracks with patching compound.
- B. Concrete surfaces cured a minimum of seven days, free from release agents, concrete curing agents, and other contaminants.

## **3.2 APPLICATION:**

- A. Priming:
  - 1. Prime concrete and masonry surfaces.
  - 2. Application method, amount of primer and condition or primer before installation of bituminous sheet as recommended by primer manufacturer.
  - 3. Reprime when required in accordance with manufacturer's instructions.
- B. Bituminous Sheet Installation:
  - 1. Remove release sheet prior to application.

2. Lay bituminous sheet from low point to high point so that laps shed water.
3. Treat expansion, construction and control joints and evident working cracks as expansion joints. Apply bituminous sheet in double thickness over joint by first applying a strip of bituminous sheet not less than 200 mm (8 inches) wide, centered over joint.
4. Lap seams not less than 50 mm (2 inches).
5. Lay succeeding sheet with laps, and roll or press into place.
6. Repair misaligned or inadequately lapped seams in accordance with manufacturer's instructions.
7. Seal seams and terminations in accordance with sheet manufacturer's instructions.

C. Corner Treatment:

1. At inside and outside corners apply double cover using an initial strip not less than 280 mm (11 inches) wide, centered along axis of corner.
2. Cover each strip completely by the regular application of bituminous sheet.
3. Provide a fillet or cant on inside corners.
4. Form cants using patching compound
5. Do not use wood, fiber, and insulating materials for cants.

D. Projection Treatment:

1. Apply a double layer of bituminous sheet around pipes and similar projections at least 150 mm (6 inches) wide.
2. At drains, apply a bead of roof cement over a double layer of bituminous sheet under clamping rings.

**3.3 PROTECTION:**

- A. Protect bituminous sheet before backfill or wearing courses are placed.
- B. Install protection material and hold in place in accordance with instructions of manufacturer of waterproofing materials.
- C. Permanent Protection:
  1. Vertical Surfaces:
    - a. Install hardboard, polystyrene, or roll roofing protection material.
    - b. Extend protection full height from footing to top of backfill.
    - c. If graded backfill is used, use roll roofing or hardboard.
- D. Horizontal Surfaces:

1. Install roll roofing protection under concrete wearing courses.
2. Install roll roofing, hardboard, or polystyrene under earth backfill.
3. Where no concrete wearing course occurs or when surfaces will bear heavy traffic and will not immediately be covered with a wearing course, use protection specified for vertical surfaces.

**E. Temporary Protection:**

When waterproofing materials are subjected to damage by sunlight and can not be immediately protected as specified, protect waterproofing materials by suitable coating approved by manufacturer of waterproofing system used.

**3.4 PATCHING:**

Repair tears, punctures, air blisters, and inadequately lapped seams, in accordance with manufacturer's instructions before protection course is applied.

**3.5 TESTING:**

- A. Before any protection or wearing course is applied, test all horizontal applications of waterproofing with a minimum of 25 mm (1-inch) head of water above highest point and leave for 24 hours.
- B. Mark leaks and repair when waterproofing is dry.
- C. Certify, to A/E, that water tests have been made and that areas tested were found watertight.

**3.6 INSPECTION:**

Do not cover waterproofed surfaces by other materials or backfill until work is approved by A/E.

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**SECTION 07 18 16**  
**VEHICULAR TRAFFIC COATINGS (DECK COATING)**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Conditions of Contract for Construction and General Requirements of Division 1 of these Specifications apply to Work in this Section.

**1.2 WORK INCLUDED**

- A. Work of this Section shall include furnishing all labor, materials, equipment and supervision to install a deck coating system, including surface preparation and crack and joint detailing.
- B. Deck coating Installer shall be specifically responsible for providing all preparation Work and joint sealants specified in Section 07 92 00, Joint Sealants.

**1.3 RELATED WORK**

- A. Following Work is related to this Section:
1. Cast-in-Place Concrete, Section 03 30 00
  2. Joint Sealants, Section 07 92 00
  3. Pavement Markings, Section 32 17 23

**1.4 QUALITY CONTROL**

- A. General:
1. Deck coating Installer shall be approved by deck coating Manufacturer.
  2. Installer shall have a minimum of five (5) years experience in application of one of the approved deck coating systems and have experience for a project in size of 5,000 SF or greater.
  3. Installer and Manufacturer shall review slope of slabs and condition of surfaces prior to bidding.
  4. Manufacturer shall make available a qualified Manufacturer's Representative to assist the Installer and Engineer as specified herein. Representative shall be experienced in placement of deck coating systems.
- B. Testing Requirements:
1. Installer shall check deck coating wet film thickness and record test results by taking five wet film readings within a 1 SF area. Wet film thickness testing shall be completed a minimum of once per every 5,000 SF of deck coating placed or per individual section placed per day. Average film thickness shall be at or above wet film thickness equivalent of specified dry film thickness.

2. Manufacturer's Representative shall perform dry film thickness tests and record test results for base coat and total system. One set of three readings shall be taken in a single 100 SF area. Average dry film thickness shall be at or above Manufacturer's calculated average dry film thickness for total system based on specified dry film thickness plus aggregate.
  3. Manufacturer and Installer in presence of Engineer shall perform adhesive pull-off strength testing on base membrane and completed system in accordance with ASTM D 4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers. One set of three tests shall be taken in a single 100 SF area. This testing can be performed in conjunction with dry film thickness testing. All test results shall be greater than 100 psi.
  4. If thickness and pull-off strength testing do not meet above requirements, corrective action will be required.
  5. Test damage is to be repaired by Installer per Manufacturer's recommendations.
- C. Flood Test: Contractor shall arrange for and wet all slabs with water for purpose of detecting any defects in waterproofing which would result in leaks. Slab surfaces shall be wetted until water flows freely to drains. No finished spaces shall be insulated or ceiling installed until drainage test has been completed on the slab above and reviewed by Engineer for acceptance.
1. Potentially leaks are located by noting whether water from flood test is observed at underside of slabs or running down faces of walls. Leaking attributed to defective traffic bearing membrane shall be corrected by repairing waterproofing.

#### 1.5 SUBMITTALS

- A. For record certification that the deck coating system is compatible with all of products in Divisions 3, 7, 9, and 32 to which it will come in contact.
- B. For review and approval a complete description of deck coating system proposed, including materials, surface preparation, and cure times, including repair materials for pitting, bug holes, popouts, and shallow scaling, and cure times and including aggregates.
- C. For review and approval Manufacturer's Spec Data Sheets of each product to be used.
- D. For record Material Safety Data Sheets of each product, solvent, or related chemicals to be used and certification that materials conform to local, state, and federal environmental and worker's safety laws and regulations.
- E. For review and approval standard color chart.
- F. For record ASTM C 957 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface test results for thin deck coatings.
- G. For review and approval sample Warranty prior to application.

- H. For review and approval upon request qualifications of Manufacturer's Representative.
- I. For record results of slab moisture testing completed in accordance with ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method.
- J. For record dry and wet film thickness test results and adhesive testing results. Include date, weather, and other pertinent information.
- K. For record upon request written certification that Installer is approved by Manufacturer.
- L. For record upon request qualification statement of Installer stating projects, size, location, owner and contact, engineer/architect and contact for projects that deck coating system has been applied.

#### **1.6 SAMPLES**

- A. Submit for review and approval, 12 inch square samples of deck coating system representative of color, thickness, and surface texture. Samples may also be requested for chemical analysis.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Manufacturer and Installer are required to confirm that all deck coating materials used in accordance with this Section conform to local, state, and federal environmental and workers' safety laws and regulations.
  - 1. VOC content of materials shall not exceed limits per Environmental Protection Agency Natural Volatile Organic Compound Emission Standards for Architectural Coatings (40CFR59).
- B. Installer is solely responsible for fume control and shall take all necessary precautions against injury to personnel or adjacent building occupants during application. As a minimum, Installer shall take the following precautions:
  - 1. Provide and maintain barricades.
  - 2. Locate and protect building air intakes during application.
  - 3. Follow all state, federal, and local safety regulations.
  - 4. Follow all Manufacturer's safety requirements.
  - 5. Dispose empty containers immediately and properly.
  - 6. Use protective equipment.
  - 7. Ensure Work area is well vented to outside.

#### **1.8 TRANSPORTATION AND HANDLING**

- A. Deliver all materials to site in original, unopened containers, bearing following information:
  - 1. Name of product
  - 2. Name of Manufacturer
  - 3. Date of Manufacturer
  - 4. Lot or batch number
  - 5. UL Labels

- B. Store materials under cover, protected from weather, within Manufacturer's recommended temperatures ranges.
- C. Replace containers or materials showing any signs of damage with new material at no additional cost to Owner.
- D. At no time shall weight of stored material placed on a slab area exceed 30 PSF or 2,000 lbs. over 20 square inches.

#### **1.9 WARRANTY**

- A. Provide to Owner a Warranty by Installer and Manufacturer that deck coating system will be free of defects, water penetration, and chemical damage related to system design, workmanship or material deficiency, consisting of, but not limited to:
  - 1. Surface crazing of other weathering deficiency (including ultraviolet light exposure).
  - 2. Abrasion or tear failure resulting from normal traffic use.
  - 3. Tear failure resulting from new or existing cracks in substrate not exceeding 1/16 inch in width.
  - 4. Debonding from substrate or delaminating between layers.
  - 5. Defective installation.
  - 6. Debonding or damage of repair material used for filling in pitting, bug holes, popouts, and shallow scaling with concrete or deck coating material.
- B. Warranty shall provide at no charge to Owner materials and labor needed to properly repair or replace product and replace parking stripes within duration of Warranty.
- C. Vandalism, abrasive maintenance equipment, and construction traffic are not normal traffic use and are exempt from Warranty.
- D. New concrete may experience shrinkage. Installer shall provide system suitable for such application. Warranty shall cover deck coating damage due to new concrete slab cracking not exceeding 1/16 inch.

#### **1.10 WARRANTY DURATION**

- A. Bid price shall include a year Warranty commencing with date of project acceptance in accordance with General Conditions.
- B. Although completed areas of facility may be opened to traffic and parking, commencement of Warranty period will not occur prior to acceptance of entire project.
- C. A single Warranty commencement date will apply to all waterproofing.

### **PART 2 - PRODUCTS**

#### **2.1 DECK COATING - GENERAL**

- A. Deck coating system shall be a fluid applied, waterproof, traffic bearing elastomeric membrane capable of preventing penetration of concrete by water, gasoline, oils, greases, salts, deicer chemicals, battery acids and radiator coolants.



- B. Color of deck coating shall be gray with Owner selecting shade of gray from standard color chart submittal.
- C. Material to fill in pitting, bug holes, popouts, and shallow scaling shall be in accordance with Manufacturer's written recommendations.
- D. Same Manufacturer's deck coating system shall be used throughout.
- E. Deck coating thicknesses specified herein are minimum dry film thicknesses and do not include the aggregate. Specified thicknesses may vary from Manufacturer's literature. A coat may have to be installed in more than one layer to achieve minimum thickness or on ramps a slope grade version of deck coating material shall be used. Install each coat in accordance with Manufacturer's recommended yield for required thickness.
- F. Thinner or solvent shall not be added to deck coating materials.
- G. All deck coating exposed to sunlight, including areas at perimeter of structure on lower levels, shall utilize a UV stable topcoat.

## **2.2 DECK COATING SYSTEM**

- A. Provide a heavy duty coating system as indicated on Drawings.
- B. Approved heavy duty deck coating systems are:
  - 1. Iso-Flex 750U-HL HVT, LymTal International, Inc., Orion, MI. Primer, base coat at 25 mils, grit coat at 25 mils and top coat at 12 mils.
  - 2. Auto-Gard Double Texture, Neogard Corporation, Dallas, TX. Primer, base coat at 25 mils, grit coat at 25 mils, and top coat at 12 mils.
  - 3. Sonoguard, BASF Building Systems, Shakopee, MN. Primer, base coat at 25 mils, grit coat at 25 mils, and top coat at 12 mils.
  - 4. CCW5123-HD, Carlisle Coatings & Waterproofing, Wylie, TX. Primer, base coat at 25 mils, grit coat at 25 mils and top coat at 12 mils.
  - 5. Sikalastic 710/715, Sika Corporation, Lyndhurst, NJ. Primer, base coat at 25 mils, grit coat at 25 mils, top coat at 12 mils.
  - 6. Vulkem 350NF/345/346, Tremco, Cleveland, OH. . Primer, base coat at 25 mils, grit coat at 25 mils, top coat at 12 mils.

## **2.3 DECK COATING AGGREGATE**

- A. Approved aggregates for medium and heavy duty deck coating systems are:
  - 1. #10 Granusil, Unimin, Ottawa, MN.
  - 2. 16-30 Fracsand, Oglebay Norton Industrial Sands, Inc., Brady, TX.
  - 3. T16/30, Badger Mining Corporation, Berlin, WI.
  - 4. or Approved Equivalent.
- B. Approved aggregates for extra heavy duty deck coating systems are basalt aggregate (traprock) as follows:
  - 1. Emeri-crete, Portsmouth, NH.
  - 2. Or Approved Equivalent.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Inspect surfaces to receive Work and report immediately in writing to Engineer as required in General Conditions any deficiencies in surface which render it unsuitable for proper execution of this Work. Do not proceed with Work until unsatisfactory conditions have been corrected in an acceptable manner in accordance with Engineer.
- B. Coordinate and verify that related Work meets following requirements:
  - 1. Concrete surfaces are finished, cleaned and prepped, and have completed required curing period.
  - 2. Previous surface treatments have been removed or are compatible with the systems to be installed.
  - 3. Systems selected for use are compatible with each other.
  - 4. All concrete repairs are completed.
  - 5. Sealant installation may occur several months prior to deck coating. Installer to repair damaged or defective sealants prior to deck coating installation.

#### **3.2 PREPARATION**

- A. Remove all oil, grease spots, and contaminates in accordance with Manufacturer's recommendations.
- B. Shotblast all concrete surfaces to receive deck coating. Shotblast equipment performance requirements are as follows:
  - 1. Equipment shall be capable of traveling at a constant speed to provide uniform profile. Speed and size of equipment and size of steel shot shall be selected to provide desired preparation without causing unnecessary damage to concrete surface.
  - 2. Equipment shall vacuum up, or otherwise retain all dirt, dust, and debris from blasting operation.
  - 3. Areas inaccessible to shotblaster (i.e. vertical surfaces, against walls, columns, stairways, etc.) are to be abrasive blasted or abraded to same performance.
  - 4. Shotblasted surface must be clean with a profile in which a minimum 1/16 inch of existing concrete surface is removed. Fine aggregates must be exposed; however, coarse aggregate must not be exposed. All laitance must be removed. Surface profile to match ICRI CSP5 in accordance with ICRI Guideline No. 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
  - 5. Remove debris immediately after surface preparation. Debris includes, but is not limited to, shot, aggregate and dust. Debris shall be placed in a covered dumpster or a covered area where it will not be rebroadcast by wind or weather.

- C. Metal surfaces that are to be deck coated shall be abrasive blasted to near white metal, SSPC SP10 in accordance with Steel Structures Painting Council Painting Manual. Rust inhibitive primer shall be installed in accordance with Manufacturer's recommendations within 8 hours of abrasive blasting.
- D. Rout and seal cracks greater than 15 mils in accordance with Section 07 92 00, Joint Sealants or as required by the Manufacturer. Cracks, coves, terminations and all unusual situations shall be detailed per Manufacturer's recommendations.
- E. Installer shall be responsible for repair or replacement of all materials damaged by surface preparation operations.
- F. Surfaces shall be air blown with sufficient pressure to remove excess dirt, dust and debris, and to assure that concrete is clean prior to application of deck coating.
- G. After shotblasting and abrasive blasting and prior to first coat of deck coating, pitting, bug holes, popouts, and shallow scaling shall be prepared in accordance with Manufacturer's recommendations. As a minimum, a thin epoxy mortar shall be used to fill voids.

### **3.3 INSTALLATION/APPLICATION**

- A. Do all Work in strict accordance with Manufacturer's written instructions and specifications and as indicated herein.
- B. Do not apply deck coating materials until concrete has been air dried at temperatures at or above 40 degrees F. for at least 28 days after curing period specified in Section 03 30 00, Cast-In-Place Concrete, or as otherwise approved by Manufacturer.
- C. Concrete shall be dry prior to application of deck coating. Installer shall perform slab moisture testing in accordance with ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. Testing must be performed in at least 1 location for every 10,000 SF of coating. Use of heat lamps for performing tests may be required in areas not exposed to sunlight.
- D. Air temperatures directly below and above the slab being coated must be maintained at a minimum of 50 degrees F up to 48 hours prior to coating and at 60 degrees F for a minimum of 72 hours after coating, or as required for full curing of material.
- E. All deck coating shall maintain straight edges at terminations.
- F. Surfaces to be deck coated shall be divided into areas in accordance with the Manufacturer's recommended yield for the specified thickness and for specific container size of material. Area is to be divided by keel marks, or another Engineer approved method.
- G. All sealants to be provided adequate cure time, minimum 8 hours, to be tack free prior to deck coating. All construction joints, control joints, joints at perimeter of patches, cold joints and cracks (sealed and unsealed) shall receive a detail coat, minimum of 4 inches wide. Detail coat shall be same thickness as base coat unless Manufacturer's requirements are more strict. Detail coat shall cure a minimum of 12 hours prior to base coating.
- H. Extend deck coating up vertical surfaces as indicated on Drawings.

- I. Incorporate aggregate until refusal. Aggregate until refusal will result in a surface that is tan in color. Additional aggregate may have to be added after first pass.
- J. Complete all Work under this Section before painting line stripes.
- K. If larger containers than 10 gallon pails and/or pumps are used, following items shall be performed.
  - 1. Submit three weeks before start of construction, plans and calculations indicating how system will be installed.
  - 2. No containers larger than 55 gallon drums
  - 3. All containers numbered consecutively with numbering unique to each container.
  - 4. Maximum of one pump and two power rollers/sprayers.
  - 5. Deck coating installed in one grid at a time. Quantity of material to determine one grid size shall be 27.5 gallons (1/2 maximum drum size).
  - 6. Develop method of measuring material in container or drum as it is being used, as approved by Engineer.
  - 7. If Work is phased and Manufacturer's yield is not met in accordance with this specification, then the use of pumps will be immediately discontinued, and maximum application grid size will be readjusted to correspond to 10 gallon pails.
  - 8. If after initial phase the Manufacturer's yield is consistently and uniformly met, then one more pump and two more power rollers/sprayers may be used with Engineer's approval. Each pump shall have its own operator and be used for separate grids.

#### **3.4 DAMAGE AND REPAIRS**

- A. Any necessary repairs for deck coating resulting from dry film testing are to be repaired by Installer.
- B. Pinholing of deck coating will be cause for rejection. Installer shall repair and take necessary steps to prevent pinholing to occur at no additional expense to Owner.

#### **3.5 CLEANUP**

- A. Remove all excess primer, sealant, deck coating, and masking materials from structure.

---END---

**SECTION 07 19 16**  
**SILANE WATER REPELLENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Conditions of Contract for Construction and General Requirements of Division 1 of these Specifications apply to Work in this Section.

**1.2 WORK INCLUDED**

- A. Work of this Section shall include furnishing all labor, materials, equipment and supervision to install concrete sealer including surface preparation. Sealer application areas as indicated on the drawings.

**1.3 RELATED WORK**

- A. The following Work is related to this Section:
1. Testing Laboratory Services, Section 01 45 29
  2. Cast-in-Place Concrete, Section 03 30 00
  3. Joint Sealants, Section 07 92 00
  4. Pavement Marking, Section 32 17 23

**1.4 QUALITY CONTROL**

- A. General
1. Sealer Installer shall be approved by sealer Manufacturer.
  2. Sealer Installer shall have a minimum of three (3) years experience in application of one of the approved concrete sealers and have experience for a project in size of 25,000 SF or greater.
  3. Manufacturer is to individually code each sealer drum prior to shipping. Each drum is to be specifically and permanently identified with markings provided both on drum and removable drum cap (drum seal). A listing of this identification, along with Manufacturer's invoice, is to be submitted to Engineer prior to sealer application. Each cap is to be submitted to Engineer with appropriate pay request. No payment will be made for material if properly identified cap is not submitted.
  4. Manufacturer shall make available a qualified Representative to assist Installer and Engineer as specified herein. Representative shall be experienced in placement of the sealer. As a minimum, Representative shall be on site to review the following:
    - a. Trial area preparation and sealer installation.
    - b. First phase of concrete surface sealer installation.
  5. Contractor shall notify Engineer 5 days in advance prior to installing sealer.

B. Trial Area Requirements

1. Prepare three 100 SF trial areas of concrete surface incorporating all of the required preparation. Engineer, Manufacturer's Representative, and Installer shall be in agreement that surface preparation in trial areas is satisfactory before preparation of concrete surfaces is continued.
2. Apply sealer in two of the 100 SF trial areas to review method of application and verify that treated surface is not glazing. One of the 100 SF areas is to remain untreated. If sealer causes glazing, Manufacturer's Representative shall provide written recommendations for solving problem. Engineer, Manufacturer's Representative, and Installer shall be in agreement that application in trial areas is satisfactory before further application of sealer.
3. Manufacturer shall obtain two core samples for each of two 100 SF trial areas that were treated and 100 SF trial area left untreated. Appropriate tests shall be performed on concrete core samples to determine product compatibility, recommended surface preparation, application rate, and to establish baseline for level of chloride ions, depth of penetration, and water absorption in accordance with Warranty requirements of this Section.

**1.5 SUBMITTALS**

- A. For record certification that concrete sealer is compatible with all products in Divisions 3, 7, 9 and 32 to which it will come in contact.
- B. For review and approval Manufacturer's Spec Data Sheets of each product to be used.
- C. For record Material Safety Data Sheets of each product, solvent, or related chemicals to be used and certification that the materials conform to local, state, and federal environmental and worker's safety laws and regulations.
- D. For review and approval upon request qualifications of Manufacturer's Representative.
- E. For record upon request qualification statement of Installer stating projects, size and location.
- F. For record sequence of sealer placement. Note: Sealer installation shall be coordinated to allow required minimum concrete cure times.
- G. For record upon request certification that sealer delivered to site conforms to all published data and that sealer chemical composition is same as that tested under NCHRP 244, Concrete Sealers for Protection of Bridge Structures.

- H. For record results of slab moisture testing completed in accordance with ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method.
- I. For record certification of trial area acceptance.
- J. For record, listing of drum seal identification and drum seal caps.
- K. For record copies of purchase orders indicating quantities of sealer.
- L. For record results of core samples.
- M. For review and approval sample Warranty prior to application.

#### **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Manufacturer and Installer are required to confirm that all materials used in accordance with this Section conform to local, state, and federal environmental and workers' safety laws and regulations.
  - 1. VOC content of materials shall not exceed the limits per Environmental Protection Agency National Volatile Organic Compound Emission Standards for Architectural Coatings (40CFR59).
- B. Installer is solely responsible for fume control and shall take all necessary precautions against injury to personnel or adjacent building occupants during application. As a minimum, Installer shall take the following precautions:
  - 1. Provide and maintain barricades.
  - 2. Locate and protect building air intakes during application.
  - 3. Follow all state, federal, and local safety regulations.
  - 4. Follow all Manufacturer's safety requirements.
  - 5. Dispose empty containers immediately and properly.
  - 6. Use protective equipment.
  - 7. Ensure work area is well vented to the exterior.

#### **1.7 TRANSPORTATION AND HANDLING**

- A. Deliver sealer to site in original, unopened containers, bearing following information:
  - 1. Name of product
  - 2. Name of Manufacturer
  - 3. Date of manufacture
  - 4. Lot or batch number
- B. Store sealer under cover and protected from weather.
- C. Replace containers showing any signs of damage with new material at no additional cost to Owner.

- D. At no time shall the weight of the stored material placed on a slab area exceed 30 PSF or 2,000 lbs. over 20 square inches.

#### **1.8 WARRANTY**

- A. Provide to Owner a Warranty indicating square footage and actual rate of application and indicating that new concrete surfaces treated with sealer will meet following:
  - 1. Surfaces will not absorb more than 250 ppm of soluble chloride at a depth of 1-1/4 to 1-3/4 inches over an established soluble chloride baseline for duration of Warranty. Testing to be completed in accordance with AASHTO T 260.
  - 2. Surfaces will not absorb more than 1.0 percent water by weight over established water absorption baseline for duration of Warranty. Testing to be completed in accordance with ASTM D 6489 - Standard Test Method for Determining Water Absorption of Hardened Concrete Treated with a Water Repellant Coating.
- B. Warranty shall provide at no charge to Owner materials and labor needed to properly repair or replace product and replace parking stripes within duration of Warranty.
- C. Approximately one year prior to end of Warranty concrete shall be tested by Manufacturer against baseline tests for level of chloride ions, depth of penetration, and water absorption. Concrete core samples shall be taken at Owner's expense at baseline locations and forwarded to Manufacturer for testing. At Owner's discretion, additional cores may be forwarded to an independent testing agency for simultaneous testing.
- D. If sealer fails to meet requirements set forth in Warranty, material shall be reapplied at no expense to Owner. Retreatment of surfaces shall be governed by effectiveness as determined in nearest adjacent test site and shall not extend to other areas where sealer performance is within specified limits.

#### **1.9 WARRANTY DURATION**

- A. The bid price shall include a five (5) year Warranty for 40 percent silanes commencing with date of project acceptance in accordance with Section 01 00 00, General Requirements and Section 01 77 00, Closeout Procedures.
- B. Although completed areas of facility may be opened to traffic and parking, commencement of Warranty period will not occur prior to acceptance of entire project. A single Warranty commencement date will apply to all waterproofing.



## **PART 2 - PRODUCTS**

### **2.1 CONCRETE SEALER**

- A. Sealer shall be water based penetrating silane chemical capable of reducing ingress of water and chlorides. Sealer to contain fugitive dye for application verification.
- B. Sealer to have minimum of 40 percent solids with a VOC content meeting requirements of this specification. Application rate to be a maximum of 125 SF per gallon. Maximum application rate is not to be modified for actual solids content.
- C. Approved water based silane sealers are:
  - 1. Enviroseal 40, Hydrozo, BASF Building Systems, Shakopee, MN.
  - 2. Iso-Flex 618-40 WB, LymTal International, Inc., Orion, MI.
  - 3. Aqua-trete BSM 40, Sivento, Inc., subsidiary of Degussa-Huls Corporation, Somerset, NJ.
  - 4. Or approved equivalent

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Inspect surfaces to receive Work and report immediately in writing to Engineer as required in General Conditions any deficiencies in surface which render it unsuitable for proper execution of this Work. Do not proceed with Work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of Work implies acceptance of related Work.
- B. Coordinate and verify that related Work meets the following requirements:
  - 1. Concrete surfaces have been finished, cleaned and prepped, as recommended by Manufacturer for system to be installed.
  - 2. Curing compounds used on concrete surfaces have been removed.
  - 3. Concrete surfaces have completed proper curing period for system selected.

### **3.2 PREPARATION**

- A. Remove all oil, grease, and contaminants in accordance with Manufacturer's recommendations.
- B. All surfaces shall be air blown with sufficient pressure to remove excess dirt, dust and debris, and to assure that concrete is clean prior to application of sealer.
- C. Installer shall be responsible for repair or replacement of all materials damaged by surface preparation operations.

### 3.3 INSTALLATION/APPLICATION

- A. Do all Work in strict accordance with Manufacturer's written instructions and specifications and as indicated on Drawings.
- B. Do not apply sealer until the concrete has been air dried at temperatures at or above 40degrees F. for at least 28 days after curing period specified in Section 03 30 00, Cast-In-Place Concrete or as otherwise approved by Manufacturer.
- C. Concrete must be dry prior to application of concrete sealer. Contractor shall perform slab moisture testing in accordance with ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method. Testing must be performed in at least one (1) location for every 25,000 SF of sealer. The use of heat lamps for performing tests may be required in areas not exposed to sunlight.
- D. In event of surface wetting all concrete to be treated shall be air dried for at least 72 hours at temperatures above 50 degrees F. immediately before applying sealer.
- E. Ambient and concrete temperatures shall be between 40 and 100 degrees F.
- F. Do not apply sealer until crack, control, construction, and cove sealants are fully cured.
- G. Apply concrete sealer after silicone sealants have fully cured a minimum of 14 days. Do not allow 100 percent silanes to puddle on silicone sealants as the silicone sealants will swell.
- H. Use following applicable method(s) to apply sealer:
  - 1. Low pressure hand sprayer
  - 2. Spray distribution bar
  - 3. Brush and roller
- I. When pressurized distribution equipment is used to apply sealer, use flow-controlled and pressure regulated equipment.
- J. Surfaces to be sealed shall be divided into areas in accordance with specified yield for specific container size of sealer. Area is to be divided by chalk lines, keel marks, or another Engineer approved method. Sealer shall be applied by placing material directly within grid.
- K. Sealer shall be applied at numerical rate (125 SF per gallon) specified unless a lower numerical rate (SF per gallon) is required to meet Warranty requirements based on testing completed core samples.

**3.4 CLEANUP**

- A. Clean all surfaces subjected to sealer overspray and repair all damage caused by overspray to adjacent construction or property at no cost to Owner.
- B. Remove all masking materials.

---END---

**SECTION 07 22 00  
ROOF AND DECK INSULATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Roof and deck insulation, and cover board on new construction ready to receive roofing or waterproofing membrane.
- B. Repairs and alteration work to existing roof insulation.

**1.2 RELATED WORK**

- A. General sustainable design documentation requirements: Section 01 81 13 SUSTAINABLE DESIGN REQUIREMENTS.
- B. Wood cants, blocking, and edge strips: Section 06 10 00, ROUGH CARPENTRY.
- C. Sheet metal components and wind uplift requirements for roof-edge design: Section 07 60 00, FLASHING AND SHEET METAL.

**1.3 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only. Editions of applicable publications current on date of issue of bidding documents apply unless otherwise indicated.
- B. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE):
  - 90.1-07.....Energy Standard for Buildings Except Low-Rise Residential Buildings
- C. ASTM International (ASTM):
  - C208-08.....Cellulosic Fiber Insulating Board
  - C552-07.....Cellular Glass Thermal Insulation
  - C726-05.....Mineral Fiber Roof Insulation Board
  - C728-05.....Perlite Thermal Insulation Board
  - C1177/C1177M-08.....Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
  - C1278/C1278M-07.....Standard Specification for Fiber-Reinforced Gypsum Panel
  - C1289-10.....Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

- C1396/C1396M-09.....Standard Specification for Gypsum Board
- D41-05.....Asphalt Primer Used in Roofing, Dampproofing,  
and Waterproofing
- D312-06.....Asphalt Used in Roofing
- D1970-09.....Standard Specification for Self-Adhering  
Polymer Modified Bituminous Sheet Materials  
Used as Steep Roofing Underlayment for Ice Dam  
Protection
- D2178-04.....Asphalt Glass Felt Used in Roofing and  
Waterproofing
- D2822-05.....Asphalt Roof Cement
- D4586-07.....Standard Specification for Asphalt Roof Cement,  
Asbestos-Free
- E84-09.....Standard Test Method for Surface Burning  
Characteristics of Building Material
- F1667-05.....Driven Fasteners: Nails, Spikes, and Staples
- D. FM Approvals: RoofNav Approved Roofing Assemblies and Products.
- 4450-89.....Approved Standard for Class 1 Insulated Steel  
Deck Roofs
- 4470-10.....Approved Standard for Class 1 Roof Coverings
- 1-28-09.....Loss Prevention Data Sheet: Design Wind Loads.
- 1-29-09.....Loss Prevention Data Sheet: Above-Deck Roof  
Components
- 1-49-09.....Loss Prevention Data Sheet: Perimeter Flashing
- E. National Roofing Contractors Association: Roofing and Waterproofing  
Manual
- F. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog,  
[www.biopreferred.gov](http://www.biopreferred.gov)
- G. Underwriters Laboratories, Inc. (UL): Fire Resistance Directory (2009)
- H. U.S. Department of Commerce National Institute of Standards and  
Technology (NIST):
- DOC PS 1-09.....U.S. Product Standard for Construction and  
Industrial Plywood
- DOC PS 2-04.....Performance Standard for Wood-Based Structural-  
Use Panels.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Thermal Performance: Provide roof insulation meeting minimum overall average R-value of 10, with minimum R-value at any location of 5.
- B. FM Approvals: Provide roof insulation complying with requirements in FM Approvals 4450 and 4470 as part of specified roofing system, listed in FM Approvals "RoofNav" as part of roofing system meeting Fire/Windstorm Classification in Division 07 roofing section.

#### **1.5 QUALITY CONTROL**

- A. Requirements of Division 07 roofing section for qualifications of roofing system insulation Installer; Work of this Section shall be performed by same Installer.
- B. Requirements of Division 07 roofing section for inspection of Work of this Section and qualifications of Inspector.
- C. Unless specified otherwise, comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to insulation for storage, handling, and application.
- D. Requirements of roofing system uplift pressure design for specified roofing system.
- E. Requirements of applicable FM Approval for specified roofing system insulation attachment.
- 1.
- G. Bio-Based Materials: Where applicable, provide products designated by USDA and meeting or exceeding USDA recommendations for bio-based content, and products meeting Rapidly Renewable Materials and certified sustainable wood content definitions; refer to [www.biopreferred.gov](http://www.biopreferred.gov).

#### **1.6 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
  - 1. Roofing cement, each type.
  - 2. Roof insulation, each type.
  - 3. Substrate board, each type.
  - 4. Cover board, each type.
  - 5. Fastening requirements.
  - 6. Insulation span data for flutes of metal decks.
- C. Shop Drawings: Include plans, sections, details, and attachments.
  - 1. Nailers, cants, and terminations.

2. Layout of insulation showing slopes, tapers, penetration, and edge conditions.

D. Samples:

1. Roof insulation, each type.
2. Nails and fasteners, each type.

E. Certificates:

1. Indicating type, thermal conductance, and minimum and average thickness of insulation.
2. Indicating materials and method of application of insulation system meet the requirements of FM Approvals for specified roofing system.

F. Laboratory Test Reports: Thermal values of insulation products.

G. Layout of tapered roof system showing units required.

H. Documentation of supervisors' and inspectors' qualifications.

**1.7 DELIVERY, STORAGE AND MARKING**

- A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to built-up roofing for storage, handling and installation requirements.

**1.8 QUALITY ASSURANCE:**

- A. Roof insulation on combustible or steel decks shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E84, or shall have successfully passed FM Approvals 4450.
  1. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in-lieu-of copies of test reports.
  2. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the particular type used for this project and the construction is listed as fire-classified in the UL Building Materials Directory or listed as Class I roof deck construction in the FM Approvals "RoofNav."
  3. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

## **PART 2 - PRODUCTS**

### **2.1 ADHESIVE MATERIALS**

- A. Adhesive Materials, General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.
1. Liquid-type adhesive materials shall comply with VOC limits of authorities having jurisdiction.
  2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Multipurpose Construction Adhesives: 70 g/L.
    - c. Fiberglass Adhesives: 80 g/L.
    - d. Contact Adhesives: 80 g/L.
    - e. Other Adhesives: 250 g/L.
    - f. Nonmembrane Roof Sealants: 300 g/L.
    - g. Sealant Primers for Nonporous Substrates: 250 g/L.
    - h. Sealant Primers for Porous Substrates: 775 g/L.
- B. Primer: ASTM D41.
- .
- C. Bead-Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Full-Spread Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. Roof Cement: Asbestos free, ASTM D2822, Type I or Type II, ; or, D4586, Type I or Type II.

### **2.2 ROOF AND DECK INSULATION**

- A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer and listed as component of FM Approvals-approved roofing system.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.



**F. Tapered Roof Insulation System:**

1. Fabricate of mineral fiberboard, polyisocyanurate, perlite board, or cellular glass. Use only one insulation material for tapered sections. Use only factory-tapered insulation.
2. Cut to provide high and low points with crickets and slopes as shown.
3. Minimum thickness of tapered sections; 38 mm (1-1/2 inch).
4. Minimum slope 1:48 (1/4 inch per 12 inches).

**2.3 INSULATION ACCESSORIES**

A. Glass (Felt): ASTM D2178, Type VI, heavy duty ply sheet.

**B. Cants and Tapered Edge Strips:**

1. Wood Cant Strips: Refer to Division 06 Section "Rough Carpentry."
2. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
3. Tapered Edge Strips: 1:12 (one inch per foot), from 0 mm (0 inches), 300 mm to 450 mm (12 inches to 18 inches) wide.
  - a. Cellulosic Fiberboard: ASTM C208.
  - b. Mineral Fiberboard: ASTM C726.
  - c. Perlite Board: ASTM C728.

**E. Cover Board:**

1. Glass-mat, water-resistant gypsum substrate, ASTM C1177/C1177M, 6 mm (1/4 inch) thick, factory primed.

**2.4 FASTENERS**

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening substrate board to roof deck.
- B. Staples and Nails: ASTM F1667. Type as designated for item anchored and for substrate.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Comply with requirements of Division 07 roofing section.

**3.2 PREPARATION**

- A. Comply with requirements of Division 07 roofing section.

### 3.5 RIGID INSULATION INSTALLATION

#### A. Insulation Installation, General:

1. Install roof insulation in accordance with roofing system manufacturer's written instructions.
2. Install roof insulation in accordance with requirements of FM Approval's Listing for specified roofing system.
3. Base Sheet: Where required by roofing system, install one lapped base sheet specified in Division 07 roofing section by mechanically fastening to roofing substrate prior to installation of insulation.
4. Cant Strips: Install preformed insulation cant strips at junctures of roofing system with vertical construction.

#### B. Insulation Thickness:

1. Thickness of roof insulation shown on drawings is nominal. Actual thickness shall provide the average thermal resistance "R" value of not less than that specified in Performance Requirements Article.
2. Insulation on Metal Decks: Provide minimum thickness of insulation for metal decks recommended by the insulation manufacturer to span rib opening (flute size) of metal deck used. Support edges of insulation on metal deck ribs.
3. When thickness of insulation to be used is more or less than that shown on the drawings, make adjustments in the alignment and location of roof drains, flashing, gravel stops, fascias and similar items at no additional cost to the Government.
4. Where tapered insulation is used, the thickness of the insulation at high points and roof edges shall be as shown on the drawings; the thickness at the low point (drains) shall be not less than 38 mm (1-1/2 inches).
5. Use not less than two layers of insulation when insulation is 68 mm (2.7 inch) or more in thickness unless specified otherwise. Stagger joints minimum 150 mm (6 inches).

#### C. Lay insulating units with close joints, in regular courses and with cross joints broken. When laid in more than one layer, break joints of succeeding layers of roof insulation with those in preceding layer.

#### D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of the roofing felt.

#### E. Seal all cut edges at penetrations and at edges against blocking with bitumen or roof cement.

- F. Cut to fit tight against blocking or penetrations.
- G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.
- H. Installation Method:
  - 1. Adhered Insulation:
    - a. Prime substrate as required.
    - b. Set each layer of insulation firmly in solid mopping of hot asphalt.
    - c. Set each layer of insulation firmly in ribbons of bead-applied insulation adhesive.
    - d. Set each layer of insulation firmly in uniform application of full-spread insulation adhesive.
  - 2. Cover Board: Install cover boards over insulation with long joints in continuous straight lines with staggered end joints. Offset cover board joints from insulation joints minimum 150 mm (6 inches). Fasten cover boards according to "Adhered Insulation" requirements.

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**SECTION 07 40 00**  
**ROOFING AND SIDING PANELS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies uninsulated metal Fascia panels as shown.

**1.2 RELATED WORK**

- A. Sealant: Section 07 92 00, JOINT SEALANTS.
- B. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 MANUFACTURER'S QUALIFICATIONS**

Metal Fascia panels shall be products of a manufacturer regularly engaged in the fabrication and erection of metal panels of the type and design shown and specified.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Metal panel, 150 mm (six inch) square, showing finish, each color and texture.
- C. Shop Drawings: Fascia and roof panels, showing details of construction and installation, thickness and kind of material, closures, flashing, fastenings and related components and accessories.
- D. Manufacturer's Literature and Data: Wall and roof panels

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extend referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A653/A653M-10 ..... Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - A463-10 ..... Steel Sheet, Cold-Rolled, Aluminum-Coated, by the Hot-Dip Process
  - A924/A924M-10 ..... Steel Sheet, Metallic Coated by the Hot-Dip Process
  - A1008/A1008M-10 ..... Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy
  - B209/209M-07 ..... Aluminum and Aluminum Alloy Sheet and Plate
  - C1396-11 ..... Standard Specification for Gypsum Board
  - C553-08 ..... Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C591-09..... Unfaced Preformed Rigid Cellular  
Polyisocyanurate Thermal Insulation  
C612-10..... Mineral Fiber Block and Board Thermal  
Insulation  
E119-10..... Fire Test of Building Construction and  
Materials

## **PART 2 - PRODUCTS**

A. Provide metal Fascia panel equivalent to the following basis of design product:

1. Berridge "L-Panel" metal Wall panel; 24 gage; smooth profile with no grooves; color Zinc-Cote.

### **2.1 SHEET STEEL**

A. Minimum 24 gage for Fascia and roof panels.

B. Steel, Sheet, Galvanized: ASTM A653/A653M, Structural.

1. Grade 40, galvanized coating conforming to ASTM A924/A924M, Class Z 275 G-90.

C. Steel, Sheet, Commercial: ASTM A1008, Type C.

### **2.2 ALUMINUM PLATE AND SHEET**

ASTM B209/209M

### **2.3 FASTENERS**

Fasteners for steel panels shall be galvanized or cadmium plated steel.

Fasteners for aluminum panels shall be aluminum or stainless steel.

### **2.4 GYPSUM BACKING BOARD**

A. GLASS MAT SHEATHING 5/8" thick, Plain face, Square edge.

### **2.5 UNDERLAYMENT**

A. Use water barrier wrap as underlayment over gypsum backing board.

Ensure wrap provides a continuous water barrier.

### **2.6 FABRICATION**

A. Metal Fascia panels shall be uninsulated single sheets, formed to be approximate overall 11 5/8" wide by 1" deep and in the configuration shown on drawings. Connection between panels shall be by interlocking. Furnish Fascia panels in one continuous length for full height or at least one story height with no horizontal joints, except at openings. Construct panels as follows:

1. Fascia panels:
  - a. 24 gage aluminum-zinc alloy coated steel sheet.
3. Accessories and flashing shall be the same material as the panels. Thickness and installation of accessories and flashing shall be as recommended by the panel manufacturer.

## **2.7 FINISH**

- A. For uninsulated Fascia panels, the finishes shall be as follows for aluminumized steel sheets:
1. Finish shall be full strength Kynar 500® or Hylar 5000™ fluoropolymer coating applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of min 0.75 mil over min 0.20 mil prime coat, to provide a total top side dry film thickness of min 0.95 mil. Bottom side shall be coated with a primer and urethane coating with a total dry film thickness of min 0.35mil.
- B. Aluminum alloy used for color coating shall be as required to produce specified color. Color shall be as specified in Section 09 06 00, SCHEDULE FOR FINISHES. Color for sheet aluminum shall not deviate more than the colors of extrusion samples.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install panels in accordance with the manufacturer's approved erection instructions and diagrams, except as specified otherwise. Panels shall be in full and firm contact with supports and with each other at side and end laps. Where panels are cut in the field, or where any of the factory applied coverings or coatings are abraded or damaged in handling or installation, they shall, after the necessary repairs have been made with material of the same type and color as the weather coating, be approved before being installed. All cut ends and edges, including those at openings through the sheets shall be sealed completely. Correct defects or errors in the materials in an approved manner. Replace materials which cannot be corrected in an approved manner with nondefective material. Provide molded closure strips where indicated and whenever sheets terminate with open ends after installation.
- B. Fascia Panels: Apply panels with the configuration in a vertical position. Provide panels in the longest obtainable lengths, with end laps occurring only at structural members full heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Seal side and end laps with joint sealing material. Flash and seal walls at the base, at the top, around windows, door frames, framed louvers, and other similar openings. Install closure strips, flashings, and sealing material in an approved manner that will assure complete weather tightness. Flashing will not be required where approved "self-flashing" panels are used.

- C. Flashing: All flashing and related closures and accessories in connection with the preformed metal panels shall be provided as indicated and as necessary to provide a watertight installation. Details of installation, which are not indicated, shall be in accordance with the panel manufacturer's printed instruction and details, or the approved shop drawings. Installation shall allow for expansion and contraction of flashing.
- D. Fasteners: Fastener spacings shall be in accordance with the manufacturer's recommendations, and as necessary to withstand the design loads indicated. Install fasteners in valleys or crowns as recommended by the manufacturer of the sheet being used. Install fasteners in straight lines within a tolerance of 13 mm (1/2-inch) in the length of a bay. Drive exposed penetrating type fasteners normal to the surface, and to a uniform depth to seat gasketed washers properly, and drive so as not to damage factory applied coating. Exercise extreme care in drilling pilot holes for fastenings to keep drills perpendicular and centered in valleys, or crowns, as applicable. After drilling, remove metal filings and burrs from holes prior to installing fasteners and washers. Torque used in applying fasteners shall not exceed that recommended by the manufacturer. Remove panels deformed or otherwise damaged by over-torqued fastenings, and provide new panels. Remove metal shavings and filings from roofs on completion to prevent rusting and discoloration of the panels.

### **3.2 ISOLATION OF ALUMINUM**

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze, or other metal compatible with aluminum by one of the following:
  - 1. Painting the dissimilar metal with a prime coat of Zinc-Molybdate followed by two coats of aluminum paint.
  - 2. Placing a non-abrasive tape or gasket between the aluminum and the dissimilar metal.
- B. Paint aluminum in contact with or built into mortar, concrete, plaster, or other masonry materials with a coat of alkali-resistant bituminous paint.
- C. Paint aluminum in contact with wood or other absorptive materials, that may become repeatedly wet, with two coats of bituminous paint, or two coats of aluminum paint. Seal joints with caulking material.

### **3.3 PROTECTION AND CLEANING**

- A. Protect panels and other components from damage during and after erection, and until project is accepted by the Government.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

- B. After completion of work, all exposed finished surfaces of panels shall be cleaned of soil, discoloration and disfiguration. Touch-up abraded surfaces of panels.

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**SECTION 07 54 23**  
**THERMOPLASTIC POLYOLEFIN (TPO) ROOFING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Thermoplastic Polyolefin (TPO) sheet roofing adhered/ to roof deck.

**1.2 RELATED WORK**

- A. General sustainable design documentation requirements: Section 01 81 13  
SUSTAINABLE DESIGN REQUIREMENTS.
- B. Treated wood framing, blocking, and nailers: Section 06 10 00, ROUGH  
CARPENTRY
- C. Roof Insulation: Section 07 22 00, ROOF AND DECK INSULATION.
- D. Sheet metal components and wind uplift requirements for roof-edge  
design: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Roof hatches, equipment supports, dome type skylights, and gravity  
ventilators: Section 07 72 00, ROOF ACCESSORIES
- F. Miscellaneous items: Section 07 71 00, ROOF SPECIALTIES/ Section 07 72  
00, ROOF ACCESSORIES.

**1.3 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the  
extent referenced. Publications are referenced in the text by the basic  
designation only. Editions of applicable publications current on date of  
issue of bidding documents apply unless otherwise indicated.
- B. American National Standards Institute/Single-Ply Roofing Institute  
(ANSI/SPRI):  
ANSI/SPRI ES-1-03.....Wind Design Standard for Edge Systems Used with  
Low Slope Roofing Systems.
- C. American Society of Civil Engineers/Structural Engineering Institute  
(ASCE/SEI):  
ASCE/SEI-7-10.....Minimum Design Loads for Buildings and Other  
Structures
- D. ASTM International (ASTM):  
C67-09.....Standard Test Methods for Sampling and Testing  
Brick and Structural Clay Tile  
C140-09.....Standard Test Methods for Sampling and Testing  
Concrete Masonry Units and Related Units

- C1371-04.....Standard Test Method for Determination of  
Emittance of Materials Near Room Temperature  
Using Portable Emissometers
- C1549-04.....Standard Test Method for Determination of Solar  
Reflectance Near Ambient Temperature Using a  
Portable Solar Reflectometer
- D4263.....Standard Test Method for Indicating Moisture in  
Concrete by the Plastic Sheet Method
- D4434-06.....Standard Specification for Poly (Vinyl Chloride)  
Sheet Roofing
- D6878-08.....Standard Specification for Thermoplastic  
Polyolefin Based Sheet Roofing
- E108-10.....Standard Test Methods for Fire Tests of Roof  
Coverings
- E408-71(R2008).....Standard Test Methods for Total Normal Emittance  
of Surfaces Using Inspection-Meter Techniques
- E1918-06.....Standard Test Method for Measuring Solar  
Reflectance of Horizontal and Low-Sloped  
Surfaces in the Field
- E1980-01.....Standard Test Method for Measuring Solar  
Reflectance of Horizontal and Low-Sloped  
Surfaces in the Field
- E. American Society of Heating, Refrigeration, and Air Conditioning  
Engineers (ASHRAE)  
ASHRAE 90.1-2007.....Energy Standard for Buildings Except Low-Rise  
Residential Buildings, Appendix f.
- F. Cool Roof Rating Council:  
CRRC-1.....Product Rating Program, [www.coolroofs.org](http://www.coolroofs.org)
- G. FM Approvals: RoofNav Approved Roofing Assemblies and Products.  
4450-89.....Approved Standard for Class 1 Insulated Steel  
Deck Roofs  
4470-10.....Approved Standard for Class 1 Roof Coverings  
1-28-09.....Loss Prevention Data Sheet: Design Wind Loads.  
1-29-09.....Loss Prevention Data Sheet: Above-Deck Roof  
Components  
1-49-09.....Loss Prevention Data Sheet: Perimeter Flashing
- H. National Roofing Contractors Association: Roofing and Waterproofing  
Manual
- I. U.S. Department of Agriculture (USDA): USDA BioPreferred Catalog,  
[www.biopreferred.gov](http://www.biopreferred.gov)

J. U.S. Department of Energy (DoE): Roof Products Qualified Product List,  
[www.energystar.gov](http://www.energystar.gov)

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- B. Roofing System Energy Performance Requirements: Provide a roofing system identical to components that that have been successfully tested by a qualified independent testing and inspecting agency to meet the following requirements:
  - 1. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E1980 based on testing identical products by a qualified testing agency.
  - 2. Energy Performance, Aged: Provide roofing system with minimum three-year aged solar reflectance not less than 0.55 when tested in accordance with ASTM C1549 or ASTM E1918, and in addition, a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with ASTM C1371 or ASTM E408.
    - a. Provide roofing system with minimum three-year aged Solar Reflectance Index of not less than 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 BTU/h-ft<sup>2</sup> (12 W/m<sup>2</sup>K).

#### **1.5 QUALITY CONTROL**

- A. Installer Qualifications:
  - 1. Licensed or approved in writing by manufacturer to perform work under warranty requirements of this Section.
  - 2. Employ full-time supervisors knowledgeable and experienced in roofing of similar types and scopes, and able to communicate with owner and workers.
- B. Inspector Qualifications: Inspection of work by third-party technical inspector or technical representative of manufacturer experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer, not engaged in the sale of products.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute (RCI), retained by the Contractor or the Manufacturer and approved by the Manufacturer.

C. Product/Material Requirements:

1. Obtain products from single manufacturer or from sources recommended by manufacturer for use with roofing system and incorporated in manufacturer's warranty.
2. 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>

D. Roofing system design standard requirements:

1. Recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to modified bituminous sheet roofing for storage, handling and application.
2. Recommendations of FM Approvals 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
3. Recommendations of ANSI/SPRI ES-1 for roof edge design.
4. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
5. FM Approvals Listing: Provide roofing membrane, base flashing, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a roofing system and that are listed in FM Approvals "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
  - a. Fire/Windstorm Classification: Class 1A-75.
  - b. Hail Resistance: MH.

E. Pre-Roofing Meeting:

1. Upon completion of roof deck installation and prior to any roofing application, hold a pre-roofing meeting arranged by the Contractor and attended by the Roofing Inspector, Material Manufacturers Technical Representative, Roofing Applicator, Contractor, and COR (Contracting Officer's Representative).

2. Discuss specific expectations and responsibilities, construction procedures, specification requirements, application, environmental conditions, job and surface readiness, material storage, and protection.
3. Inspect roof deck at this time to:
  - a. Verify that work of other trades which penetrates roof deck is completed.
  - b. Determine adequacy of deck anchorage, presence of foreign material, moisture and unlevel surfaces, or other conditions that would prevent application of roofing system from commencing or cause a roof failure.
  - c. Examine samples and installation instructions of manufacturer.

#### **1.6 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, SAMPLES.
- B. Product Data:
  1. Adhesive materials.
  2. Membrane sheet roofing and flashing membrane.
  3. Roofing cement.
  4. Fastening requirements.
  5. Application instructions.
- C. Federal Sustainable Design Submittals:
  1. Product Test Reports: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
  2. Product Data for Federally-Mandated Bio-Based Materials: For roof materials, indicating USDA designation and compliance with definitions for bio-based products, Rapidly Renewable Materials, and certified sustainable wood content.
- D. Shop Drawings: Include plans, sections, details, and attachments.
  1. Base flashings and terminations.
- E. Certificates:
  1. Indicating materials and method of application of roofing system meets requirements of FM Approvals "RoofNav" for specified fire/windstorm classification.
- F. Contract Close-out Submittals:
  1. Maintenance Manuals.
  2. Warranty signed by installer and manufacturer.

### **1.7 DELIVERY, STORAGE AND HANDLING**

- A. Comply with the recommendations of the NRCA "Roofing and Waterproofing Manual" applicable to single ply membrane roofing for storage, handling and installation.

### **1.8 ENVIRONMENTAL REQUIREMENTS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Environmental Controls: Refer to Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Protection of interior spaces: Refer to Section 01 00 00, GENERAL REQUIREMENTS.

### **1.9 WARRANTY**

Roofing work subject to the terms of the Article "Warranty of Construction," FAR clause 52.246-21.

## **PART 2 - PRODUCTS**

### **2.1 TPO MEMBRANE ROOFING**

- A. TPO Sheet: ASTM D6878, internally fabric or scrim reinforced, 1.5 mm (60 mils) thick, with no backing.
  - 1. Color: White.

### **2.2 ACCESSORIES:**

- A. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as TPO sheet membrane.
- B. Bonding Adhesive: Manufacturer's standard, water based.
- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 25 by 3 mm (1 by 1/8 inch) thick; with anchors.
- D. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 25 mm wide by 1.3 mm (1 inch wide by 0.05 inch) thick, prepunched.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with FM Approvals 4470, designed for fastening membrane to substrate.

- F. Miscellaneous Accessories: Provide sealers, preformed flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories acceptable to manufacturer.

### **2.3 ADHESIVE AND SEALANT MATERIALS:**

- A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use, identical to materials utilized in approved listed roofing system, and compatible with roofing membrane.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION:**

- A. Examine substrates and conditions with roofing Installer and roofing inspector to verify compliance with project requirements and suitability to accept subsequent roofing work. Correct unsatisfactory conditions before proceeding with roofing work.
- B. Do not apply roofing if roof surface will be used for subsequent work platform, storage of materials, or staging or scaffolding will be erected thereon unless system is protected.

### **3.2 PREPARATION**

- A. Complete roof deck construction prior to commencing roofing work:
1. Install curbs, blocking, edge strips, nailers, cants, and other components where insulation, roofing, and base flashing is attached to, in place ready to receive insulation and roofing.
  2. Complete deck and insulation to provide designed drainage to working roof drains.
  3. Document installation of related materials to be concealed prior to installing roofing work.
- B. Dry out surfaces, including the flutes of metal deck that become wet from any cause during progress of the work before roofing work is resumed. Apply materials to dry substrates.
- C. Sweep decks to broom clean condition. Remove all dust, dirt or debris.
- D. Remove projections that might damage materials.
- E. Concrete Decks, except Insulating Concrete:

1. Test concrete decks for moisture prior to application of roofing materials. Test for capillary moisture by plastic sheet method according to ASTM D4263.
2. Prime concrete decks, including precast units, with primer as specified. Keep primer back four inches from joints in precast units.
3. Allow primer to dry before application of adhesive.

### **3.3 TEMPORARY PROTECTION**

- A. Install temporary protection when work is halted for an indefinite period or work is stopped when precipitation is imminent. Comply with approved temporary protection plan.
- B. Install temporary cap flashing over the top of base flashings where permanent flashings are not in place to provide protection against moisture entering the roof system through or behind the base flashing. Securely anchor in place to prevent blow off and damage by construction activities.
- C. Provide for removal of water or drainage of water away from the work.
- D. Provide temporary protection over installed roofing by means of duckboard walkways, plywood platforms, or other materials, as approved by COR, for roof areas that are to remain intact, and that are subject to foot traffic and damage. Provide notches in sleepers to permit free drainage.

### **3.4 INSTALLATION, GENERAL**

- A. FM Approvals Installation Standard: Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system as listed in FM Approval's "RoofNav" for fire/windstorm classification indicated. Comply with recommendations in FM Approvals' Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.
- B. NRCA Installation Standard: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations.
- C. Manufacturer Recommendations: Comply with roofing system manufacturer's written installation recommendations.
- D. Coordination with related work: Coordinate roof operations with roof insulation and sheet metal work so that insulation and flashings are installed concurrently to permit continuous roofing operations.
- E. Installation Conditions:



1. Apply dry roofing materials. Apply roofing work over dry substrates and materials.
2. Apply materials within temperature range and surface and ambient conditions recommended by manufacturer.
3. Except for temporary protection, do not apply materials during damp or rainy weather, during excessive wind conditions, nor while moisture (dew, snow, ice, fog or frost) is present in any amount in or on the materials to be covered or installed:
  - a. Do not apply materials when the temperature is below 4 deg. C (40 deg. F).
  - b. Do not apply materials to substrate having temperature of 4 deg. C (40 deg. F) or less.

### **3.5 INSTALLATION OF TPO ROOFING**

- A. Do not allow the membrane to come in contact with surfaces contaminated with asphalt, coal tar, oil, grease, or other substances which are not compatible with TPO.
- B. Install the membrane so the sheets run perpendicular to the long dimension of the insulation boards.
- C. Commence installation at the low point of the roof and work towards the high point. Lap the sheets so the flow of water is not against the edges of the sheet.
- D. Position the membrane so it is free of buckles and wrinkles.
- E. Roll sheet out on deck; inspect for defects as being rolled out and remove defective areas. Allow for relaxing before proceeding.
  1. Lap edges and ends of sheets 50 mm (two inches) or more as recommended by the manufacturer.
  2. Heat weld laps. Apply pressure as required. Seam strength of laps as required by ASTM D4434.
  3. Check seams to ensure continuous adhesion and correct defects.
  4. Finish edges of laps with a continuous beveled bead of sealant to sheet edges to provide smooth transition.
  5. Finish seams as the membrane is being installed (same day).
  6. Anchor perimeter to deck or wall as specified.
- F. Repair areas of welded seams where samples have been taken or marginal welds, bond voids, or skips occurs.
- G. Repair fishmouths and wrinkles by cutting to lay flat and installing patch over cut area extending 100 mm (four-inches) beyond cut.
- H. Membrane Perimeter Anchorage:

1. Install metal fastening strip at the perimeter of each roof level, curb flashing, expansion joints and similar penetrations as indicated and in accordance with membrane manufacturer's instructions on top of roof membrane to deck or wall.
2. Mechanically Fastened Metal Fastening Strip:
  - a. Set top of mechanical fastener set flush with top surface of the metal fastening strip. Space mechanical fasteners a maximum 300 mm (12 inches) on center starting 25 mm (one inch) from the end of the nailing strip.
  - b. When strips are cut round corners and eliminate sharp corners.
  - c. After mechanically fastening strip cover and seal strip with a six-inch wide roof membrane strip; heat weld to roof membrane and seal edges.
  - d. At roof edge metal, turn the membrane down over the front edge of the blocking or the nailer to below blocking. Secure the membrane to the vertical portion of the nailer; or, if required by the membrane manufacturer with fasteners spaced not over 300 mm (12 inches) on centers.
  - e. At parapet walls, intersecting building walls and curbs, secure the membrane to the structural deck with fasteners 300 mm (12 inches) on centers or as shown on NRCA manual.
- I. Adhered System:
  1. Apply adhesive in quantities required by roof membrane manufacturer.
  2. Fold sheet back on itself after rolling out and coat the bottom side of the membrane and the top of the deck with adhesive. Do not coat the lap joint area.
  3. After adhesive has set according to adhesive manufacturers application instruction, roll the membrane into the adhesive in a manner that minimizes voids and wrinkles.
  4. Repeat for other half of sheet. Cut voids and wrinkles to lay flat and clean for repair patch over cut area.

### **3.6 INSTALLATION OF FLASHING**

- A. Install flashings as the membrane is being installed. If the flashing can not be completely installed in one day, complete the installation until the flashing is in a watertight condition and provide temporary covers or seals.
- B. Flashing Roof Drains:
  1. Install roof drain flashing as recommended by the membrane manufacturer, generally as follows:

- a. Coordinate to set the metal drain flashing in asphalt roof cement, holding cement back from the edge of the metal flange.
  - b. Do not allow the roof cement to come in contact with the TPO roof membrane.
  - c. Adhere the TPO roof membrane to the metal flashing with the membrane manufacturer's recommended adhesive.
2. Turn down the metal drain flashing and TPO roof membrane into the drain body and install clamping ring and strainer.
- C. Installing TPO Base Flashing and Pipe Flashing:
  1. Install TPO flashing membranes to pipes, wall or curbs to a height not less than eight-inches above roof surfaces and 100 mm (four inches) on roof membrane.
    - a. Adhere flashing to pipe, wall or curb with adhesive.
    - b. Form inside and outside corners of TPO flashing membrane in accordance with NRCA manual. Form pipe flashing in accordance with NRCA manual use pipe boot.
    - c. Lap ends not less than 100 mm (four inches).
    - d. Heat weld flashing membranes together and flashing membranes to roof membranes. Finish exposed edges with sealant as specified.
    - e. Install flashing membranes in accordance with NRCA manual.
  2. Anchor top of flashing to walls or curbs with fasteners spaced not over 200 mm (eight inches) on centers. Use fastening strip on ducts. Use pipe clamps on pipes or other round penetrations.
  3. Apply sealant to top edge of flashing.
- D. Installing Building Expansion Joints:
  1. Install base flashing on curbs as specified.
  2. Coordinate installation with metal expansion joint cover or roof expansion joint system.
  2. Install flexible tubing 1-1/2 times width of joint over joint. Cover tubing with TPO flashing strip adhered to base flashing and lapping base flashing 100 mm (four inches). Finish edges of laps with sealants as specified.
- E. Repairs to membrane and flashings:
  1. Remove sections of TPO sheet roofing or flashing that is creased wrinkled or fishmouthed.
  2. Cover removed areas, cuts and damaged areas with a patch extending 100 mm (four inches) beyond damaged, cut, or removed area. Heat weld to roof membrane or flashing. Finish edge of lap with sealant as specified.

### **3.7 FIELD QUALITY CONTROL:**

- A. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of 5 full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports.
  - 1. Examine and probe seams in the membrane and flashing in the presence of COR and Membrane Manufacturer's Inspector.
  - 2. Probe edge of welded seams with a blunt tipped instrument. Use sufficient hand pressure to detect marginal welds, voids, skips, and fishmouths.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
  - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of roofing work where test results or inspections indicate that they do not comply with specified requirements.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### **3.8 PROTECTING AND CLEANING**

- A. Protect membrane roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of acceptance by Owner.
- C. Clean overspray and spillage from adjacent construction. Clean membrane and restore surface to like-new condition meeting solar reflectance requirements.

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**SECTION 07 72 00**  
**ROOF ACCESSORIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies copings, gravel stops, and fascias.

**1.2 RELATED WORK**

- A. Color and texture of finish: Section 09 06 00, SCHEDULE FOR FINISHES
- B. Sealant material and installation: Section 07 92 00, JOINT SEALANTS.
- C. Rigid insulations for roofing: Section 07 22 00, ROOF AND DECK  
INSULATION

**1.3 QUALITY CONTROL**

- A. All roof accessories shall be the products of manufacturers regularly engaged in producing the kinds of products specified.
- B. Each accessory type shall be the same and be made by the same manufacturer.
- C. Each accessory shall be completely assembled to the greatest extent possible before delivery to the site.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Representative sample panel of color anodized aluminum not less than 100 mm X 100 mm (four by four inches), except extrusions shall be a width not less than section to be used. Sample shall show coating with integral color and texture and shall include manufacturer's identifying label.
- C. Shop Drawings: Each item specified showing design, details of construction, installation and fastenings.
- D. Manufacturer's Literature and Data: Each item specified.
- E. Certificates: Stating that aluminum has been given specified thickness of anodizing.

**1.5 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification to the extend referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Material (ASTM):
  - B209/209M-07.....Aluminum and Aluminum Alloy-Sheet and Plate
  - B221/221M-08.....Aluminum-Alloy Extruded Bars, Rods, Wire,  
Shapes, and Tubes
  - C612-10.....Mineral Fiber Block and Board Thermal Insulation

D1187-97 (R2002).....Asphalt-Base Emulsions for Use as Protective  
Coatings for Metal

C. National Association of Architectural Metal Manufacturers (NAAMM):  
AMP 500-06.....Metal Finishes Manual

D. American Architectural Manufacturers Association (AAMA):  
2605-11.....High Performance Organic Coatings on  
Architectural Extrusions and Panels.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum, Extruded: ASTM B221/B221M.
- B. Aluminum Sheet: ASTM B209/B209M.
- C. Galvanized Sheet Steel: ASTM A526/A526M; G-90 coating.
- D. Insulation: ASTM C612, Class 1 or 2.
- E. Asphalt Coating: ASTM D 1187, Type I, quick setting.

### **2.2 COPINGS**

- A. Fabricate of aluminum not less than 2 -mm (0.08 inch thick
- B. Turn outer edges down each face of wall as shown.
- C. Maximum lengths of 3000 mm (10 feet).
- D. Shop fabricate external and internal corners as one piece assemblies with not less than 300 mm (12 inch) leg lengths.
- E. Provide 100 mm (four inch) wide 0.8 mm (0.032 inch) thick watertight joint covers.
- F. Provide anchor gutter bar of 0.8 mm (0.032 inch) thick with anchor holes formed for underside of joint.
- G. Provide concealed guttered splice plate of 0.8 mm (0.032 inch) thick with butyl or other resilient seal strips anchored to splice plate for underside of joint. Use galvanized steel anchor plate providing compression spring anchoring of coping cover.
- H. Finish: Anodized .

### **2.3 EXTRUDED ALUMINUM GRAVEL STOPS AND FASCIAS**

- A. Fabricate of aluminum not less than 2 mm (0.078 inch) thick.
- B. Turn fascia down face of wall and up above roof as shown.
- C. Maximum lengths of 3000 mm (10-feet).
- D. Shop fabricate external and internal corners as one piece assemblies with not less than 300 mm (12 inch) leg lengths.

- E. Provide 100 mm (four inch) wide 2 mm (0.078 inch) thick watertight joint covers with 150 mm (six inch) wide 0.8 mm (0.030 inch) thick underside joint flashing.

#### **2.4 EXTRUDED ALUMINUM FASCIA-CANT SYSTEM**

- A. The fascia-cant system consists of three pieces, an extruded aluminum fascia, a galvanized steel cant, and an aluminum compression clamp.
- B. Furnish in stock lengths of not more than 3000 mm (10 feet) long.
- C. Form fascia from not less than 2 mm (0.070 inch) thick aluminum. Provide four inch wide 0.8 mm (0.032-inch) thick concealed sheet aluminum joint cover plates in back of fascia.
- D. Form cant strip from galvanized steel not less than 0.8 mm (0.0299 inch) thick, to profile shown and design to hold lower edge of the fascia.
- E. Form compression clamp of not less than 0.8 mm (0.032 inch) thick aluminum designed to hold the top edge of the fascia and the built-up flashing.
- F. Internal and external corners:
  - 1. Factory fabricate and fully weld mitered joints.
  - 2. Furnish corner sections in manufacturers standard sizes.
- G. Factory fabricated fascia sump assemblies.
  - 1. Fabricate sump assemblies with stainless steel cores and extruded aluminum cover to match fascia-cant.
  - 2. Provide stainless steel outlet, tube sized to suit downspout and solder to core to make watertight.
  - 3. Furnish sump assembly in 500 mm (20 inch) minimum lengths.
- H. Factory fabricated scupper assemblies:
  - 1. Fabricate scupper assembly with extended plates to match fascia-cant in 500 mm (20 inch) minimum lengths.
  - 2. Extend outlet opening not less than 50 mm (two inches) with drip edge.
  - 3. Fabricate with stainless steel cores or sleeve to drain water from toe of cant and flash in to built-up roofing with 100 mm (4 inch) wide flange.
- I. Finish on aluminum: anodized.

#### **2.5 FINISH**

- A. In accordance with NAAMM Amp 500-505.
- B. Aluminum, Mill Finish: AA-MIX, as fabricated.
- C. Aluminum, Clear Finish: AA-C22A41 medium matte, clear anodic coating, Class 1, Architectural, 0.7 mils thick. .

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install roof accessories where shown.
- B. Secure with fasteners in accordance with manufacture's printed installation instructions and approved shop drawings unless shown otherwise.
- C. Coordinate to install insulation where shown; Section 07 22 00, ROOF AND DECK INSULATION.
- D. Comply with section 07 92 00, JOINT SEALANTS to install sealants where manufactures installation instructions require sealant.
- E. Coordinate with roofing work for installation of items in sequence to prevent water infiltration.
- F. Gravel Stops and Fascias:
  - 1. Install gravel stops and fascia with butt joints with approximately 6 mm (1/4 inch) space for expansion.
  - 2. Over each joint provide cover plates of sheet aluminum, complete with concealed sheet aluminum flashing, centered under each joint.
  - 3. Lap cover plates and concealed flashing over the gravel stop and fascia not less than four inches.
  - 4. Extend concealed flashing over built-up roofing, embed in roof cement and turn down over face of blocking at roof edge.
- G. Aluminum Coping:
  - 1. Install sections of coping with approximately 6 mm (1/4-inch) space between ends of sections.
  - 2. Center joint gutter bar and covers at joints and securely lock in place.
  - 3. When snap-on system is used insure front and back edges are locked in place.
- H. Fascia-Cant System:
  - 1. Install galvanized steel cant; coordinate with roofing work and after completion of roofing work install extruded aluminum fascia, concealed joint cover plate, and aluminum compression clamp, where shown.
  - 2. Install system to allow for expansion and contraction with 6 mm (1/4 inch) space between extruded aluminum members and galvanized steel cant as required by manufacturer of system.
  - 3. Offset joints in extruded aluminum members from galvanized steel cant joints.



### **3.2 PROTECTION OF ALUMINUM**

- A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with two coats of asphalt coating (complete coverage), or by separating the contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on side.
- B. Paint aluminum in contact with wood, concrete and masonry, or other absorptive materials, that may become repeatedly wet, with two coats of asphalt coating.

### **3.3 ADJUSTING**

Adjust expansion joints to close tightly and be watertight; insuring maximum allowance for building movement.

### **3.4 PROTECTION**

Protect roof accessories from damage during installation and after completion of the work from subsequent construction.

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**SECTION 07 84 00  
FIRESTOPPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Closures of openings in walls, floors, and roof decks against penetration of flame, heat, and smoke or gases in fire resistant rated construction.

**1.2 RELATED WORK**

**FIREPROOFING**

- A. Sealants and application: Section 07 92 00, JOINT SEALANTS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers literature, data, and installation instructions for types of firestopping and smoke stopping used.
- C. List of FM, UL, or WH classification number of systems installed.
- D. Certified laboratory test reports for ASTM E814 tests for systems not listed by FM, UL, or WH proposed for use.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in their original unopened containers with manufacturer's name and product identification.
- B. Store in a location providing protection from damage and exposure to the elements.

**1.5 WARRANTY**

Firestopping work subject to the terms of the Article "Warranty of Construction", FAR clause 52.246-21.

**1.6 QUALITY ASSURANCE**

FM, UL, or WH or other approved laboratory tested products will be acceptable.

**1.7 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):  
E84-10.....Surface Burning Characteristics of Building  
Materials

E814-11.....Fire Tests of Through-Penetration Fire Stops

C. Factory Mutual Engineering and Research Corporation (FM):

Annual Issue Approval Guide Building Materials

D. Underwriters Laboratories, Inc. (UL):

Annual Issue Building Materials Directory

Annual Issue Fire Resistance Directory

1479-10.....Fire Tests of Through-Penetration Firestops

E. Warnock Hersey (WH):

Annual Issue Certification Listings

**PART 2 - PRODUCTS**

**2.1 FIRESTOP SYSTEMS**

- A. Use either factory built (Firestop Devices) or field erected (through-Penetration Firestop Systems) to form a specific building system maintaining required integrity of the fire barrier and stop the passage of gases or smoke.
- B. Through-penetration firestop systems and firestop devices tested in accordance with ASTM E814 or UL 1479 using the "F" or "T" rating to maintain the same rating and integrity as the fire barrier being sealed. "T" ratings are not required for penetrations smaller than or equal to 100 mm (4 in) nominal pipe or 0.01 m<sup>2</sup> (16 sq. in.) in overall cross sectional area.
- C. Products requiring heat activation to seal an opening by its intumescence shall exhibit a demonstrated ability to function as designed to maintain the fire barrier.
- D. Firestop sealants used for firestopping or smoke sealing shall have following properties:
  - 1. Contain no flammable or toxic solvents.
  - 2. Have no dangerous or flammable out gassing during the drying or curing of products.
  - 3. Water-resistant after drying or curing and unaffected by high humidity, condensation or transient water exposure.
  - 4. When used in exposed areas, shall be capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.
- E. Firestopping system or devices used for penetrations by glass pipe, plastic pipe or conduits, unenclosed cables, or other non-metallic materials shall have following properties:

1. Classified for use with the particular type of penetrating material used.
  2. Penetrations containing loose electrical cables, computer data cables, and communications cables protected using firestopping systems that allow unrestricted cable changes without damage to the seal.
  3. Intumescent products which would expand to seal the opening and act as fire, smoke, toxic fumes, and, water sealant.
- F. Maximum flame spread of 25 and smoke development of 50 when tested in accordance with ASTM E84.
- G. FM, UL, or WH rated or tested by an approved laboratory in accordance with ASTM E814.
- H. Materials to be asbestos free.

### **BPART 3 - EXECUTION**

#### **3.1 EXAMINATION**

Submit product data and installation instructions, as required by article, submittals, after an on site examination of areas to receive firestopping.

#### **3.2 PREPARATION**

- A. Remove dirt, grease, oil, loose materials, or other substances that prevent adherence and bonding or application of the firestopping or smoke stopping materials.
- B. Remove insulation on insulated pipe for a distance of 150 mm (six inches) on either side of the fire rated assembly prior to applying the firestopping materials unless the firestopping materials are tested and approved for use on insulated pipes.

#### **3.3 INSTALLATION**

- A. Do not begin work until the specified material data and installation instructions of the proposed firestopping systems have been submitted and approved.
- B. Install firestopping systems with smoke stopping in accordance with FM, UL, WH, or other approved system details and installation instructions.
- C. Install smoke stopping seals in smoke partitions.

#### **3.4 CLEAN-UP AND ACCEPTANCE OF WORK**

- A. As work on each floor is completed, remove materials, litter, and debris.

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October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

- B. Do not move materials and equipment to the next-scheduled work area until completed work is inspected and accepted by the Resident Engineer.
- C. Clean up spills of liquid type materials.

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**SECTION 07 92 00**  
**JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

**1.2 RELATED WORK:**

- A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- C. Glazing: Section 08 80 00, GLAZING.
- D. Glazed aluminum curtain wall: Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.
- E. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION
- E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

**1.3 QUALITY CONTROL:**

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
  - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
  - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:

1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
2. Conduct field tests for each application indicated below:
  - a. Each type of elastomeric sealant and joint substrate indicated.
  - b. Each type of non-elastomeric sealant and joint substrate indicated.
3. Notify Resident Engineer seven days in advance of dates and times when test joints will be erected.

F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution: 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

#### **1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
  1. Caulking compound
  2. Primers
  3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

#### **1.5 PROJECT CONDITIONS:**

- A. Environmental Limitations:
  1. Do not proceed with installation of joint sealants under following conditions:
    - a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).
    - b. When joint substrates are wet.
- B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

**1.6 DELIVERY, HANDLING, AND STORAGE:**

- A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.
- B. Carefully handle and store to prevent inclusion of foreign materials.
- C. Do not subject to sustained temperatures exceeding 32° C (90° F) or less than 5° C (40° F).

**1.7 DEFINITIONS:**

- A. Definitions of terms in accordance with ASTM C717 and as specified.
- B. Back-up Rod: A type of sealant backing.
- C. Bond Breakers: A type of sealant backing.
- D. Filler: A sealant backing used behind a back-up rod.

**1.8 WARRANTY:**

- A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21.
- B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

**1.9 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):  
C509-06.....Elastomeric Cellular Preformed Gasket and  
Sealing Material.  
C612-10.....Mineral Fiber Block and Board Thermal  
Insulation.



- C717-10.....Standard Terminology of Building Seals and Sealants.
- C834-10.....Latex Sealants.
- C919-08.....Use of Sealants in Acoustical Applications.
- C920-10.....Elastomeric Joint Sealants.
- C1021-08.....Laboratories Engaged in Testing of Building Sealants.
- C1193-09.....Standard Guide for Use of Joint Sealants.
- C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- E84-09.....Surface Burning Characteristics of Building Materials.

C. Sealant, Waterproofing and Restoration Institute (SWRI).  
The Professionals' Guide

## **PART 2 - PRODUCTS**

### **2.1 SEALANTS:**

- A. S-1:
1. ASTM C920, polyurethane or polysulfide.
  2. Type M.
  3. Class 25.
  4. Grade NS.
  5. Shore A hardness of 20-40
- B. S-2:
1. ASTM C920, polyurethane or polysulfide.
  2. Type M.
  3. Class 25.
  4. Grade P.
  5. Shore A hardness of 25-40.
- C. S-3:
1. ASTM C920, polyurethane or polysulfide.
  2. Type S.
  3. Class 25, joint movement range of plus or minus 50 percent.
  4. Grade NS.
  5. Shore A hardness of 15-25.
  6. Minimum elongation of 700 percent.

D. S-4:

1. ASTM C920 polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-40.

E. S-5:

1. ASTM C920, polyurethane or polysulfide.
2. Type S.
3. Class 25.
4. Grade P.
5. Shore hardness of 15-45.

F. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.
6. Minimum elongation of 1200 percent.

G. S-7:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxycure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.

4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

**2.2 CAULKING COMPOUND:**

- A. C-1: ASTM C834, acrylic latex.
- B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

**2.3 COLOR:**

- A. Sealants used with exposed masonry shall match color of mortar joints.
- B. Sealants used with unpainted concrete shall match color of adjacent concrete.
- C. Color of sealants for other locations shall be light gray or aluminum, unless specified otherwise.
- D. Caulking shall be light gray or white as approved by the COR, unless specified otherwise.

**2.4 JOINT SEALANT BACKING:**

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers,

and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## **2.5 FILLER:**

- A. Mineral fiber board: ASTM C612, Class 1.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

## **2.6 PRIMER:**

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

## **2.7 CLEANERS-NON POUROUS SURFACES:**

Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

# **PART 3 - EXECUTION**

## **3.1 INSPECTION:**

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.
- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

### 3.2 PREPARATIONS:

- A. Prepare joints in accordance with manufacturer's instructions and SWRI.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
  - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
  - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
  - 1. Apply primer prior to installation of back-up rod or bond breaker tape.
  - 2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

**3.3 BACKING INSTALLATION:**

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

**3.4 SEALANT DEPTHS AND GEOMETRY:**

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

**3.5 INSTALLATION:**

- A. General:
  - 1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° and 100° F).
  - 2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
  - 3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
  - 4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
  - 5. Avoid dropping or smearing compound on adjacent surfaces.
  - 6. Fill joints solidly with compound and finish compound smooth.
  - 7. Tool joints to concave surface unless shown or specified otherwise.
  - 8. Finish paving or floor joints flush unless joint is otherwise detailed.
  - 9. Apply compounds with nozzle size to fit joint width.

10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
- C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.
  1. Apply a 6 mm (1/4 inch) minimum bead of sealant each side of runners (tracks), including those used at partition intersections with dissimilar wall construction.
  2. Coordinate with application of gypsum board to install sealant immediately prior to application of gypsum board.
  3. Partition intersections: Seal edges of face layer of gypsum board abutting intersecting partitions, before taping and finishing or application of veneer plaster-joint reinforcing.
  4. Openings: Apply a 6 mm (1/4 inch) bead of sealant around all cut-outs to seal openings of electrical boxes, ducts, pipes and similar penetrations. To seal electrical boxes, seal sides and backs.
  5. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

### **3.6 FIELD QUALITY CONTROL:**

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:
  1. Extent of Testing: Test completed elastomeric sealant joints as follows:
    - a. Perform 10 tests for first 300 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.
    - b. Perform one test for each 300 m (1000 feet) of joint length thereafter or one test per each floor per elevation.
- B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
- C. Inspect tested joints and report on following:

1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
  2. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
  3. Whether sealants filled joint cavities and are free from voids.
  4. Whether sealant dimensions and configurations comply with specified requirements.
- D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### **3.7 CLEANING:**

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

### **3.8 LOCATIONS:**

- A. Exterior Building Joints, Horizontal and Vertical:
  1. Metal to Metal: Type S-1, S-2
  2. Metal to Masonry or Stone: Type S-1
  3. Masonry to Masonry or Stone: Type S-1
  4. Stone to Stone: Type S-1
  5. Cast Stone to Cast Stone: Type S-1
  6. Threshold Setting Bed: Type S-1, S-3, S-4



- 7. Masonry Expansion and Control Joints: Type S-6
- 8. Wood to Masonry: Type S-1
- B. Metal Reglets and Flashings:
  - 1. Flashings to Wall: Type S-6
  - 2. Metal to Metal: Type S-6
- C. Sanitary Joints:
  - 1. Walls to Plumbing Fixtures: Type S-9
  - 2. Pipe Penetrations: Type S-9
- D. Horizontal Traffic Joints:
  - 1. Concrete Paving, Unit Pavers: Type S-12
  - 2. Garage/Parking Decks: Type S-10
- E. Interior Caulking:
  - 1. Typical Narrow Joint 6 mm, (1/4 inch) or less at Walls and Adjacent Components: Types C-1 and C-2.
  - 2. Perimeter of Doors, Windows, Access Panels which Adjoin Concrete or Masonry Surfaces: Types C-1 and C-2.
  - 3. Joints at Masonry Walls and Columns, Piers, Concrete Walls or Exterior Walls: Types C-1 and C-2.
  - 4. Exposed Isolation Joints at Top of Full Height Walls: Types C-1 and C-2.

- - - E N D - - -

**SECTION 07 95 13**  
**EXPANSION JOINT COVER ASSEMBLIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies floor, wall and ceiling, seismic and building expansion joint assemblies.
- B. Types of assemblies:
  - 1. Metal Plate Cover
  - 2. Elastomeric Joint Covers
  - 3. Preformed Elastomeric Sealant Joint

**1.2 RELATED WORK**

- A. Sheet Metal Expansion Joint Seals: Section 07 60 00, FLASHING AND SHEET METAL.
- B. Roof Expansion Joint Cover Assemblies: Section 07 72 00, ROOF ACCESSORIES.
- C. Color of Elastomer Inserts, Filler Strips, Exterior Wall Seals and Metal Finishes: Section 09 06 00, SCHEDULE FOR FINISHES
- D. Steel Plate Expansion Joint Covers: Section 05 50 00, METAL FABRICATIONS.
- E. Expansion joint systems for vehicular traffic as indicated on the waterproofing drawings.

**1.3 QUALITY ASSURANCE**

- A. Project Conditions:
  - 1. Check actual locations of walls and other construction, to which work must fit, by accurate field measurements before fabrication.
  - 2. Show recorded measurements on final shop drawings.
- B. Fire tests performed by Factory Mutual, Underwriters Laboratories, Inc., Warnock Hersey or other approved independent testing laboratory.

**1.4 DELIVERY STORAGE AND HANDLING**

- A. Take care in handling of materials so as not to injure finished surface and components.
- B. Store materials under cover in a dry and clean location off the ground.
- C. Remove materials which are damaged or otherwise not suitable for installation from job site and replace with acceptable materials.

**1.5 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:

1. Submit copies of manufacturer's current literature and data for each item specified.
2. Clearly indicate movement capability of cover assemblies and suitability of material used in exterior seals for ultraviolet exposure.
- C. Certificates: Material test reports from approved independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint assemblies with requirements specified.
- D. Shop Drawings:
  1. Showing full extent of expansion joint cover assemblies; include large-scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joiners with other type assemblies, special end conditions, anchorages, fasteners, and relationship to adjoining work and finishes.
  2. Include description of materials and finishes and installation instructions.
- E. Samples:
  1. Samples of each type and color of metal finish on metal of same thickness and alloy used in work.
  2. Samples of each type and color of flexible seal used in work.

#### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed form part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A36/A36M-05.....Structural Steel
  - A167-99 (R2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  - A283/A283M-03.....Low and Intermediate Tensile Strength Carbon Steel Plates
  - A786/A786M-05.....Rolled Steel Floor Plates
  - B36/B36M-06.....Brass, Plate, Sheet, Strip, and Rolled Bar
  - B121-01(R2006).....Leaded Brass Plate, Sheet, Strip and Rolled Bar
  - B209M-06.....Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
  - B221M-06.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes (Metric)
  - B455-05.....Copper-Zinc Lead Alloy (Leaded Brass) Extruded Shapes

- C864-05.....Dense Elastomeric Compression Seal  
Gaskets, Setting Blocks, and Spacers
- C920-05.....Elastomeric Joint Sealants
- D1187-97 (R2002).....Asphalt Base Emulsions for Use as  
Protective Coatings for Metal
- D2287-96 (R2001).....Non-rigid Vinyl Chloride Polymer and  
Copolymer Molding and Extrusion Compounds
- E119-07.....Fire Tests of Building Construction and  
Materials
- E814-06.....Fire Tests of Through-Penetration Fire  
Stops
- C. Federal Specifications (Fed. Spec):  
TT-P-645B.....Primer, Paint, Zinc-Molybdate, Alkyd Type
- D. The National Association of Architectural Metal Manufacturers  
(NAAMM):  
AMP 500 Series.....Metal Finishes Manual.
- E. National Fire Protection Association (NFPA):  
251-05.....Tests of Fire Endurance of Building  
Construction and Materials
- F. Underwriters Laboratories Inc. (UL):  
263-03.....Fire Tests of Building Construction and  
Materials

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Stainless Steel: ASTM A167, Type 302 or 304.
- B. Structural Steel Shapes: ASTM A36.
- C. Steel Plate: ASTM A283, Grade C.
- D. Rolled Steel Floor Plate: ASTM A786.
- E. Aluminum:
  - 1. Extruded: ASTM B221, alloy 6063-T5.
  - 2. Plate and Sheet: ASTM B209, alloy 6061-T6.
- F. Brass: ASTM B36.
- G. Elastomeric Sealant (unless specified otherwise):
  - 1. ASTM C920, polyurethane.
  - 2. Type.
  - 3. Class 25.
  - 4. Grade P or NS.
  - 5. Shore A hardness 25, unless specified otherwise.
- H. Expansion Joint System for Vehicular Traffic - Multicell  
Gland/Ambient Cured Nosing:
  - 1. Expansion Joint System shall be capable of bearing  
vehicular traffic while maintaining a watertight seal.  
Expansion joint shall be capable of cyclic movement

- expected at joint without overstress in gland or nosing material.
2. Elastomeric membrane shall be a multicell extruded shape gland with integral perforated side flanges made from Santoprene thermoplastic rubber.
  3. Nosing material shall be ambient cured, elastomeric, 100% solids, two-component urethane resin plus sand mixture.
  4. Provide preformed or fabricated wall mount plates with appropriate anchors and sealants.
  5. Approved Elastomeric Membrane with Ambient Cured Urethane Nosing Expansion Joint Systems for Vehicular Traffic are:
    - a. Thermaflex TCR Membrane Nosing System (TCR-300), Emseal Joint Systems, LTD, Westborough, MA.
    - b. Polycrete/Membrane CR-Series System (CR-325), Erie Metals Specialties, Inc., Akron, NY.
    - c. Iso-Flex Winged Expansion Joint Sealing System (J30), LymTal International, Inc., Orion, MI.
    - d. WaboCrete II/Membrane 201 Expansion Joint System (ME-300), Watson Bowman Acme Corp., Amherst, NY.
    - e. LokCrete Membrane System (LMS-350), MM Systems Corp., Pendergrass, GA.
    - f. Or approved equivalent.
- I. Thermoplastic Rubber:
1. ASTM C864.
  2. Dense Neoprene or other material standard with expansion joint manufacturers having the same physical properties.
- J. Vinyl Invertor Sealant Waterstops: Manufacturers' standard shapes and grade.
- K. Fire Barrier:
1. Designed for indicated or required dynamic structural movement without material degradation or fatigue.
  2. Tested in maximum joint width condition as a component of an expansion joint cover assembly in accordance with UL 263 NFPA 251, or ASTM E119 and E814, including hose steam test at full-rated period.
- L. Zinc-Molybdate Primer: Fed. Spec. TT-P-645.
- M. Accessories:
1. Manufacturer's standard anchors, fasteners, set screws, spaces, flexible secondary water stops or seals and filler materials, drain tubes, adhesive and other accessories as indicated or required for complete installations.
  2. Compatible with materials in contact.
  3. Water stops.

## 2.2 FABRICATION

- A. General:
1. Use ceiling and wall expansion joint cover assemblies of same design as floor to wall and floor to floor expansion joint cover assemblies. Unless shown otherwise.
  2. Provide expansion joint cover assemblies of design, basic profile, materials and operation indicated required to accommodate joint size variations in adjacent surfaces, and as required for anticipated structural movement.

3. Deliver to job site ready for use and fabricated in as large sections and assemblies as practical. Assemblies identical to submitted and reviewed shop drawings, samples and certificates.
4. Furnish units in longest practicable lengths to minimize number of end joints. Provide mitered corners where joint changes directions or abuts other materials.
5. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections and other assemblies.
6. Fire Performance Characteristics:
  - a. Provide expansion joint cover assemblies identical to those of assemblies whose fire resistance has been determined per ASTM E119 and E814, NFPA 251, or UL 263 including hose stream test at full-rated period.
  - b. Fire rating: Not less than rating of adjacent floor or wall construction.
7. Fire Barrier Systems:
  - a. Material to carry label of approved independent testing laboratory, and be subject to follow-up system for quality assurance.
  - b. Include thermal insulation where necessary, in accordance with above tests, with factory cut miters and transitions.
  - c. For joint widths up to and including 150 mm (six inches), supply barrier in lengths up to 15000 mm (50 feet) to eliminate field splicing.
  - d. For joint widths of seven inches and wider, supply barrier 3000 mm (10-foot) modules with overlapping ends for field splicing.
  - e. For joints within enclosed spaces such as chase walls, include 1 mm (0.032-inch) thick galvanized steel cover where conventional expansion joint cover is not used.
8. Seal Strip factory - formed and bonded to metal frames and anchor members.
9. Compression Seals: Prefabricate from thermoplastic rubber or dense neoprene to sizes and approximate profiles shown.
- B. Floor-to-Floor Metal Plate Joints:
  1. Frames on each side of joint designed to support cover plate of design shown.
    - a. Continuous frame designed to finish flush with adjacent floor of profile indicated with seating surface and raised floor rim to accommodate flooring.
    - b. Provide concealed bolt and steel anchors for embedment in concrete.
    - c. Designed for filler materials between raised rim of frame and edge of cover plate where shown.
    - d. Frame and cover plates of some metal where exposed.
      - 1) Design cover plates to support 180 Kg (400 lbs) per 0.3 square meters (1-square foot).
      - 2) Cover plates free of rattle due to traffic.
      - 3) No gaps or budes occur on filler material during design movement of joint.

- 4) Provide manufacturer's continuous standard flexible vinyl water stop under floor joint cover assemblies.
- C. Floor-to-Wall Metal Plate Joints:
1. Provide one frame on floor side of joint only. Provide wall side frame where required by manufacturer's design.
  2. Angle Cover Plates: Provide angle cover plates for joints to wall with countersunk flat-head exposed fasteners for securing to wall unless shown otherwise.
  3. Space fasteners as recommended by manufacturer.
  4. Match cover of adjacent floor to floor cover.
- D. Interior Wall Joint Cover Assemblies:
1. Surface Mounted Metal Cover Plates:
    - a. Concealed frame for fastening to wall on one sides of joint.
    - b. Extend cover to lap each side of joint and to permit free movement on one side.
    - c. Provide concealed attachment of cover t frame cover in close contact with adjacent finish wall surfaces.
    - d. Use angle cover plates at intersection of walls.
    - e. Use smooth surface cover plates matching floor plates.
    - f. Use expansion fire inserts in fire rated walls, rated same as hour rating of wall.
- E. Exterior Wall Joint Assemblies:
1. Variable movement with seal designed to prevent water and air infiltration.
  2. Use vinyl seal strip as secondary seal behind primary seal.
  3. Cover Plate Assemblies:
    - a. Surface mounted cover plate.
    - b. Concealed frame for fastening to wall on one side of joint.
    - c. Extend cover to lap each side of joint and to permit free movement on one side.
    - d. Provide concealed attachment of cover to frame for cover with cover in close contact with adjacent finish surfaces.
    - e. Use angle cover plate of intersection of walls.
  4. Extruded thermoplastic rubber joint assemblies.
    - a. Aluminum frames both sides of joint.
      - 1) Designed to receive flexible rubber primary seal on exposed face after installation of frame.
      - 2) Designed to receive continuous secondary vinyl sheet seal.
      - 3) Anchor spaced at ends and not over 600 mm (24-inches).
    - b. Variable movement extruded rubber primary seal designed to remain in aluminum frame, throughout movement of joint.
      - 1) Flush mounted seal minimum 3 mm (0.125-inch) thick with dual movement grooves designed for

- plus or minus 50 percent, movement of joint width.
- 2) Seismic seal minimum 3 mm (0.125-inch) thick with multimovement grooves designed for plus or minus 100 percent movement of joint width.
- 3) Recessed front face seal minimum 3 mm (0.125-inch) thick with no movement grooves, designed for plus or minus 50 percent movement of joint width.
- c. Provide factory heat welded transitions where directional changes occur to ensure a watertight system.
- d. Provide pantographic wind load supports, maximum 2400 mm (8 feet) on center to support seal systems of 300 mm (12-inches) and wider.
- F. Ceiling and Soffit Assemblies:
  - 1. Variable movement vinyl insert in metal frame on both sides of joint.
  - 2. Designed for flush mounting with no exposed fasteners.
  - 3. Vinyl insert locked into metal frame.
  - 4. Vinyl and metal finish as specified in section 09 06 00, SCHEDULE FOR FINISHES.
  - 5. Vinyl insert semi rigid either flush face or accordion shape as showed to span joint width without sagging.
- G. Preformed Sealant Joint: Factory installed elastomeric sealant between extruded aluminum angle frame both sides.
  - 1. Elastomeric Sealant: Two part polyurethane sealant with movement capability of +/- 25% of joint width per ASTM-C-920, Type M, Grade P, Class 25, Shore A hardness of 25+/-5.
    - a. Color:
  - 2. Frame: Extruded Aluminum: Clear anodized.

### 2.3 METAL FINISHES

- A. General:
  - 1. Apply finishes in factory after products are fabricated.
  - 2. Protect finishes on exposed surfaces with protective covering before shipment.
- B. Aluminum Finishes:
  - 1. Finish letters and numbers for anodized aluminum are in accordance with the NAAMM AMP 501, Aluminum Association's Designation System).
    - a. Clear anodized finish: AA-C22A41 Chemically etched medium matte, clear anodic coating, Class I Architectural, 0.7 - mil thick.
    - b. Color anodized finish: AA-C22A42, Chemically etched medium matte, integrally colored anodic coating, Class I Architectural, 0.7-mil thick; or AA-C22A44, Chemically etched medium matte, electrolytically deposited metallic compound, Class I Architectural, 0.7-mil thick finish. Dyes not accepted.



- 2. Fluorocarbon Finish: NAAMM AMP 503 AAMA 605.2, high performance organic coating.
- 3. Factory-Primed Concealed Surface: NAAMM AMP 505 Protect concealed aluminum surfaces that will be in contact with plaster, concrete or masonry surfaces when installed by applying a shop coat of zincmolybdate primer to contact surfaces. Provide minimum dry film thickness of 2.0 mils.
- C. Bronze Finish: NAAMM-AMP 502-M32, mechanical finish, directional textured, natural medium satin.
- D. Stainless Steel: NAAMM AMP 503, finish No. 2B.
- E. Carbon Steel: NAAMM AMP 504, Galvanized 690.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Manufacturer's representative shall make a thorough examination of surfaces receiving work of this section.
- B. Before starting installation, notify prime contractor of defects which would affect satisfactory completion of work.

#### **3.2 PREPARATION**

- A. Verify measurements and dimensions at job site and cooperate in coordination and scheduling of work with work of related trades.
- B. Give particular attention to installation of items embedded in concrete and masonry so as not to delay job progress.
- C. Provide templates to related trade for location of support and anchorage items.

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturers installation instructions unless specified otherwise.
- B. Provide anchorage devices and fasteners for securing expansion joint assemblies to in-place construction including threaded fasteners with drilled-in fasteners for masonry and concrete where anchoring members are not embedded in concrete. Provide metal fasteners of type and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
- C. Perform cutting, drilling and fitting required for installation of expansion joint cover assemblies.
- D. Install joint cover assemblies in true alignment and proper relationship to expansion joint opening and adjoining finished surfaces measured from established lines and levels.
- E. Allow for thermal expansion and contraction of metal to avoid buckling.
- F. Set floor covers at elevations flush with adjacent finished floor materials unless shown otherwise.
- G. Material and method of grouting floor frames set in prepared recesses in accordance with manufacturer's instructions.
- H. Locate wall, ceiling and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with required accessories.

- I. Locate anchors at interval recommended by manufacturer, but not less than 75 mm (3-inches) from each ends, and, not more than 600 mm (24-inches) on centers.
- J. Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints.
- K. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames or plates.
- L. Flush Metal Cover Plates:
  - 1. Secure flexible filler between frames so that it will compress and expand.
  - 2. Adhere flexible filler materials to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- M. Waterstops:
  - 1. Install in conjunction with floor joints and where shown, run continuously to prevent water damage to finish spaces.
  - 2. Provide seal with frame to prevent water leakage.
  - 3. Provide outlet tubes from waterstops to drain to prevent damage to finish spaces.
- N. Fire Barriers:
  - 1. Install in compliance with tested assembly.
  - 2. Install in floors and in fire rated walls.
  - 3. Use fire barrier sealant or caulk supplied with system.
- O. Sealants:
  - 1. Install to prevent water and air infiltration.
- P. Vertical Exterior Extruded Thermoplastic Rubber.
  - 1. Install side frames mounted on sealant or butyl caulk tape with appropriate anchors 600 mm (24 inches) on center complete with independent continuous PVC back seal.
  - 2. Install primary seals retained in extruded aluminum side frames.
- Q. Installation of Extruded Thermoplastic Rubber or Seals:
  - 1. For straight sections, provide preformed seals in continuous lengths.
  - 2. Vulcanize or heat-seal field splice joints to provide watertight joints using manufacturer's recommended procedures.
- R. Installation of Preformed Elastomeric Sealant Joint:
  - 1. Locate joint directly over joints in wall or floor substrates.
  - 2. Full length shall be fastened to substrate using a construction adhesive.
  - 3. Install flush or slightly below finish material.

#### **3.4 PROTECTION**

- A. Take proper precautions to protect the expansion joint covers from damage after they are in place.
- B. Cover floor joints with plywood where wheel traffic occurs.

---END---

**SECTION 08 11 13  
HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies steel doors, steel frames and related components.
- B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

**1.2 RELATED WORK**

- A. Frames fabricated of structural steel: Section 05 50 00, METAL FABRICATIONS.
- B. Aluminum frames entrance work: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- D. Overhead doors: Section 08 36 13, SECTIONAL DOORS.
- F. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- M. Card readers and biometric devices: Section 28 13 00, ACCESS CONTROL.
- N. Intrusion Alarm: Section 28 16 11, INTRUSION DETECTION SYSTEM.
- O. Security Monitors: Section 28 51 00, SECURITY CONTROL CENTER.

**1.3 TESTING**

An independent testing laboratory shall perform testing.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers Literature and Data:
  - 1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Intertek Testing Services or Factory Mutual fire rating requirements and temperature rise rating for stairwell doors. Submit proof of temperature rating.

**1.5 SHIPMENT**

- A. Prior to shipment label each door and frame to show location, size, door swing and other pertinent information.
- B. Fasten temporary steel spreaders across the bottom of each door frame.

**1.6 STORAGE AND HANDLING**

- A. Store doors and frames at the site under cover.
- B. Protect from rust and damage during storage and erection until completion.

## 1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):  
L-S-125B.....Screening, Insect, Nonmetallic
- C. Door and Hardware Institute (DHI):  
A115 Series.....Steel Door and Frame Preparation for Hardware,  
Series A115.1 through A115.17 (Dates Vary)
- D. Steel Door Institute (SDI):  
113-01 (R2006).....Thermal Transmittance of Steel Door and Frame  
Assemblies  
128-09.....Acoustical Performance for Steel Door and Frame  
Assemblies
- E. American National Standard Institute:  
A250.8-2003 (R2008).....Specifications for Standard Steel Doors and  
Frames
- F. American Society for Testing and Materials (ASTM):  
A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel  
Steel Plate, Sheet, and Strip  
A568/568-M-11.....Steel, Sheet, Carbon, and High-Strength, Low-  
alloy, Hot-Rolled and Cold-Rolled  
A1008-10.....Steel, sheet, Cold-Rolled, Carbon, Structural,  
High Strength Low Alloy and High Strength Low  
Alloy with Improved Formability  
B209/209M-10.....Aluminum and Aluminum-Alloy Sheet and Plate  
B221/221M-12.....Aluminum and Aluminum-Alloy Extruded Bars,  
Rods, Wire, Profiles and Tubes  
D1621-10.....Compressive Properties of Rigid Cellular  
Plastics  
D3656-07.....Insect Screening and Louver Cloth Woven from  
Vinyl Coated Glass Yarns  
E90-09.....Laboratory Measurement of Airborne Sound  
Transmission Loss of Building Partitions
- G. The National Association Architectural Metal Manufacturers (NAAMM):  
Metal Finishes Manual (AMP 500-06)
- H. National Fire Protection Association (NFPA):

80-13.....Fire Doors and Fire Windows

- I. Underwriters Laboratories, Inc. (UL):  
Fire Resistance Directory
- J. Intertek Testing Services (ITS):  
Certifications Listings...Latest Edition
- K. Factory Mutual System (FM):  
Approval Guide

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Stainless Steel: ASTM A167, Type 302 or 304; finish, NAAMM Number 4.
- B. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.
- C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.
- D. Insect Screening: ASTM D3656, 18 by 18 regular mesh.
- E. Aluminum Sheet: ASTM B209/209M.
- F. Aluminum, Extruded: ASTM B221/221M.
- G. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

### **2.2 FABRICATION GENERAL**

- A. GENERAL:
  - 1. Follow ANSI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08 71 00, DOOR HARDWARE. Tolerances as per ANSI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.
  - 2. Close top edge of exterior doors flush and seal to prevent water intrusion.
  - 3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.
- C. Heavy Duty Doors: ANSI A250.8, Level 2, Full flush seamless design of size and design shown. Core construction types b, c, e, or f, for exterior doors.

Core Construction Type	Door Core Description
a	Kraft honeycomb
b	Polyurethane
c	Polystyrene
d	Unitized steel grid

e	Mineral fiberboard
f	Vertical steel stiffeners

G. Custom Metal Hollow Doors:

1. Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages and finish shall be as specified for of standard steel doors.

**2.3 METAL FRAMES**

A. General:

1. ANSI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.
2. Frames for exterior doors: Fabricate from 1.7 mm (0.067 inch) thick galvanized steel conforming to ASTM A525.
3. Frames for labeled fire rated doors.
  - a. Comply with NFPA 80. Test by Underwriters Laboratories, Inc., Inchcape Testing Services, or Factory Mutual.
  - b. Fire rated labels of approving laboratory permanently attached to frames as evidence of conformance with these requirements.  
Provide labels of metal or engraved stamp, with raised or incised markings.
4. Knocked-down frames are not acceptable.

C. Terminated Stops: ANSI A250.8.

D. Glazed Openings:

- a. Integral stop on exterior, corridor, or secure side of door.
- b. Design rabbet width and depth to receive glazing material or panel shown or specified.

E. Frame Anchors:

1. Floor anchors:

- a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
- b. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm by (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.
- c. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.
- d. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.

2. Jamb anchors:

- a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24 inches) apart.
- b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.
- c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:
  - 1) Wire loop type of 5 mm (3/16 inch) diameter wire.
  - 2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.
- d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
- e. Anchors for frames set in prepared openings:
  - 1) Steel pipe spacers with 6 mm (1/4 inch) inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 50 mm (2 inches) wide, welded to jamb near stop.
  - 2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.

- 3) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.
- f. Anchors for observation windows and other continuous frames set in stud partitions.
  - 1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.
  - 2) Anchors spaced 600 mm (24 inches) on centers maximum.
- g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

#### **2.4 TRANSOM PANELS**

- A. Fabricate panels as specified for flush doors.
- B. Fabricate bottom edge with rabbet stop to fit top of door where no transom bar occurs.

#### **2.5 SHOP PAINTING**

ANSI A250.8.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Plumb, align and brace frames securely until permanent anchors are set.
  - 1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
  - 2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
  - 3. Protect frame from accidental abuse.
  - 4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
  - 5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.
- B. Floor Anchors:
  - 1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
  - 2. Power actuated drive pins may be used to secure frame anchors to concrete floors.
- C. Jamb Anchors:



1. Anchors in masonry walls: Embed anchors in mortar. Fill space between frame and masonry wall with grout or mortar as walls are built.
  2. Coat frame back with a bituminous coating prior to lining of grout filling in masonry walls.
  3. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
  4. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.
- D. Install anchors for labeled fire rated doors to provide rating as required.

### **3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE**

Install doors and hardware as specified in Sections: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 71 00, DOOR HARDWARE.

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**SECTION 08 36 13**  
**SECTIONAL DOORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies electrically operated thermal insulated sectional overhead steel doors.

**1.2 RELATED WORK:**

- A. Lock cylinders for cylindrical locks: Section 08 71 00, DOOR HARDWARE.
- B. Field painting: Section 09 91 00, PAINTING.
- C. Electrical Installation: Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**1.3 MANUFACTURER'S AND INSTALLER'S QUALIFICATIONS:**

- A. Manufacturer's regularly engaged in manufacturing items of type specified.
- B. Installers under direct supervision of manufacturer's representative or trained personnel.

**1.4 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
  - 1. Details of construction, accessories and hardware, electrical and mechanical items, supporting brackets for motors, location, and ratings of motors, and safety devices.
  - 2. Wiring diagrams for motors and controls, including wiring diagram for door, showing electrical interlock for motor with manually operated dead lock.
- C. Manufacturer's Literature and Data:
  - 1. Brochures or catalog cuts.
  - 2. Manufacturer's installation procedures and instructions.
  - 3. Maintenance instructions, parts list.
- D. Certificates:
  - 1. Attesting door, anchors and hardware will withstand the horizontal loads specified.
  - 2. Attesting door complies with thermal performance, air infiltration, and water infiltration requirements.

#### 1.5 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A36/A36M-08.....Structural Steel
  - A227/A227M-06.....Steel Wire, Cold-Drawn for Mechanical Springs
  - A229/229M-99(R2005).....Steel Wire, Oil-Tempered for Mechanical Springs
  - A653-10.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot Dip Process
  - C1036-06.....Flat Glass
  - E283-04.....Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Difference Across the Specimen
  - E330-02(R2010).....Structural Performance of Exterior Windows, Curtain Walls, and Doors by the Uniform Static Air Pressure Difference.
  - E331-00(R2009).....Water Penetration of Exterior Windows, Curtain Walls, and Doors by the Uniform Static Air Pressure Difference.
- C. American National Standards Institute and Door and Access Systems Manufacturers Association (ANSI/DASMA):
- 102-04.....Sectional Overhead Type Doors.
- D. National Electrical Manufacturer's Association (NEMA):
- ICS 2-00 (R2005).....Industrial Control and Systems: Controllers, Contactors, and Overload Relays
  - MG 1-10.....Motors and Generators
- E. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code
- F. National Association of Architectural Metal Manufacturers (NAAMM):
- AMP 500-06.....Metal Finishes Manual

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS:

- A. Steel: ASTM A653 for forming operations. ASTM A36 for structural sections.

- B. Hard Drawn Spring wire: ASTM A227.
- C. Oil Tempered Spring wire: ASTM A229.
- D. Weather-strips, Gaskets, and Thermal Breaks:
  - 1. Neoprene, EPDM, PVC, silicone rubber, or other low conductance material.
  - 2. Standard with door manufacturer.

## **2.2 DESIGN REQUIREMENTS:**

- A. Wind Load: Design to withstand a horizontal or wind pressure of 960 Pa (20 pounds per square foot) of door area without damage when tested in accordance with ASTM E330.
- B. Air Infiltration: Maximum of 0.10 cfm at 24 Km (15 miles per hour) wind speed per foot of crack between door sections and door perimeter opening when tested in accordance with ASTM E283.
- C. Water Infiltration: No infiltration when tested in accordance with ASTM E331.
- D. Comply with ANSI/NAGDM 102, for an Industrial door and specified design criteria, inside face mounted with tracks at jambs set back a sufficient distance to provide a clear opening when door is in open position.
- E. Operation-Cycle Requirements: Door components and operators to operate for not less than 10,000 cycles.

## **2.3 FABRICATION:**

- A. Steel Door Sections:
  - 1. Formed of hot-dipped galvanized steel.
  - 2. Meeting rails: interlocking joints with thermal breaks separating face sheets formed to provide weathertight closure and alignment for full width of door.
  - 3. Height of sections: Not to exceed 600 mm (24 inches) may be varied to suit door height.
  - 4. Insulation shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.
  - 5. Reinforced for hardware anchorage with not less than 10 gage galvanized steel.
- B. Tracks:
  - 1. Manufacturer's standard formed of galvanized steel.

2. Minimum of 14 gage for 50 mm (2 inch) tracks and 12 gage for 75 mm (3 inch) tracks.
3. Vertical tracks fabricated with adjustable brackets for mounting at incline to continuous steel angle wall bracket.
4. Horizontal track: Reinforce with continuous steel angle anchored to vertical steel angle wall bracket and to ceiling angle supports. Use vertical and cross or diagonal braced to obtain rigid installation of horizontal track.
5. Use not less than 13 gage galvanized steel angles.

C. Hardware:

1. Manufacturers standard hinges, brackets, rollers, locking devices and other hardware required for a complete installation.
2. Hinges and roller brackets minimum of 13 gage galvanized steel.
3. Use rollers with ball bearings and case hardened races.
4. Positive locking device to receive cylinder lock, specified in Section 08 71 00, DOOR HARDWARE, with interlocking switch to motor operator.

**2.4 ELECTRIC MOTOR OPERATORS:**

- A. Complete with electric motor, machine cut reduction gears, steel chain and sprockets, magnetic brake, overload protection, brackets, push button controls, limit switches, magnetic reversing contactor, and other accessories necessary for proper operation, including emergency manual operator.

B. Design:

1. Design the operator for motor removal without disturbing the limit-switch timing and without affecting the emergency manual operators.
2. Make provision for emergency manual operation of door by chain-gear mechanism in case of electrical failure.
3. Arrange the emergency manual operating mechanism to immediately be put into and out of operation from the floor with a mechanical device to disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged and not affect the timing of the limit switches.
4. Provide interlock with motor to prevent motor from operating when manual locks are activated.

C. Motors:

1. Motor conform to NEMA MG 1, maximum operation 3600 rpm.

2. Suitable for operation on current specified in Division 26,  
ELECTRICAL.
3. Use high starting torque, reversible type, of sufficient horsepower  
and torque output to move the door in either direction from door  
position, and produce door travel speed range of 0.20 to 0.30 m per  
second (8 to 12 inches per second), without exceeding the rated  
capacity.
4. Single-phase motors shall not have commutation or more than one  
starting contact.
5. Motor Enclosures: Drip proof type or NEMA TENV type.

D. Controls:

1. Control equipment: NEMA 2.
2. Control enclosures: NEMA ICS 6, Type 12 or Type 4, except that  
contractor enclosures may be Type 1. Use weatherproof corrosion-  
resistant covers for exterior locations.
3. At door motors use an enclosed, across-the-line type, magnetic  
reversing contactor, thermal overload protection, solenoid operated  
brake, limit switches, and remote control switches at locations  
indicated.
4. Control switches:
  - a. Three push button type on interior, unless noted to be key  
activated.
  - b. Buttons marked, OPEN, CLOSE and STOP.
  - c. The OPEN and STOP buttons: Momentary pressure or contact type.
  - d. The CLOSE button: Constant pressure type.
  - e. Use key activated switch on exterior requiring constant pressure  
to operate.
  - f. Limit switches: Manufacturers standard, position of switches  
readily adjustable.
5. Operation:
  - a. Open door upon activation of Open switch.
  - b. Close door only when constant pressure applied.
  - c. When the door is in motion, and the STOP button is pressed, door  
shall stop instantly and remain in the stop position; from stop  
position, door may be operated in either direction by OPEN or  
CLOSE button.

- d. Limit switches automatically stop doors at their fully open and closed positions.
- 6. Push buttons full-guarded to prevent accidental operation.
- 7. Transformer:
  - a. Use a control transformer in power circuits to reduce the voltage on control circuits to 120 volts or less.
  - b. Conform to NEMA ST 20.
- 8. Electrical Components: Conform to NFPA 70.
- 9. Safety Device:
  - a. Bottom door edge weather-strip safety device to immediately stop and reverse the door closing to full open position upon contact with an obstruction. Door is to open upon failure of device, component of device or component of control system.
  - b. The door closing circuit shall be electrically locked out and door to remain capable of manual operation until the failure or damage has been corrected.
  - c. Do not use as a limit switch.
  - d. Safety device connecting cable to motor to be flexible type SO cable with spring loaded automatic take up reel or equivalent device, as required for proper operation of the doors.

## **2.5 FINISHES:**

- A. Steel:
  - 1. Comply with NAAMM's Metal Finishes Manual.
  - 2. Clean surfaces free of scale, rust, oil and grease.
  - 3. Non-galvanized steel: Pretreatment to assure maximum paint adherence.
  - 4. Galvanized steel: Apply phosphate treatment.
  - 5. Apply shop prime coat of corrosion inhibitive paint on exposed surfaces after fabrication.
  - 6. Apply finish paint on color scheduled when specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 7. Do not paint track, rollers, hinges, or locks.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Install in accordance with approved shop drawings and manufacturer's instructions. For electrical work, see Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

- B. Locate anchors and inserts for tracks, brackets, motors, switches, hardware, and other accessories accurately.
- C. Securely attach tracks to adjoining construction with not less than 9 mm (3/8 inch) diameter bolts, spaced near each end and not over 600 mm (24 inches) apart.
- D. Locate control switches where shown at least five feet above the floor line so that the operator will have complete visibility of the door.
- E. Lubricate, properly adjust and demonstrate door to operate freely.
- F. Upon completion, door openings shall be weathertight and doors shall be free from warp, twists, or distortion.

**3.2 REPAIR:**

- A. Repair zinc-coated surfaces both bare and painted, by the application of galvanizing repair compound.
- B. Spot prime and apply finish paint to all repairs.

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**SECTION 08 41 13**  
**ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies aluminum entrance work including storefront assembly construction, hung doors and other components to make a complete assembly.

**1.2 RELATED WORK:**

- A. Glass and Glazing: Section 08 80 00, GLAZING.
- B. Hardware: Section 08 71 00, DOOR HARDWARE.
- C. Automatic Door Operators: Section 08 71 13, POWER DOOR OPERATORS.
- D. Texture and color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: (1/2 full scale) showing construction, anchorage, reinforcement, and installation details.
- C. Manufacturer's Literature and Data:
  - 1. Doors, each type.
  - 2. Entrance and Storefront construction.
- D. Samples:
  - 1. Door corner section, 450 mm x 450 mm (18 x 18 inches), of each door type specified, showing vertical and top hinge edges, and internal reinforcement.
  - 2. Two samples of anodized aluminum of each color showing finish and maximum shade range.
- E. Manufacturer's Certificates:
  - 1. Stating that aluminum has been given specified thickness of anodizing.
  - 2. Indicating manufacturer's qualifications specified.

**1.4 QUALITY ASSURANCE:**

- A. Approval by A/E is required of products of proposed manufacturer, or supplier, and will be based upon submission by Contractor certification.
- B. Certify manufacturer regularly and presently manufactures aluminum entrances and storefronts as one of their principal products.

**1.5 DELIVERY, STORAGE AND HANDLING:**

- A. Deliver aluminum entrance and storefront material to the site in packages or containers; labeled for identification with the manufacturer's name, brand and contents.
- B. Store aluminum entrance and storefront material in weather-tight and dry storage facility.
- C. Protect from damage from handling, weather and construction operations before, during and after installation.

**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 the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
  - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
  - E283-04.....Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
  - E331-00(R2009).....Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
  - F468-10.....Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
  - F593-02(R2008).....Stainless Steel Bolts, Hex Cap Screws, and Studs
- C. National Association of Architectural Metal Manufacturers (NAAMM):
  - AMP 500 Series.....Metal Finishes Manual
- D. American Architectural Manufacturer's Association (AAMA):
  - 2604-10.....High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels
- E. American Welding Society (AWS):
  - D1.2-08.....Structural Welding Code Aluminum

**1.7 PERFORMANCE REQUIREMENTS:**

- A. Shapes and thickness of framing members shall be sufficient to withstand a design wind load of not less than 1.4kilopascals (30 pounds per square foot) of supported area with a deflection of not more

than 1/175 times the length of the member and a safety factor of not less than 1.65 (applied to overall load failure of the unit). Provide glazing beads, moldings, and trim of not less than 1.25 mm (0.050 inch) nominal thickness.

- B. Air Infiltration: When tested in accordance with ASTM E 283, air infiltration shall not exceed  $2.63 \times 10^{-5}$  cm per square meter (0.06 cubic feet per minute per square foot) of fixed area at a test pressure of 0.30 kPa (6.24 pounds per square foot) 80 kilometers (50 mile) per hour wind.
- C. Water Penetration: When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa (8 pounds per square foot) of fixed area.

## **PART 2 - PRODUCTS**

Provide Aluminum Storefront products equivalent to the basis of design product: Kawneer Trifab® VG451 Storefront System, thermally broken.

### **2.1 MATERIALS:**

- A. Aluminum, ASTM B209 and B221:
  - 1. Alloy 6063 temper T5 for doors, door frames, fixed glass sidelights, storefronts, and transoms.
  - 2. Alloy 6061 temper T6 for guide tracks for sliding doors and other extruded structural members.
  - 3. For color anodized finish, use aluminum alloy as required to produce specified color.
- B. Thermal Break: Manufacturer standard low conductive material retarding heat flow in the framework, where insulating glass is scheduled.
- C. Fasteners:
  - 1. Aluminum: ASTM F468, Alloy 2024.
  - 2. Stainless Steel: ASTM F593, Alloy Groups 1, 2 and 3.

### **2.2 FABRICATION:**

- A. Fabricate doors, of extruded aluminum sections not less than 3 mm (0.125 inch) thick. Fabricate glazing beads of aluminum not less than 1.0 mm (0.050 inch) thick.
- B. Accurately form metal parts and accurately fit and rigidly assemble joints, except those joints designed to accommodate movement. Seal joints to prevent leakage of both air and water.

- C. Make welds in aluminum in accordance with the recommended practice AWA D1.2. Use electrodes and methods recommended by the manufacturers of the metals and alloys being welded. Make welds behind finished surfaces so as to cause no distortion or discoloration of the exposed side. Clean welded joints of welding flux and dress exposed and contact surfaces.
- D. Make provisions in doors and frames to receive the specified hardware and accessories. Coordinate schedule and template for hardware specified under Section 08 71 00, DOOR HARDWARE. Where concealed closers or other mechanisms are required, provide the necessary space, cutouts, and reinforcement for secure fastening.
- E. Fit and assemble the work at the manufacturer's plant. Mark work that cannot be permanently plant-assembled to assure proper assembly in the field.

#### **2.3 PROTECTION OF ALUMINUM:**

- A. Isolate aluminum from contact with dissimilar metals other than stainless steel, white bronze, or zinc by any of the following:
  - 1. Coat the dissimilar metal with two coats of heavy-bodied alkali resistant bituminous paint.
  - 2. Place caulking compound, or non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
  - 3. Paint aluminum in contact with mortar, concrete and plaster, with a coat of aluminum paint primer.

#### **2.4 FRAMES:**

- A. Fabricate doors, frames, mullions, transoms, frames for fixed glass and similar members from extruded aluminum not less than 3 mm (0.125 inch) thick.
- B. Provide integral stops and glass rebates and applied snap-on type trim.
- C. Use concealed screws, bolts and other fasteners. Secure cover boxes to frames in back of all lock strike cutouts.
- D. Fabricate framework with thermal breaks in frames where insulating glass is scheduled and specified under Section 08 80 00, GLAZING.

#### **2.5 STILE AND RAIL DOORS:**

- A. Nominal 45 mm (1-3/4 inch) thick, with stile and head rail 90 mm (3-1/2 inches) wide, and bottom rail 250 mm (10 inches) wide.
- B. Bevel single-acting doors 3 mm (1/8 inch) at lock, hinge and meeting stile edges. Provide clearances of 2 mm (1/16 inch) at hinge stiles, 3

mm (1/8 inch) at lock stiles and top rails, and 5 mm (3/16 inch) at floors and thresholds. Form glass rebates integrally with stiles and rails. Glazing beads may be formed integrally with stiles and rails or applied type secured with fasteners at 150 mm (six inches) on centers.

- C. Construct doors with a system of welded joints or interlocking dovetail joints between stiles and rails. Clamp door together through top and bottom rails with 9 mm (3/8 inch) primed steel rod extending into the stiles, and having a self-locking nut and washer at each end. Reinforce stiles and rails to prevent door distortion when tie rods are tightened. Provide a compensating spring-type washer under each nut to take up any stresses that may develop. Construct joints between rails and stiles to remain rigid and tight when door is operated.
- D. Weather-stripping: Provide removable, woven pile type (silicone-treated) weather-stripping attached to aluminum or vinyl holder. Make slots for applying weather-stripping integral with doors and door frame stops. Apply continuous weather-stripping to heads, jambs, bottom, and meeting stiles of doors and frames. Install weather-stripping so doors can swing freely and close positively.

#### **2.6 FLUSH PANEL DOORS:**

- A. Nominal 45 mm (1-3/4 inches) thick. Form from aluminum face sheets not less than 1.5 mm (0.060 inch) thick with internal impact reinforcement, laminated to the door edges and the core.
- B. Provide extruded aluminum tubular members to form the perimeter of the door. Reinforce doors internally with extruded tubular members welded in place, and extending full width of door at top, bottom, and intermediate points.
- C. Fill voids between tubular members with noncombustible mineral insulation.

#### **2.7 REINFORCEMENT FOR BUILDERS HARDWARE:**

- A. Fabricate from stainless steel plates.
- B. Hinge and pivot reinforcing: 4.55 mm (0.1793 inch) thick.
- C. Reinforcing for lock face, flush bolts, concealed holders, concealed or surface mounted closers: 2.66 mm (0.1046 inch) thick.
- D. Reinforcing for all other surface mounted hardware: 1.5 mm (0.0598 inch) thick.

## **2.8 COLUMN COVERS AND TRIM**

- A. Fabricate column covers and trim shown from 1.5 mm (0.0625 inch) thick sheet aluminum of longest available lengths.
- B. Use concealed fasteners.
- C. Provide aluminum stiffener and other supporting members shown or as required to maintain the integrity of the components.

## **2.9 FINISH**

- A. In accordance with NAAMM AMP 500 series.
- B. Anodized Aluminum:
  - 1. Clear Finish: Chemically etched medium matte, with clear anodic coating, Class I Architectural, 7 mils thick.
- C. Provide Clear Anodized Aluminum in locations where indicated on architectural drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Allowable Installation Tolerances: Install work plumb and true, in alignment and in relation to lines and grades shown. Variation of 3 mm (1/8 inch) in 2400 mm (eight feet), non-accumulative, is maximum permissible for plumb, level, warp, bow and alignment.
- B. Anchor aluminum frames to adjoining construction at heads, jambs and bottom and to steel supports, and bracing. Anchor frames with stainless steel or aluminum countersunk flathead, expansion bolts or machine screws, as applicable. Use aluminum clips for internal connections of adjoining frame sections.
- C. Where work is installed within masonry or concrete openings, place no parts other than built-in anchors and provision for operating devices located in the floor, until after the masonry or concrete work is completed.
- D. Install hardware specified under Section 08 71 00, DOOR HARDWARE.
- E. Install hung door operators specified under Section 08 71 13, POWER DOOR OPERATORS.

### **3.2 ADJUSTING:**

After installation of entrance and storefront work is completed, adjust and lubricate operating mechanisms to insure proper performance.

**3.3 PROTECTION, CLEANING AND REPAIRING:**

Remove all mastic smears and other unsightly marks, and repair any damaged or disfiguration of the work. Protect the installed work against damage or abuse.

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**SECTION 08 44 13**  
**GLAZED ALUMINUM CURTAIN WALLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies glazed aluminum curtain wall system.
  - 1. Thermally isolated, pressure equalized on interior.
  - 2. Type: Stick Unit and Mullion system to include following:
    - a. Integral reinforcing.
    - b. Closures, trim, subsills and flashings.
    - c. Column covers.
    - d. Fasteners, anchors, and related reinforcement.

**1.2 RELATED WORK**

- A. Structural Sections: DIV 03 and DIV 05
- B. Miscellaneous metal members: Section 05 50 00, METAL FABRICATIONS.
- C. Joint sealants: Section 07 92 00, JOINT SEALANTS.
- D. Aluminum and glass hinged entry doors and storefront construction:  
Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- E. Aluminum windows: Section 08 51 13, ALUMINUM WINDOWS.
- F. Glazing: Section 08 80 00, GLAZING.
- G. Finish Color: Section 09 06 00, SCHEDULE FOR FINISHES.
- H. Louvers and wall vents: Section 08 90 00, LOUVERS AND VENTS.

**1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Approval is required of products or service of proposed manufacturer, suppliers and installers, and will be based upon submission by Contractor of certification that:
    - a. Manufacturers Qualifications: Manufacturer with five (5) years continuous documented experience in design, fabrication, and installation of glazed aluminum curtain wall systems of type and size required for that project.
    - b. Installer: Manufacturer approved in writing. Continuously installed glazed aluminum curtain walls systems for previous five (5) years.
    - c. Manufacturer shall provide technical field representation at project site, as a minimum, at start of project, during middle, towards end of project, and during field testing of field mockup panel.
    - d. Testing Laboratory: Contractor retained. Engage an AAMA accredited commercial testing laboratory to perform tests specified. Submit information regarding testing laboratory's facilities and



qualifications of technical personnel to perform testing specified in this section.

- e. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of glazed aluminum curtain wall system. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, one another, and adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.

- 1) Do not modify intended aesthetic effects. If modifications are proposed, submit comprehensive explanatory data for review.

- f. Qualification of Welders:

- 1) Welding shall be performed by certified welders qualified in accordance with AWS D1.2, using procedures, materials, and equipment of the type required for this work.

C. Pre-Installation Conference

- 1. Prior to starting installation of glazed curtain wall system schedule conference with Contracting Officer to ensure following:
  - a. Clear understanding of drawings and specifications.
  - b. Onsite inspection and acceptance of structural and pertinent structural details relating to curtain wall system.
  - c. Coordination of work of various trades involved in providing system. Conference shall be attended by Contractor; personnel directly responsible for installation of curtain wall system, flashing and sheet metal work, firestopping system and curtain wall manufacturer and their Technical Field Representatives. Conflicts shall be resolved and confirmed in writing.

**1.4 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data:
  - 1. Manufacturer's standard details and fabrication methods.
  - 2. Data on finishing, components, and accessories.
  - 3. Instructions: Submit descriptive literature, detail specifications, available performance test data and instructions for installation, and adjustments.
  - 4. Recommendations for maintenance and cleaning of exterior surfaces.

C. Shop Drawings:

1. Show elevations of glazed curtain wall system at 1:50 (1/4 inch) scale, metal gages, details of construction, methods of anchorage, glazing details, and details of installation.
2. Submit for curtain wall system, accessories. Tentative approval of drawings shall be received before fabrication of mock-up. Final approval of drawings shall be deferred pending approval of mock-up and accessories. Drawings shall indicate in detail all system parts including elevations, full size sections, framing, jointing, panels, types and thickness of metal anchorage details, flashing and coping details, field connections, weep and drainage system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.
3. Operation and Maintenance Manuals
  - a. Submit cleaning and maintenance instructions.

D. Samples:

1. Submit pairs of samples of each specified color and finish on 300 mm (12-inch) long section by width of each tubular, or extruded shape section or 300 mm by 300 mm (12-inch by 12-inch) wide sections of sheet shapes.
2. Submit corner section of framing members showing fasteners, panels, glazing methods, glazing materials, and weather-stripping. Submit one sample minimum 300 mm by 300 mm (12 inches by 12 inches). In lieu of submitting separate samples for corner section, intermediate section, and panel, one composite sample incorporating all components and features listed may be submitted.
3. Where normal color variations are anticipated, include 2 or more units in set indicating extreme limits of color variations.

E. Glass:

1. Specified in Section 08 80 00, GLAZING.

F. Quality Control Submittals:

1. Design Data:
  - a. Submit structural and thermal calculations for complete wall assembly. Structural calculations and design shop drawings shall be signed and sealed by a structural engineer registered in state in which project is to be located.
2. Factory Test Reports:
  - a. Test Reports: Provide certified test reports, for each of following listed tests, from a qualified independent testing laboratory showing that glazed aluminum curtain wall system

assembly has been tested in accordance with specified test procedures and complies with performance characteristics as indicated by manufacturer's testing procedures. Manufacturer shall submit appropriate testing numbers for specific tests indicated below.

- 1) Deflection and structural tests.
- 2) Water penetration tests.
- 3) Air infiltration tests.
- 4) Delamination tests.
- 5) Thermal conductance tests.
- 6) Submit factory tests required except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested within last year, under conditions specified herein, resulting test reports may be submitted in lieu of listed testing.

G. Manufacturer's Certificates:

1. Submit Certificates of Compliance, with specification requirements, for the following:
  - a. Metal extrusions.
  - b. Metal accessories.
  - c. Stating that aluminum has been given specified thickness of anodizing or organic coating finish.
  - d. Indicating manufacturer's and installer's meet qualifications as specified.
  - e. Submit list of equivalent size installations, for both manufacturer and installer, which have had satisfactory and efficient operation.

H. Manufacturer's Field Reports:

1. Submit field reports of manufacturer's field representative observations of curtain wall installation indicating observations made during inspection at beginning of project, during middle of installation and at conclusion of project. Indicate results of field testing of mockup field panel, and any directions given Contractor for corrective action.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Refer to AAMA CW 10 for care and handling of architectural aluminum from shop to site.
- B. Prior to packaging for shipment from factory, mark wall components to correspond with shop and erection drawings and their placement location and erection.

- C. Prior to shipment from factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of members with protective covering of adhesive paper, waterproof tape, or strippable plastic. Do not cover metal surfaces that will be in contact with sealants after installation.
- D. Inspect materials delivered to site for damage; unload and store with ventilation, free from heavy dust, not subject to combustion products or sources of water, and shall permit easy access for inspection and handling. Sealing and caulking compounds, including handling, shall be in accordance with requirements of Section 07 92 00 JOINT SEALANTS.

#### 1.6 PROJECT CONDITIONS

Field Measurements: Where glazed aluminum curtain wall systems are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying Work.

#### 1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Architectural Manufacturers Association (AAMA):
  - MCWM-1-89.....Metal Curtain Wall Manual
  - CW 10-04.....Care and Handling of Architectural Aluminum from Shop to Site
  - CW 11-85.....Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing
  - CW 13-85.....Structural Sealant Glazing Systems (A Design Guide)
  - CWG 1-89.....Installation of Aluminum Curtain Walls
  - TIR A1-04.....Sound Control for Fenestration Products
  - TIR A8-08.....Structural Performance of Composite Thermal Barrier Framing Systems
  - TIR A9-91.....Metal Curtain Wall Fasteners
  - TIR A11-04.....Maximum Allowable Deflection of Framing Systems for Building Cladding Components of Design Wind Loads
  - 101/I.S.2/A440-08.....Windows, Doors and Unit Skylights
  - 501-05.....Methods of Test for Exterior Walls
  - 503-08.....Field Testing of Metal Storefronts, Curtain walls and Sloped Glazing Systems

- 2605-98.....High Performance Organic Coatings on  
Architectural Extrusions and Panels
- 1503-09.....Thermal Transmission and Condensation Resistance  
of Windows, Doors and Glazed Wall Sections
- C. American National Standards Institute (ANSI):
- Z97.1-09.....Glazing Materials Used in Buildings, Safety  
Performance Specifications and Methods of Test
- D. American Society of Civil Engineers (ASCE):
- ASCE 7-10.....Minimum Design Loads for Buildings and Other  
Structures
- E. American Society for Testing and Materials (ASTM):
- A36/A36M-08.....Structural Steel
- A123-09.....Zinc (Hot-Dip Galvanized) Coatings on Iron and  
Steel Products
- A193-10.....Alloy-Steel and Stainless Steel Bolting  
Materials for High Temperature Service
- A307-10.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile  
Strength
- B209-10.....Aluminum and Aluminum Alloy Sheet and Plate
- B211-03.....Aluminum and Aluminum Alloy Bar, Rod, Wire
- B221/B221M-08.....Aluminum and Aluminum Alloy Extruded Bars, Rods,  
Wire, Shapes and Tubes
- B316/B316M-10.....Aluminum and Aluminum Alloy Rivet and Cold-  
Heading, Wire, and Rods
- C578-10.....Rigid Cellular Polystyrene Thermal Insulation
- C612-10.....Mineral Fiber Block and Board Thermal Insulation
- C920-11.....Elastomeric Joint Sealants
- C794-10.....Standard Test Method for Adhesion-In-Peel of  
Elastomeric Joint Sealants.
- C1363-05.....Thermal Performance of Building Materials and  
Envelope Assemblies by Means of a Hot Box  
Apparatus
- D1037-06.....Evaluating the Properties of Wood-Base Fibers  
and Particle Panel Materials
- E84-10.....Surface Burning Characteristics of Building  
Materials
- E90-09.....Laboratory Measurement of Airborne Sound  
Transmission Loss of Building Partitions and  
Elements

- E283-04.....Determining Rate of Air Leakage Through Exterior  
Windows, Curtain Walls, and Doors under  
Specified Pressure Difference Across this  
Specification
- E330-02(R2010).....Structural Performance of Exterior Windows,  
Curtain Walls, and Doors by Uniform Static Air  
Pressure Difference
- E331-00(R2009).....Water Penetration of Exterior Windows, Curtain  
Walls, and Doors By Uniform Static Air Pressure  
Difference
- E413-10.....Classification for Rating Sound Insulation
- E783-02(R2010).....Test Method for Field Measurement of Air Leakage  
Through Installed Exterior Windows and Doors.
- E1105-00(R2008).....Field Determination of Water Penetration of  
Installed Exterior Windows, Curtain Walls, and  
Doors By Uniform or Cyclic Static Air Pressure  
Differences
- F. American Welding Society, Inc. (AWS):
- D1.2-08.....Structural Welding Code-Aluminum
- G. Consumer Product Safety Commission (CPSC):
- 16 CFR 1201.....Architectural Glazing Standards and Related  
Material
- H. Federal Specifications (FS):
- TT-P-645B-90.....Primer, Paint, Zinc-Molybdate, Alkyd Type
- I. Glass Association of North America (GANA):
- 2010 Edition.....GANA Glazing Manual
- 2008 Edition.....GANA Sealant Manual
- 2009 Edition.....GANA Laminated Glazing Reference Manual
- 2008 Edition.....Tempered Glass Engineering Standard Manual
- J. Military Specifications (MIL):
- MIL-C-18480.....(Rev. B) Coating Compound, Bituminous Solvent,  
Coal Tar Base
- K. National Association of Architectural Metal Manufacturers (NAAMM):
- 500 Series (2006).....Metal Finishes Manual.
- L. Steel Structures Painting Council (SSPC)
- Paint 25-97 (2004).....Red Iron Oxide Raw Linseed Oil and Alkyd Primer  
(Without Lead and Chromate Pigments)

## **1.8 WARRANTY**

A. Submit manufacturer's written warranty for materials, installation and weathertightness, and work subject to terms of "Warranty of Construction", FAR clause 52.246-21.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

#### **A. Design Requirements:**

1. Curtain Wall System: Tubular aluminum sections with thermal break condition, self-supporting, supplementary support, framing, factory prefinished, vision glass,; related flashings, anchorage and attachment devices.
2. System Assembly: Site assembled.
3. No curtain wall framing member shall deflect, in a direction normal to plane of wall, more than 1/175 of its clear span or 20 mm (3/4 inch), whichever is less, when designed in accordance with requirements of TIR A11 and tested in accordance with ASTM E330, except that when a gypsum wallboard surface will be affected, deflection shall not exceed 1/360 of span. No framing member shall have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E330 for a minimum test period of 10 seconds at 1.5 times design wind pressures indicated as part of structural drawing wind load requirements. No glass breakage, damage to fasteners, hardware or accessories shall be permitted due to deformation stated above:
  - a. Provide system complete with framing, mullions, trim, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing wall to structure as specified or indicated. Unless noted otherwise, comply with MCWM-1.
  - b. Curtain wall system components and integral door and/or window units shall be furnished by one manufacturer or fabricator; however, all components need not be products of same manufacturer.
  - c. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.
  - d. Provide system with adequate allowances for expansion and contraction of components and fastenings to prevent buckling damage, joint seal failure, glass breakage, undue stress on fastenings or other detrimental effects. For design purposes, base provisions for thermal movement on assumed ambient temperature

range of from -18 degrees C to 49 degrees C (0 degrees F to 120 degrees F).

e. Provide wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified.

B. Manufacturer's Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of curtain walls that are similar to those indicated for this Project in material, design, and extent.

C. Performance Requirements:

1. System shall meet or exceed all performance requirements specified.

2. Curtain wall components shall have been tested in accordance with requirements below and shall meet performance requirements specified:

3. System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with IBC 2012 and ASCE 7-10- Design Loads for Buildings and Other Structures.

4. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with IBC 2012 code.

5. Water Penetration:

a. No water penetration shall occur when wall is tested in accordance with ASTM E331 at a differential static test pressure of 20 percent of inward acting design wind pressure as indicated on structural drawings, but not less than 479 Pa (10 psf).

b. Make provision in wall construction for adequate drainage to outside of water leakage or condensation that occurs within outer face of wall. Leave drainage and weep openings in members and wall open during test.

6. Deflections Test: ASTM E330, Procedure B:

a. No member shall deflect in a direction parallel to plane of wall, when carrying its full design load, more than an amount which will reduce edge cover or glass bite below 75 percent of design dimension. No member after deflection under full design load, shall have a clearance between itself and top of panel, glass, sash, or other part immediately below it less than 3 mm (1/8 inch); clearance between member and an operable window or door shall be minimum 1.5 mm (1/16 inch).

7. Window Tests:



- a. Windows shall meet the requirements specified in Section 08 51 13 ALUMINUM WINDOWS or except where requirements of this section differ, this section shall govern. Windows shall meet same requirements for deflection and structural adequacy as specified for framing members when tested in accordance with ASTM E330 except permanent deformation shall not exceed 0.4 percent; there shall be no glass breakage, and no permanent damage to fasteners, anchors, hardware, or operating devices. Windows shall have no water penetration when tested in accordance with requirements of ASTM E331.

## **2.2 MATERIALS**

- A. Extruded Aluminum Framing Members: ASTM B221M; 6063-T5 extruded aluminum for non-structural components or 6063-T6 extruded aluminum for structural members; temper and alloy as recommended by manufacturer.
- B. Sheet Aluminum: ASTM B209M; 6065-T5 temper and alloy as recommended by manufacturer.
  1. Formed flashing and closures: Minimum 1.58 mm (0.062 inch) thick aluminum, in finish as selected.
  2. Extruded sill members: Minimum 1.58 mm (0.062 inch) thick aluminum, in finish as selected.
- C. Steel Sections: ASTM A36M.
- D. Primer: TS TT-P-645; red, for shop application and field touch-up.
- E. Fasteners:
  1. For Exterior Cap Retainers: ASTM A193 B8 300 series, stainless steel screws.
  2. For Framework Connections: ASTM B211M 2024-T4 aluminum, ASTM A193 B8 300 series, stainless steel, and ASTM B316 aluminum rivets, as required by connection.
  3. For Anchoring Glazed Aluminum Curtain Wall to Support Structure: ASTM A307 zinc plated steel fasteners.
- F. Shims: Metal or plastic.
- G. Joint Sealants and Accessories:
  1. In accordance with requirements specified in Section 07 92 00, JOINT SEALANTS.
  2. Structural Flush Glazed Joints: High performance silicone sealant applied in accordance with manufacturer's recommendations.
  3. Non-structural Flush Glazed Joints and Weather Seal Joints: Silicone sealants applied in accordance with manufacturer's recommendations.
  4. Structural silicone sealant performance requirements: ASTM C920.
    - a. Hardness: Type A, 30 durometer.

- b. Ultimate Tensile Strength: 1172 kPa (170 psi).
  - c. Tensile at 150% Elongation: 55 kPa (80 psi).
  - d. Joint Movement Capability after 14 Day Cure: +/- 50%.
  - e. Peel Strength aluminum, after 21 Day Cure: 599 g/mm (34 pounds per inch).
  - 5. Structural silicone shall not be used to support dead weight of vertical glass or panels.
  - 6. Comply with recommendations of sealant manufacturer for specific sealant selections.
  - 7. Provide only sealants that have been tested per ASTM C794 to exhibit adequate adhesion to samples of glass and metal equivalent to those required for project.
  - 8. Exposed metal to metal joints: Silicone sealant selected from manufacturer's standard colors.
- H. Glazing Materials:
- 1. As specified under Section 08 80 00, GLAZING.
  - 2. Glazing Gaskets:
    - a. Exterior: Continuous EPDM gaskets at each glass and spandrel panel.
    - b. Interior: Continuous, closed cell PVC foam sealant tape, sealed at corners.
  - 3. Glass Sizes and Clearances:
    - a. Accommodate up to 25 mm (1 inch) glazing.
    - b. Sizes indicated are nominal. Verify actual sizes required by measuring frames. Coordinate dimensions for glass and glass holding members to meet applicable minimum clearances as recommended by glass manufacturer. Do not nip glass to remove flares or to reduce oversized dimensions. All cutting shall occur in factory.
  - 4. Glass Setting Materials:
    - a. Provide head bead and drive wedge required for glass installation to suit curtain wall system in accordance with manufacture's recommendations.

## **2.3 FABRICATION**

- A. Curtain wall components shall be of materials and thickness indicated or specified. Details indicated are representative of required design and profiles. Maintain sightlines indicated on drawings. Unless specifically indicated or specified otherwise, methods of fabrication and assembly shall be at discretion of curtain wall manufacturer. Perform fitting and assembling of components in shop to maximum extent practicable.

Anchorage devices shall permit adjustment in three directions. There shall be no exposed fasteners.

- B. Joints: Joints exceeding +1.5 mm (+1/16") shall be mechanically fastened.
- C. Ventilation and Drainage: Direct water leakage to exterior by means of concealed drainage system and weeps. Flashings and other materials used internally shall be nonstaining, noncorrosive, and nonbleeding.
- D. Protection and Treatment of Metals:
  - 1. Remove from metal surfaces lubricants used in fabrication and clean off other extraneous material before leaving shop.
  - 2. Provide protection against galvanic action wherever dissimilar metals are in contact, except in case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint conforming to MIL-C-18480 or apply appropriate caulking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.
- E. Metal sills and Closures: Fabricate accessories, spandrel panels, trim closures of sizes and shapes indicated from similar materials and finish as specified for wall system.

#### **2.4 PROTECTION**

- A. Provide protection for aluminum against galvanic action, wherever dissimilar materials are in contact, by painting contact surfaces of dissimilar material with a heavy coat of bituminous paint (complete coverage), or by separating contact surfaces with a preformed neoprene tape having pressure sensitive adhesive coating on one side.

#### **2.5 METAL FINISHES**

- A. In accordance with NAAMM AMP500 series.
- B. Anodized Aluminum:
  - 1. AA-C22A41 Chemically etched medium matte, with clear anodic coating, Class 1 Architectural, 0.7-mil thick.
- C. Shop and Touch-Up Primer for Steel Components: SSPC Paint 25 red oxide. As specified.
- E. Touch-Up Primer for galvanized Steel Surfaces: SSPC Paint 20 zinc rich. As specified.
- F. Concealed Steel Items: Galvanized in accordance with ASTM A123 to (610 gm/sq m) 2.0 oz/sq ft.
- G. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Prior to installation of glazed curtain wall system, arrange for representative(s) of manufacturer to examine structure and substrate to determine that they are properly prepared, and ready to receive glazed curtain wall work included herein.
- B. Verifying Conditions and Adjacent Surfaces: After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in building frame.

#### **3.2 PREPARATION**

- A. Take field dimensions and examine condition of substrates, supports, and other conditions under which work of this section is to be performed to verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Contact between aluminum and dissimilar metals shall receive a protective coating of asphaltic paint for prevention of electrolytic action and corrosion.

#### **3.3 INSTALLATION**

- A. Installation and erection of glazed curtain wall system and all components shall be in accordance with written directions of curtain wall manufacturer. Match profiles, sizes, and spacing indicated on approved shop drawings.
- B. Bench Marks and Reference Points: Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of marks, stop erection work in that area until discrepancies have been corrected.
- C. Ensure that drainage system operates properly in accord with AAMA 501 procedures.
- D. Do not proceed with structural silicone work when metal temperature is below 0 degrees C (32 degrees F).
- E. Isolate between aluminum and dissimilar metals with protective coating or plastic strip to prevent electrolytic corrosion.
- F. Install glazed aluminum curtain wall system so as to maintain a virtually flat face cap, with no visible bowing.
- G. Install entire system so that fasteners are not visible.
- H. Tolerances:

1. Maximum variation from plane or location shown on approved shop drawings: 3 mm per 3600 mm (1/8 inch per 12 feet) of length up to not more than 13 mm (1/2 inch) in any total length.
2. Maximum offset from true alignment between two identical members abutting end to end in line: 0.8 mm (1/32 inch).
3. Sealant Space Between Curtain Wall Mullion and Adjacent Construction: Maximum of 19 mm (3/4 inch) and minimum of 6 mm (1/4 inch).

I. Windows:

1. Refer to Section 08 51 13, ALUMINUM WINDOWS for window requirements.

J. Joint Sealants:

1. Joint Sealants: Shall be in accordance with requirements of Section 07 92 00, JOINT SEALANTS.
2. Surfaces to be primed and sealed shall be clean, dry to touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions shall conform to approved detail drawings with a tolerance of plus 3 mm (1/8 inch). Do not apply compound unless ambient temperature is between 5 and 35 degrees C (40 and 90 degrees F). Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings shall be of type that leave no residue on metals.
3. Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound shall be uniformly smooth and free of wrinkles and, unless indicated otherwise, shall be tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, but at no time shall this amount exceed 19 liters (5 gallons).
4. Apply primer to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after caulking is completed.
5. Tightly pack backing in bottom of joints which are over 13 mm (1/2 inch) in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.

6. Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.
7. Remove compound smears from surfaces of materials adjacent to sealed joints as work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of caulking and sealing, remove remaining smears, stains, and other soiling, and leave work in clean neat condition.

K. Glass:

1. Refer to Section 08 80 00, GLAZING, and drawing for glass types. Install in accordance with manufacturer's recommendations as modified herein.
2. Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.
3. Clean sealing surfaces at perimeter of glass and sealing surfaces of rebates and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer. All sashes shall be designed for outside glazing. Provide continuous snap in glazing beads to suit glass as specified.
4. Insulating and tempered glass, and glass of other types that exceed 100 united inches in size: Provide void space at head and jamb to allow glass to expand or move without exuding sealant. Perimeter frames and ventilator sections shall have glazing rebates providing an unobstructed glazing surface 19 mm (3/4 inch) in height. Glazing rebate surfaces must be sloped to shed water.
5. Provide adequate means to weep incidental water and condensation away from sealed edges of insulated glass units and out of wall system. Weeping of lock-strip gaskets should be in accordance with recommendation of glass manufacturer.

L. Metal Copings:

1. Refer to Section 07 60 00, FLASHING AND SHEET METAL for requirements of metal copings when they are not a part of glazed curtain wall system work.

2. Coordinate curtain wall installation with metal coping detail on contract drawings. Provide watertight seal to meet criteria set forth in this section regarding air and water penetration.

### 3.5 CLEANING

- A. Install curtain wall frame and associated metal to avoid soiling or smudging finish.
- B. Clean metal surfaces promptly after installation, exercising care to avoid damage to coatings.
- C. Remove excess glazing and sealant compounds, dirt, and other substances.
- D. Follow recommendations of manufacturer in selection of cleaning agents. Do not use cleaning agents containing ammonia or other compounds that might damage finished metal surfaces.
- E. Replace cracked, broken, and defective glass with new glass at no additional cost to Government. Just prior to final acceptance of curtain wall system clean glass surfaces on both sides, remove labels, paint spots, compounds, and other defacements, and clean metal fixed panels. Remove and replace components that cannot be cleaned successfully.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an AAMA accredited commercial qualified independent testing and inspecting agency to perform field quality-control tests specified, and to prepare test reports: Submit information regarding testing laboratory's facilities and qualifications of technical personnel to Contracting Officer for approval.
- B. Conduct field check test for water leakage on designated wall areas after erection to comply with MCWM-1. Conduct test on two wall areas, two bays wide by two stories high where directed. Conduct test and take necessary remedial action as directed by Contracting Officer.
- C. Test Specimen:
  1. Test specimen shall include curtain wall assembly and construction. Test chamber shall be affixed to exterior side of test specimen and test shall be conducted using positive static air pressure.
  2. Test specimens shall be selected by Contracting Officer after curtain wall system has been installed in accordance with contract drawings and specification.
- D. Sealant Adhesion Tests: Test installed sealant, in presence of sealant manufacturer's field representative, in a minimum of two areas and as follows:
  1. Test structural silicone sealant according to field adhesion test method described in AAMA CW 13, "Structural Sealant Glazing Systems (A Design Guide)."

2. Test weatherseal sealant as recommended in writing by sealant manufacturer.
- E. Water Penetration: Test glazed aluminum curtain wall system for compliance with requirements according to AAMA 503, which requires testing according to ASTM E1105.
1. Uniform Static-Air-Pressure Difference: 20 percent of positive design wind load, but not less than 479 Pa (10 psf). No uncontrolled water shall be present.
- F. Retesting:
1. Should system fail field test, system may be modified or repaired, and retested.
  2. Should system fail second field test, system may be additionally modified or repaired, and retested.
  3. All modifications and repairs made to tested areas shall be recorded, and same modifications and repairs made to all system and adjacent construction on project.
  4. Should second test fail, Contracting Officer may require testing of additional areas of the curtain wall.
- G. Rejection:
1. Failure of any of specimens to meet test requirements of third test shall be cause for rejection of wall system and adjacent construction on project.

### **3.8 PROTECTION**

- A. After installation, protect windows, and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods shall be in accordance with recommendations of product manufacturers or of respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or respective trade association.

- - - END - - -



**SECTION 08 51 13**  
**ALUMINUM WINDOWS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Aluminum windows of type and size shown, complete with hardware, related components and accessories.
- B. Types:
  - 1. Fixed

**1.2 DEFINITIONS**

- A. Accessories: Mullions, staff beads, casings, closures, trim, moldings, panning systems, sub-sills, clips anchors, fasteners, weather-stripping, and other necessary components required for fabrication and installation of window units.
- B. Uncontrolled Water: Water not drained to the exterior, or water appearing on the room side of the window.

**1.3 RELATED WORK**

- A. Steel subframes: Section 05 50 00, METAL FABRICATIONS.
- B. Storefront: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Glazing: Section 08 80 00, GLAZING.
- D. Color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Protect windows from damage during handling and construction operations before, during and after installation.
- B. Store windows under cover, setting upright.
- C. Do not stack windows flat.
- D. Do not lay building materials or equipment on windows.

**1.5 QUALITY ASSURANCE**

- A. Approval by contracting officer is required of products or service of proposed manufacturers and installers.
- B. Approval will be based on submission of certification by Contractor that:
  - 1. Manufacturer regularly and presently manufactures the specified windows as one of its principal products.
  - 2. Installer has technical qualifications, experience, trained personnel and facilities to install specified items.
- C. Provide each type of window produced from one source of manufacture.

D. Quality Certified Labels or certificate:

1. Architectural Aluminum Manufacturers Association, "AAMA label" affixed to each window indicating compliance with specification.
2. Certificates in lieu of label with copy of recent test report (not more than 4 years old) from an independent testing laboratory and certificate signed by window manufacturer stating that windows provided comply with specified requirements and AAMA 101/I.S.2/A440 for type of window specified.

**1.6 SUBMITTAL**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
1. Minimum of 1/2 full scale types of windows on project.
  2. Identifying parts of window units by name and kind of metal or material, show construction, locking systems, mechanical operators, trim, installation and anchorages.
  3. Include glazing details and standards for factory glazed units.
- C. Manufacturer's Literature and Data: Window.
- D. Certificates:
1. Certificates as specified in paragraph QUALITY ASSURANCE.
  2. Indicating manufacturers and installers qualifications.
  3. Manufacturer's Certification that windows delivered to project are identical to windows tested.
- E. Test Reports:
- Copies of test reports as specified in paragraph QUALITY ASSURANCE.

**1.7 WARRANTY**

Warrant windows against malfunctions due to defects in thermal breaks, hardware, materials and workmanship, subject to the terms of Article "WARRANTY OF CONSTRUCTION", FAR clause 52.246-21, and include manufacturer's warranty.

**1.8 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)  
90.1-07.....Energy Standard of Buildings

- C. American Architectural Manufacturers Association (AAMA):  
101/I.S.2/A440-11.....Windows, Doors, and Unit Skylights  
505-09.....Dry Shrinkage and Composite Performance Thermal  
Cycling Test Procedures  
2605-05.....Superior Performing Organic Coatings on  
Architectural Aluminum Extrusions and Panels  
TIR-A8-08.....Structural Performance of Poured and Debridged  
Framing Systems
- D. American Society for Testing and Materials (ASTM):  
A653/A653M-09.....Steel Sheet, Zinc Coated (Galvanized), Zinc-  
Iron Alloy-Coated (Galvannealed) by the Hot-dip  
Process  
E 90-09.....Test Method for Laboratory Measurement of  
Airborne Sound Transmission Loss of Building  
Partitions
- E. National Fenestration Rating Council (NFRC):  
NFRC 100-10.....Determining Fenestration Product U-Factors  
NFRC 200-10.....Determining Fenestration Product Solar Heat  
Gain Coefficient and Visible Transmittance at  
Normal Incidence
- F. National Association of Architectural Metal Manufacturers (NAAMM):  
AMP 500-06.....Metal Finishes Manual

## **PART 2- PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum Extrusions; Sheet and Plate: AAMA 101/I.S.2/A440.
- B. Sheet Steel, Galvanized: ASTM A653; G90 galvanized coating.
- C. Weather-strips: AAMA 101/I.S.2/A440; except leaf type weather-stripping is not permitted.
- D. Fasteners: AAMA 101/I.S.2/A440. Screws, bolts, nuts, rivets and other fastening devices to be non-magnetic stainless steel.
1. Fasteners to be concealed when window is closed. Where wall thickness is less than 3 mm (0.125 inch) thick, provide backup plates or similar reinforcements for fasteners.
  2. Stainless steel self tapping screws may be used to secure Venetian blind hanger clips, vent guide blocks, friction adjuster, and limit opening device.

3. Attach locking and hold-open devices to windows with concealed fasteners. Provide reinforcing plates where wall thickness is less than 3 mm (0.125 inch) thick.

## **2.2 THERMAL AND CONDENSATION PERFORMANCE**

- A. Condensation Resistance Factor (CRF): Minimum CRF of C 50.
- B. Thermal Transmittance:
  1. Maximum U value class for insulating glass windows: 50 (U=0.50).
  2. Maximum U value class for dual glazed windows: 70 (U=0.70), or as required by ASHRAE 90.1.
- C. Solar Heat Gain Coefficient (SHGC): SHGC shall comply with State or local energy code requirement.

## **2.3 FABRICATION**

- A. Fabrication to exceed or meet requirements of Physical Load Tests, Air Infiltration Test, and Water Resistance Test of AAMA 101/I.S.2/A440.
- B. Glazing:
  1. Factory or field glazing optional.
  2. Glaze in accordance with Section 08 80 00, GLAZING.
  3. Windows reglazable without dismantling sash framing.
  4. Design rabbet to suit glass thickness and glazing method specified.
  5. Glaze from interior except where not accessible.
  7. Provide removable fin type glazing beads.
- C. Trim:
  1. Trim includes casings, closures, and panning.
  2. Fabricate to shapes shown of aluminum not less than 1.6 mm (0.062 inch) thick
  3. Extruded or formed sections, straight, true, and smooth on exposed surfaces.
  4. Exposed external corners mitered and internal corners coped; fitted with hairline joints.
  5. Reinforce 1.6 mm (0.062 inch) thick members with not less than 3 mm (1/8-inch) thick aluminum.
  6. Except for strap anchors, provide reinforcing for fastening near ends and at intervals not more than 305 mm (12 inches) between ends.
  7. Design to allow unrestricted expansion and contraction of members and window frames.
  8. Secure to window frames with machine screws or expansion rivets.

9. Exposed screws, fasteners or pop rivets are not acceptable on exterior of the casing or trim cover system.

D. Thermal-Break Construction:

1. Manufacturer's Standard.
2. Low conductance thermal barrier.
3. Capable of structurally holding sash in position and together.
4. All Thermal Break Assemblies (Pour & Debridge, Insulbar or others) shall be tested as per AAMA TIR A8 and AAMA 505 for Dry Shrinkage and Composite Performance.
5. Location of thermal barrier and design of window shall be such that, in closed position, outside air shall not come in direct contact with interior frame of the window.

E. Mullions: AAMA 101/I.S.2/A440.

F. Flashing, Subsills and Stools:

1. Fabricate to shapes shown of not less than 2 mm (0.080 inch) thick extruded aluminum.
2. One piece full length of opening with concealed anchors.
3. Sills turned up back edge not less than 6 mm (1/4 inch). Front edge provide with drip.
4. Sill back edge behind face of window frame. Do not extend to interior surface or bridge thermal breaks.
5. Do not perforate for anchorage, clip screws, or other requirements.

**2.4 FIXED WINDOWS**

- A. AAMA 101/I.S.2/A440; Type HC25.
- B. AAMA certified product to the AAMA 101/I.S.2/A440. - 11 standard.

**2.5 FINISH**

- A. In accordance with NAAMM AMP 500 series.
- B. Finish exposed aluminum surfaces as follows:
  1. Anodized Aluminum:
    - a. Finish in accordance with AMP 501 letters and numbers.
    - b. Clear anodized Finish: AA-C22A41 Medium matte, clear anodic coating, Class 1 Architectural, 0.7 mils thick.
    - c. Colored anodized Finish: AA-C22A42 (anodized) or AA-C22A44 (electrolytically deposited metallic compound) medium matte, integrally colored coating, Class 1 Architectural, 0.7 mils thick.
  - 1) Dyes not accepted.

2) Coated Aluminum:

3) Variation of more than 50 percent of maximum shade range approved will not be accepted in a single window or in adjacent windows and mullions on a continuous series.

a) AMP 501 and 505.

b) Fluorocarbon Finish: AAMA 2605, superior performing organic coating.

c) Steel: AMP 504.

d) Stainless steel: AMP 503.

1. Concealed: 2B or 2D.

2. Exposed: No. 4 unless specified otherwise.

E. Hardware: Finish hardware exposed when window is in the closed position: Match window color.

### **PART 3 - EXECUTION**

**3.1 PROTECTION (DISSIMILAR MATERIALS):** AAMA 101/I.S.2/A440.

#### **3.2 INSTALLATION, GENERAL**

A. Install window units in accordance with manufacturer's specifications and recommendations for installation of window units, hardware, operators and other components of work.

B. Where type, size or spacing of fastenings for securing window accessories or equipment to building construction is not shown or specified, use expansion or toggle bolts or screws, as best suited to construction material.

1. Provide bolts or screws minimum 6 mm (1/4-inch) in diameter.

2. Sized and spaced to resist the tensile and shear loads imposed.

3. Do not use exposed fasteners on exterior, except when unavoidable for application of hardware.

4. Provide non-magnetic stainless steel Phillips flat-head machine screws for exposed fasteners, where required, or special tamper-proof fasteners.

5. Locate fasteners to not disturb the thermal break construction of windows.

C. Set windows plumb, level, true, and in alignment; without warp or rack of frames or sash.

D. Anchor windows on four sides with anchor clips or fin trim.

1. Do not allow anchor clips to bridge thermal breaks.

2. Use separate clips for each side of thermal breaks.

3. Make connections to allow for thermal and other movements.
4. Do not allow building load to bear on windows.
5. Use manufacturer's standard clips at corners and not over 600 mm (24 inches) on center.
6. Where fin trim anchorage is shown build into adjacent construction, anchoring at corners and not over 600 mm (24 inches) on center.

E. Flashing, Sills and Stools:

1. Set in bed of mortar or other compound to fully support, true to line shown.
2. Do not extend sill to inside window surface or past thermal break.
3. Leave space for sealants at ends and to window frame unless shown otherwise.

**3.3 MULLIONS CLOSURES, TRIM, AND PANNING**

- A. Cut mullion full height of opening and anchor directly to window frame on each side.
- B. Closures, Trim, and Panning: External corners mitered and internal corners coped, fitted with hairline, tightly closed joints.
- C. Secure to concrete or solid masonry with expansion bolts, expansion rivets, split shank drive bolts, or powder actuated drive pins.
- D. Toggle bolt to hollow masonry units. Screwed to wood or metal.
- E. Fasten except for strap anchors, near ends and corners and at intervals not more than 300 mm (12 inches) between.
- F. Seal units following installation to provide weathertight system.

**3.4 ADJUST AND CLEAN**

- A. Adjust ventilating sash and hardware to provide tight fit at contact points, and at weather-stripping for smooth operation and weathertight closure.
- B. Clean aluminum surfaces promptly after installation of windows, exercising care to avoid damage to protective coatings and finishes.
- C. Remove excess glazing and sealant compounds, dirt, and other substances.
- D. Lubricate hardware and moving parts.
- E. Clean glass promptly after installation of windows. Remove glazing and sealant compound, dirt and other substances.
- F. Except when a window is being adjusted or tested, keep locked in the closed position during the progress of work on the project.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

- - - E N D - - -



**SECTION 08 71 00**  
**DOOR HARDWARE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Door hardware and related items necessary for complete installation and operation of doors.

**1.2 RELATED WORK**

- A. Caulking: Section 07 92 00 JOINT SEALANTS.
- B. Application of Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS , Section 08 71 13, POWER DOOR OPERATORS
- C. Finishes: Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Painting: Section 09 91 00, PAINTING.
- E. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
- F. Electrical: Division 26, ELECTRICAL.
- G. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

**1.3 GENERAL**

- A. All hardware shall comply with UFAS, (Uniform Federal Accessible Standards) unless specified otherwise.
- B. Provide rated door hardware assemblies where required by most current version of the International Building Code (IBC).
- C. Hardware for Labeled Fire Doors and Exit Doors: Conform to requirements of NFPA 80 for labeled fire doors and to NFPA 101 for exit doors, as well as to other requirements specified. Provide hardware listed by UL, except where heavier materials, large size, or better grades are specified herein under paragraph HARDWARE SETS. In lieu of UL labeling and listing, test reports from a nationally recognized testing agency may be submitted showing that hardware has been tested in accordance with UL test methods and that it conforms to NFPA requirements.
- D. Hardware for application on metal and wood doors and frames shall be made to standard templates. Furnish templates to the fabricator of these items in sufficient time so as not to delay the construction.
- E. The following items shall be of the same manufacturer, except as otherwise specified:
  - 1. Mortise locksets.
  - 2. Hinges for hollow metal.
  - 3. Surface applied overhead door closers.

4. Exit devices.
5. Floor closers.

#### **1.4 WARRANTY**

A. Automatic door operators shall be subject to the terms of FAR Clause 52.246-21, to include manufacturer's warranty for all items except as noted below:

1. Locks, latchsets, and panic hardware: Manufacturer's warranty or industry standard, whichever is greater.
2. Door closers and continuous hinges: Manufacturer's warranty or industry standard, whichever is greater.

#### **1.5 MAINTENANCE MANUALS**

A. In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS", furnish maintenance manuals and instructions on all door hardware. Provide installation instructions with the submittal documentation.

#### **1.6 SUBMITTALS**

A. Submittals shall be in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Submit 6 copies of the schedule per Section 01 33 23. Submit 2 final copies of the final approved schedules to VAMC Locksmith as record copies (VISN Locksmith if the VAMC does not have a locksmith).

B. Hardware Schedule: Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (if fire rated and listed)	ANSI/BHMA Finish Designation

C. Samples and Manufacturers' Literature:

1. Samples: All hardware items (proposed for the project) that have not been previously approved by Builders Hardware Manufacturers Association shall be submitted for approval. Tag and mark all items with manufacturer's name, catalog number and project number.

2. Samples are not required for hardware listed in the specifications by manufacturer's catalog number, if the contractor proposes to use the manufacturer's product specified.

D. Certificate of Compliance and Test Reports: Submit certificates that hardware conforms to the requirements specified herein. Certificates shall be accompanied by copies of reports as referenced. The testing shall have been conducted either in the manufacturer's plant and certified by an independent testing laboratory or conducted in an independent laboratory, within four years of submittal of reports for approval.

#### **1.7 DELIVERY AND MARKING**

A. Deliver items of hardware to job site in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to COR (Contracting Officer's Representative) for reference purposes. Tag shall identify items by Project Specification number and manufacturer's catalog number. These items shall remain on file in COR's office until all other similar items have been installed in project, at which time the COR will deliver items on file to Contractor for installation in predetermined locations on the project.

#### **1.8 PREINSTALLATION MEETING**

A. Convene a preinstallation meeting not less than 30 days before start of installation of door hardware. Require attendance of parties directly affecting work of this section, including Contractor and Installer, Architect, Project Engineer and VA Locksmith, Hardware Consultant, and Hardware Manufacturer's Representative. Review the following:

1. Inspection of door hardware.
2. Job and surface readiness.
3. Coordination with other work.
4. Protection of hardware surfaces.
5. Substrate surface protection.
6. Installation.
7. Adjusting.
8. Repair.
9. Field quality control.
10. Cleaning.

## 1.9 INSTRUCTIONS

- A. Hardware Set Symbols on Drawings: Except for protective plates, door stops, mates, thresholds and the like specified herein, hardware requirements for each door are indicated on drawings by symbols. Symbols for hardware sets consist of letters (e.g., "HW") followed by a number. Each number designates a set of hardware items applicable to a door type.
- B. Keying: All cylinders shall be keyed into existing Grand Master Key System AND KEY CARD SYSTEM. Provide removable core cylinders that are removable only with a special key or tool without disassembly of knob or lockset. Cylinders shall be 7 pin type. Keying information shall be furnished at a later date by the COR.

## 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. In text, hardware items are referred to by series, types, etc., listed in such specifications and standards, except as otherwise specified.
- B. American Society for Testing and Materials (ASTM):
- F883-04.....Padlocks
  - E2180-07.....Standard Test Method for Determining the  
Activity of Incorporated Antimicrobial Agent(s)  
In Polymeric or Hydrophobic Materials
- C. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
- A156.1-06.....Butts and Hinges
  - A156.2-03.....Bored and Pre-assembled Locks and Latches
  - A156.3-08.....Exit Devices, Coordinators, and Auto Flush  
Bolts
  - A156.4-08.....Door Controls (Closers)
  - A156.5-01.....Auxiliary Locks and Associated Products
  - A156.6-05.....Architectural Door Trim
  - A156.8-05.....Door Controls-Overhead Stops and Holders
  - A156.12-05 .....Interconnected Locks and Latches
  - A156.13-05.....Mortise Locks and Latches Series 1000
  - A156.14-07 .....Sliding and Folding Door Hardware

- A156.15-06.....Release Devices-Closer Holder, Electromagnetic  
and Electromechanical
- A156.16-08.....Auxiliary Hardware
- A156.17-04 .....Self-Closing Hinges and Pivots
- A156.18-06.....Materials and Finishes
- A156.20-06 .....Strap and Tee Hinges, and Hasps
- A156.21-09.....Thresholds
- A156.22-05.....Door Gasketing and Edge Seal Systems
- A156.23-04.....Electromagnetic Locks
- A156.24-03.....Delayed Egress Locking Systems
- A156.25-07 .....Electrified Locking Devices
- A156.26-06.....Continuous Hinges
- A156.28-07 .....Master Keying Systems
- A156.29-07 .....Exit Locks and Alarms
- A156.30-03 .....High Security Cylinders
- A156.31-07 .....Electric Strikes and Frame Mounted Actuators
- A250.8-03.....Standard Steel Doors and Frames
- D. National Fire Protection Association (NFPA):
  - 80-10.....Fire Doors and Fire Windows
  - 101-09.....Life Safety Code
- E. Underwriters Laboratories, Inc. (UL):
  - Building Materials Directory (2008)

## **PART 2 - PRODUCTS**

### **2.1 BUTT HINGES**

- A. ANSI A156.1. Provide only three-knuckle hinges, except five-knuckle where the required hinge type is not available in a three-knuckle version (e.g., some types of swing-clear hinges). The following types of butt hinges shall be used for the types of doors listed, except where otherwise specified:
  - 1. Exterior Doors: Type A2112/A5112 for doors 900 mm (3 feet) wide or less and Type A2111/A5111 for doors over 900 mm (3 feet) wide.  
Hinges for exterior outswing doors shall have non-removable pins.  
Hinges for exterior fire-rated doors shall be of stainless steel material.
  - 2. Interior Doors: Type A8112/A5112 for doors 900 mm (3 feet) wide or less and Type A8111/A5111 for doors over 900 mm (3 feet) wide.  
Hinges for doors exposed to high humidity areas (shower rooms,

toilet rooms, kitchens, janitor rooms, etc. shall be of stainless steel material.

B. Provide quantity and size of hinges per door leaf as follows:

1. Doors up to 1210 mm (4 feet) high: 2 hinges.
2. Doors 1210 mm (4 feet) to 2260 mm (7 feet 5 inches) high: 3 hinges minimum.
3. Doors greater than 2260 mm (7 feet 5 inches) high: 4 hinges.
4. Doors up to 900 mm (3 feet) wide, standard weight: 114 mm x 114 mm (4-1/2 inches x 4-1/2 inches) hinges.
5. Doors over 900 mm (3 feet) to 1065 mm (3 feet 6 inches) wide, standard weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
6. Doors over 1065 mm (3 feet 6 inches) to 1210 mm (4 feet), heavy weight: 127 mm x 114 mm (5 inches x 4-1/2 inches).
7. Provide heavy-weight hinges where specified.
8. At doors weighing 330 kg (150 lbs.) or more, furnish 127 mm (5 inch) high hinges.

C. See Articles "MISCELLANEOUS HARDWARE" and "HARDWARE SETS" for pivots and hinges other than butts specified above and continuous hinges specified below.

**2.2 DOOR CLOSING DEVICES**

- A. Closing devices shall be products of one manufacturer.

**2.3 OVERHEAD CLOSERS**

- A. Conform to ANSI A156.4, Grade 1.
- B. Closers shall conform to the following:
1. The closer shall have minimum 50 percent adjustable closing force over minimum value for that closer and have adjustable hydraulic back check effective between 60 degrees and 85 degrees of door opening.
  2. Where specified, closer shall have hold-open feature.
  3. Size Requirements: Provide multi-size closers, sizes 1 through 6, except where multi-size closer is not available for the required application.
  4. Material of closer body shall be forged or cast.
  5. Arm and brackets for closers shall be steel, malleable iron or high strength ductile cast iron.

6. Where closers are exposed to the exterior or are mounted in rooms that experience high humidity, provide closer body and arm assembly of stainless steel material.
7. Closers shall have full size metal cover; plastic covers will not be accepted.
8. Closers shall have adjustable hydraulic back-check, separate valves for closing and latching speed, adjustable back-check positioning valve, and adjustable delayed action valve.
9. Provide closers with any accessories required for the mounting application, including (but not limited to) drop plates, special soffit plates, spacers for heavy-duty parallel arm fifth screws, bull-nose or other regular arm brackets, longer or shorter arm assemblies, and special factory templating. Provide special arms, drop plates, and templating as needed to allow mounting at doors with overhead stops and/or holders.
10. Closer arms or backcheck valve shall not be used to stop the door from overswing, except in applications where a separate wall, floor, or overhead stop cannot be used.
11. Provide parallel arm closers with heavy duty rigid arm.
12. Where closers are to be installed on the push side of the door, provide parallel arm type except where conditions require use of top jamb arm.
13. Provide all surface closers with the same body attachment screw pattern for ease of replacement and maintenance.
14. All closers shall have a 1 ½" (38mm) minimum piston diameter.

#### **2.4 DOOR STOPS**

- A. Conform to ANSI A156.16.
- B. Provide door stops wherever an opened door or any item of hardware thereon would strike a wall, column, equipment or other parts of building construction. For concrete, masonry or quarry tile construction, use lead expansion shields for mounting door stops.
- C. Where cylindrical locks with turn pieces or pushbuttons occur, equip wall bumpers Type L02251 (rubber pads having concave face) to receive turn piece or button.
- D. Provide floor stops (Type L02141 or L02161 in office areas; Type L02121 x 3 screws into floor elsewhere. Wall bumpers, where used, must be installed to impact the trim or the door within the leading half of its

- width. Floor stops, where used, must be installed within 4-inches of the wall face and impact the door within the leading half of its width.
- E. Where drywall partitions occur, use floor stops, Type L02141 or L02161 in office areas, Type L02121 elsewhere.
  - F. Provide stop Type L02011, as applicable for exterior doors. At outswing doors where stop can be installed in concrete, provide stop mated to concrete anchor set in 76mm (3-inch) core-drilled hole and filled with quick-setting cement.
  - G. Omit stops where floor mounted door holders are required and where automatic operated doors occur.
  - H. Provide appropriate roller bumper for each set of doors (except where closet doors occur) where two doors would interfere with each other in swinging.
  - I. Provide appropriate door mounted stop on doors in individual toilets where floor or wall mounted stops cannot be used.
  - J. Provide overhead surface applied stop Type C02541, ANSI A156.8 on patient toilet doors in bedrooms where toilet door could come in contact with the bedroom door.
  - K. Provide door stops on doors where combination closer magnetic holders are specified, except where wall stops cannot be used or where floor stops cannot be installed within 4-inches of the wall.
  - L. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

## **2.5 OVERHEAD DOOR STOPS AND HOLDERS**

- A. Conform to ANSI Standard A156.8. Overhead holders shall be of sizes recommended by holder manufacturer for each width of door. Set overhead holders for 110 degree opening, unless limited by building construction or equipment. Provide Grade 1 overhead concealed slide type: stop-only at rated doors and security doors, hold-open type with exposed hold-open on/off control at all other doors requiring overhead door stops.

## **2.6 FLOOR DOOR HOLDERS**

- A. Conform to ANSI Standard A156.16. Provide extension strikes for Types L01301 and L01311 holders where necessary.

## **2.7 LOCKS AND LATCHES**

- A. Conform to ANSI A156.2. Locks and latches for doors 45 mm (1-3/4 inch) thick or over shall have beveled fronts. Lock cylinders shall have not



less than seven pins. Cylinders for all locksets shall be removable core type. Cylinders shall be furnished with construction removable cores and construction master keys. Cylinder shall be removable by special key or tool. Construct all cores so that they will be interchangeable into the core housings of all mortise locks, rim locks, cylindrical locks, and any other type lock included in the Great Grand Master Key System. Disassembly of lever or lockset shall not be required to remove core from lockset. All locksets or latches on double doors with fire label shall have latch bolt with 19 mm (3/4 inch) throw, unless shorter throw allowed by the door manufacturer's fire label. Provide temporary keying device or construction core of allow opening and closing during construction and prior to the installation of final cores.

B. In addition to above requirements, locks and latches shall comply with following requirements:

1. Mortise Lock and Latch Sets: Conform to ANSI/BHMA A156.13. Mortise locksets shall be series 1000, minimum Grade 2. All locksets and latchsets, except on designated doors in Psychiatric (Mental Health) areas, shall have lever handles fabricated from cast stainless steel. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. All lock cases installed on lead lined doors shall be lead lined before applying final hardware finish. Furnish armored fronts for all mortise locks. Where mortise locks are installed in high-humidity locations or where exposed to the exterior on both sides of the opening, provide non-ferrous mortise lock case.
2. Cylindrical Lock and Latch Sets: levers shall meet ADA (Americans with Disabilities Act) requirements. Cylindrical locksets shall be series 4000 Grade I. All locks and latchsets shall be furnished with 122.55 mm (4-7/8-inch) curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 21mm (7/8-inch) lip-to-center dimension. Provide lever design

to match design selected by Architect or to match existing lever design. Where two turn pieces are specified for lock F76, turn piece on inside knob shall lock and unlock inside knob, and turn piece on outside knob shall unlock outside knob when inside knob is in the locked position. (This function is intended to allow emergency entry into these rooms without an emergency key or any special tool.)

3. Auxiliary locks shall be as specified under hardware sets and conform to ANSI A156.5.
4. Locks on designated doors in Psychiatric (Mental Health) areas shall be paddle type with arrow projection covers and be UL Listed. Provide these locks with paddle in the down position on both sides of the door. Locks shall be fabricated of wrought stainless steel.
5. Privacy locks in non-mental-health patient rooms shall have an inside thumbturn for privacy and an outside thumbturn for emergency entrance. Single occupancy patient privacy doors shall typically swing out; where such doors cannot swing out, provide center-pivoted doors with rescue hardware (see HW-2B).

## **2.8 ELECTRIC STRIKES**

- A. ANSI/ BHMA A156.31 Grade 1.
- B. General: Use fail-secure electric strikes at fire-rated doors.

## **2.9 KEYS**

- A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

<b>Locks/Keys</b>	<b>Quantity</b>
Cylinder locks	2 keys each
Cylinder lock change key blanks	100 each different key way
Master-keyed sets	6 keys each
Grand Master sets	6 keys each
Great Grand Master set	5 keys
Control key	2 keys

- B. Psychiatric keys shall be cut so that first two bittings closest to the key shoulder are shallow to provide greater strength at point of greatest torque.

## **2.10 ARMOR PLATES, KICK PLATES, MOP PLATES AND DOOR EDGING**

- A. Conform to ANSI Standard A156.6.
- B. Provide protective plates and door edging as specified below:
  - 1. Kick plates, mop plates and armor plates of metal, Type J100 series.
  - 2. Provide kick plates and mop plates where specified. Kick plates shall be 254 mm (10 inches) or 305 mm (12 inches) high. Mop plates shall be 152 mm (6 inches) high. Both kick and mop plates shall be minimum 1.27 mm (0.050 inches) thick. Provide kick and mop plates beveled on all 4 edges (B4E). On push side of doors where jamb stop extends to floor, make kick plates 38 mm (1-1/2 inches) less than width of door, except pairs of metal doors which shall have plates 25 mm (1 inch) less than width of each door. Extend all other kick and mop plates to within 6 mm (1/4 inch) of each edge of doors. Kick and mop plates shall butt astragals. For jamb stop requirements, see specification sections pertaining to door frames.
  - 3. Kick plates and/or mop plates are not required on following door sides:
    - a. Armor plate side of doors;
    - b. Exterior side of exterior doors;
    - c. Closet side of closet doors;
    - d. Both sides of aluminum entrance doors.
  - 4. Armor plates for doors are listed under Article "Hardware Sets". Armor plates shall be thickness as noted in the hardware set, 875 mm (35 inches) high and 38 mm (1-1/2 inches) less than width of doors, except on pairs of metal doors. Provide armor plates beveled on all 4 edges (B4E). Plates on pairs of metal doors shall be 25 mm (1 inch) less than width of each door. Where top of intermediate rail of door is less than 875 mm (35 inches) from door bottom, extend armor plates to within 13 mm (1/2 inch) of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 13 mm (1/2 inch) of panic bolt push bar.
  - 5. Where louver or grille occurs in lower portion of doors, substitute stretcher plate and kick plate in place of armor plate. Size of stretcher plate and kick plate shall be 254 mm (10 inches) high.
  - 6. Provide stainless steel edge guards where so specified at wood doors. Provide mortised type instead of surface type except where door construction and/or ratings will not allow. Provide edge

guards of bevel and thickness to match wood door. Provide edge guards with factory cut-outs for door hardware that must be installed through or extend through the edge guard. Provide full-height edge guards except where door rating does not allow; in such cases, provide edge guards to height of bottom of typical lockset armor front. Forward edge guards to wood door manufacturer for factory installation on doors.

#### **2.11 EXIT DEVICES**

- A. Conform to ANSI Standard A156.3. Exit devices shall be Grade 1; type and function are specified in hardware sets. Provide flush with finished floor strikes for vertical rod exit devices in interior of building. Trim shall have cast satin stainless steel lever handles of design similar to locksets, unless otherwise specified. Provide key cylinders for keyed operating trim and, where specified, cylinder dogging.
- B. Surface vertical rod panics shall only be provided less bottom rod; provide fire pins as required by exit device and door fire labels. Do not provide surface vertical rod panics at exterior doors.
- C. Concealed vertical rod panics shall be provided less bottom rod at interior doors, unless lockable or otherwise specified; provide fire pins as required by exit device and door fire labels. Where concealed vertical rod panics are specified at exterior doors, provide with both top and bottom rods.
- D. Where removable mullions are specified at pairs with rim panic devices, provide mullion with key-removable feature.
- E. At non-rated openings with panic hardware, provide panic hardware with key cylinder dogging feature.
- F. Exit devices for fire doors shall comply with Underwriters Laboratories, Inc., requirements for Fire Exit Hardware. Submit proof of compliance.

#### **2.12 FLUSH BOLTS (LEVER EXTENSION)**

- A. Conform to ANSI A156.16. Flush bolts shall be Type L24081 unless otherwise specified. Furnish proper dustproof strikes conforming to ANSI A156.16, for flush bolts required on lower part of doors.
- B. Lever extension manual flush bolts shall only be used at non-fire-rated pairs for rooms only accessed by maintenance personnel.

- C. Face plates for cylindrical strikes shall be rectangular and not less than 25 mm by 63 mm (1 inch by 2-1/2 inches).
- D. Friction-fit cylindrical dustproof strikes with circular face plate may be used only where metal thresholds occur.
- E. Provide extension rods for top bolt where door height exceeds 2184 mm (7 feet 2 inches).

#### **2.13 FLUSH BOLTS (AUTOMATIC)**

- A. Conform to ANSI A156.3. Dimension of flush bolts shall conform to ANSI A115. Bolts shall conform to Underwriters Laboratories, Inc., requirements for fire door hardware. Flush bolts shall automatically latch and unlatch. Furnish dustproof strikes conforming to ANSI A156.16 for bottom flushbolt. Face plates for dustproof strike shall be rectangular and not less than 38 mm by 90 mm (1-1/2 by 3-1/2 inches).

#### **2.14 DOOR PULLS WITH PLATES**

- A. Conform to ANSI A156.6. Pull Type J401, 152 mm (6 inches) high by 19 mm (3/4 inches) diameter with plate Type J302, 90 mm by 350 mm (3-1/2 inches by 14 inches), unless otherwise specified. Provide pull with projection of 70 mm (2 3/4 inches) and a clearance of 51 mm (2 inches). Cut plates of door pull plate for cylinders, or turn pieces where required.

#### **2.15 PUSH PLATES**

- A. Conform to ANSI A156.6. Metal, Type J302, 200 mm (8 inches) wide by 350 mm (14 inches) high. Provide metal Type J302 plates 100 mm (4 inches wide by 350 mm (14 inches) high) where push plates are specified for doors with stiles less than 200 mm (8 inches) wide. Cut plates for cylinders, and turn pieces where required.

#### **2.16 COMBINATION PUSH AND PULL PLATES**

- A. Conform to ANSI 156.6. Type J303, stainless steel 3 mm (1/8 inch) thick, 80 mm (3-1/3 inches) wide by 800 mm (16 inches) high), top and bottom edges shall be rounded. Secure plates to wood doors with 38 mm (1-1/2 inch) long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

#### **2.17 COORDINATORS**

- A. Conform to ANSI A156.16. Coordinators, when specified for fire doors, shall comply with Underwriters Laboratories, Inc., requirements for fire door hardware. Coordinator may be omitted on exterior pairs of doors where either door will close independently regardless of the

position of the other door. Coordinator may be omitted on interior pairs of non-labeled open where open back strike is used. Open back strike shall not be used on labeled doors. Paint coordinators to match door frames, unless coordinators are plated. Provide bar type coordinators, except where gravity coordinators are required at acoustic pairs. For bar type coordinators, provide filler bars for full width and, as required, brackets for push-side surface mounted closers, overhead stops, and vertical rod panic strikes.

#### **2.18 THRESHOLDS**

- A. Conform to ANSI A156.21, mill finish extruded aluminum, except as otherwise specified. In existing construction, thresholds shall be installed in a bed of sealant with  $\frac{1}{4}$ -20 stainless steel machine screws and expansion shields. In new construction, embed aluminum anchors coated with epoxy in concrete to secure thresholds. Furnish thresholds for the full width of the openings.
- B. For thresholds at elevators entrances see other sections of specifications.
- C. At exterior doors and any interior doors exposed to moisture, provide threshold with non-slip abrasive finish.
- D. Provide with miter returns where threshold extends more than 12 mm (0.5 inch) from frame face.

#### **2.19 WEATHERSTRIPS (FOR EXTERIOR DOORS)**

- A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 CFM per foot of crack length ( $0.000774\text{m}^3/\text{s/m}$ ).

#### **2.20 MISCELLANEOUS HARDWARE**

- A. Access Doors (including Sheet Metal, Screen and Woven Wire Mesh Types): Except for fire-rated doors and doors to Temperature Control Cabinets, equip each single or double metal access door with Lock Type E76213, conforming to ANSI A156.5. Key locks as directed. Ship lock prepaid to the door manufacturer. Hinges shall be provided by door manufacturer.
- B. Cylinders for Various Partitions and Doors: Key cylinders same as entrance doors of area in which partitions and door occur. Provide cylinders to operate locking devices where specified for following partitions and doors:
  - 1. Folding doors and partitions.
  - 2. Wicket door (in roll-up door assemblies).
  - 3. Slide-up doors.

4. Swing-up doors.
  5. Fire-rated access doors-Engineer's key set.
  6. Doors from corridor to electromagnetic shielded room.
  7. Day gate on vault door.
- C. Mutes: Conform to ANSI A156.16. Provide door mutes or door silencers Type L03011 or L03021, depending on frame material, of white or light gray color, on each steel or wood door frame, except at fire-rated frames, lead-lined frames and frames for sound-resistant, lightproof and electromagnetically shielded doors. Furnish 3 mutes for single doors and 2 mutes for each pair of doors, except double-acting doors. Provide 4 mutes or silencers for frames for each Dutch type door. Provide 2 mutes for each edge of sliding door which would contact door frame.

## **2.21 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES**

- A. ASTM E883, size 50 mm (2 inch) wide chain; furnish extended shackles as required by job conditions. Provide padlocks, with key cylinders, for each door in following areas as noted.
- B. Key padlocks as follows:
1. Roof Access and Scuttles: Engineer's set.

## **2.22 FINISHES**

- A. Exposed surfaces of hardware shall have ANSI A156.18, finishes as specified below. Finishes on all hinges, pivots, closers, thresholds, etc., shall be as specified below under "Miscellaneous Finishes." For field painting (final coat) of ferrous hardware, see Section 09 91 00, PAINTING.
- B. 626 or 630: All surfaces on exterior and interior of buildings, except where other finishes are specified.
- C. Miscellaneous Finishes:
1. Hinges -- Doors: 630.
  3. Pivots: Match door trim.
  4. Door Closers: Factory applied paint finish. Dull or Satin Aluminum color.
  5. Thresholds: Mill finish aluminum.
  6. Cover plates for floor hinges and pivots: 630.
  7. Other primed steel hardware: 652.

- E. Special Finish: Exposed surfaces of hardware for dark bronze anodized aluminum doors shall have oxidized oil rubbed bronze finish (dark bronze) finish on door closers shall closely match doors.

## **2.23 BASE METALS**

- A. Apply specified U.S. Standard finishes on different base metals as following:

<b>Finish</b>	<b>Base Metal</b>
652	Steel
630	Stainless steel

## **PART 3 - EXECUTION**

### **3.1 HARDWARE HEIGHTS**

- B. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 1024 mm (40-5/16 inches).
  2. Locksets and latch sets centerline of strike 1024 mm (40-5/16 inches).
  3. Deadlocks centerline of strike 1219 mm (48 inches).
  4. Hospital arm pull 1168 mm (46 inches) to centerline of bottom supporting bracket.
  5. Centerline of door pulls to be 1016 mm (40 inches).
  6. Push plates and push-pull shall be 1270 mm (50 inches) to top of plate.
  7. Push-pull latch to be 1024 mm (40-5/16 inches) to centerline of strike.
  8. Locate other hardware at standard commercial heights. Locate push and pull plates to prevent conflict with other hardware.

### **3.2 INSTALLATION**

- A. Closer devices, including those with hold-open features, shall be equipped and mounted to provide maximum door opening permitted by building construction or equipment. Closers shall be mounted on side of door inside rooms, inside stairs, and away from corridors. At exterior doors, closers shall be mounted on interior side. Where closers are mounted on doors they shall be mounted with sex nuts and bolts; foot shall be fastened to frame with machine screws.

- B. Hinge Size Requirements:

<b>Door Thickness</b>	<b>Door Width</b>	<b>Hinge Height</b>
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45 mm (1-3/4 inch)	900 mm (3 feet) and less	113 mm (4-1/2 inches)
45 mm (1-3/4 inch)	Over 900 mm (3 feet) but not more than 1200 mm (4 feet)	125 mm (5 inches)
35 mm (1-3/8 inch) (hollow core wood doors)	Not over 1200 mm (4 feet)	113 mm (4-1/2 inches)

C. Hinge leaves shall be sufficiently wide to allow doors to swing clear of door frame trim and surrounding conditions.

D. Where new hinges are specified for new doors in existing frames or existing doors in new frames, sizes of new hinges shall match sizes of existing hinges; or, contractor may reuse existing hinges provided hinges are restored to satisfactory operating condition as approved by COR. Existing hinges shall not be reused on door openings having new doors and new frames. Coordinate preparation for hinge cut-outs and screw-hole locations on doors and frames.

E. Hinges Required Per Door:

Doors 1500 mm (5 ft) or less in height	2 butts
Doors over 1500 mm (5 ft) high and not over 2280 mm (7 ft 6 in) high	3 butts
Doors over 2280 mm (7 feet 6 inches) high	4 butts
Dutch type doors	4 butts
Doors with spring hinges 1370 mm (4 feet 6 inches) high or less	2 butts
Doors with spring hinges over 1370 mm (4 feet 6 inches)	3 butts

F. Fastenings: Suitable size and type and shall harmonize with hardware as to material and finish. Provide machine screws and lead expansion shields to secure hardware to concrete, ceramic or quarry floor tile, or solid masonry. Fiber or rawl plugs and adhesives are not permitted. All fastenings exposed to weather shall be of nonferrous metal.

G. After locks have been installed; show in presence of COR that keys operate their respective locks in accordance with keying requirements. (All keys, Master Key level and above shall be sent Registered Mail to the Medical Center Director along with the bitting list. Also a copy of the invoice shall be sent to the COR for his records.) Installation of

locks which do not meet specified keying requirements shall be considered sufficient justification for rejection and replacement of all locks installed on project.

### **3.3 FINAL INSPECTION**

- A. Installer to provide letter to VA COO that upon completion, installer has visited the Project and has accomplished the following:
  - 1. Re-adjust hardware.
  - 2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA locksmith and maintenance personnel.
  - 3. Identify items that have deteriorated or failed.
  - 4. Submit written report identifying problems.

### **3.4 DEMONSTRATION**

- A. Demonstrate efficacy of mechanical hardware and electrical, and electronic hardware systems, including adjustment and maintenance procedures, to satisfaction of COR and VA Locksmith.

### **3.5 HARDWARE SETS**

- A. Following sets of hardware correspond to hardware symbols shown on drawings. Only those hardware sets that are shown on drawings will be required. Disregard hardware sets listed in specifications but not shown on drawings.
- B. Hardware Consultant working on a project will be responsible for providing additional information regarding these hardware sets. The numbers shown in the following sets come from BHMA standards.

SECURITY HARDWARE ABBREVIATIONS LEGEND:

AC = Access Control Device (Card reader, biometric reader, keypad, etc.)  
ADO = Automatic Door Operator  
DEML = Delayed Egress Magnetic Lock  
DEPH = Delayed Egress Panic Exit Device  
DPS = Door Position Switch (Door or Alarm Contact)  
EL = Electric Lock or Electric Lever Exit Device  
PB = Push-button Combination Lock (stand-alone)  
RR = Remote Release Button  
ELR = Electric Latch Retraction Exit Device  
REX = Request-to-Exit Switch in Latching Device Inside Trim

HW-MH1

**SET #01**

Doors: 101

2	Continuous Hinge	661HD UL 83" EPT Prep	AL	ST
1	Power Transfer	EPT-12C	PR	
1	Exit Device	C ELR 2803 CD LBR	630	PR
1	Exit Device	C ELR 2801 CD LBR	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
2	Mortise Cylinder	1E-74 PATD	626	BE
2	Door Pull	1191-3	630	TR
2	Auto Operators	MAGIC FORCE	689	STAN
2	Actuator Button	ACTUATOR BUTTON	630	STAN
2	Floor Stop	1211626	TR	
1	Integral Seals By Frame Mfr.	INTEGRAL SEALS BY FRAME MFR.	B/O	
1	Threshold	896 S 72"	AL	NA
1	Power Supply	ELR151	PR	

NOTE: Doors are equipped with auto operators. Pushing on actautors will retract latchbolt of panic devices and automatically open both doors simultaneously allowing ingress and egress. Free egress at all times.

**SET #02**

Doors: 101A, 201A, 301A

3	Hinges	FBB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Storeroom Lockset	45H-7D14H PATD	630	BE
1	Door Closer	CLD-4551 HCS	689	SD
3	Door Silencers	1229A	GREY	TR

**SET #03**

Doors: 103A, 105A

3	Hinges	FBB191 4 1/2 X 4 1/2	US32D	ST
1	Storeroom Lockset	45H-7D14H PATD	630	BE
1	Door Closer	CLD-4551 H	689	SD
1	Floor Stop	1211626	TR	

3	Door Silencers	1229A	GREY	TR
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**SET #04**

Doors: 103B

ALL HARDWARE BY DOOR MFR.	B/O
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**SET #05**

Doors: 104A

3	Hinges	FBB191 4 1/2 X 4 1/2	US32D	ST
1	Power Transfer	EPT-12C	PR	
1	Electronic Lockset	45HM-7DEU14PH PATD C SH	630	BE
1	Door Closer	CLD-4551 STD W/PA BRKT	689	SD
1	Floor Stop	1211626	TR	
3	Door Silencers	1229A	GREY	TR
1	Power Supply	PS160-6	PR	
1	Wire Harness	WH-192P	BE	
1	Card Reader	CARD READER BY OWNER'S SECURITY		B/O

VENDOR

NOTE: Door is normally closed and locked. Presenting card to lock's integral reader will unlock door allowing ingress. Lockset will fail secure (remain locked) in the event of a power outage. Free egress at all times.

**SET #06**

Doors: 402A

1	Continuous Hinge	661HD UL 83"	AL	ST
1	Exit Device	2414 X 2914D	630	PR
1	Door Closer	CLD-4551 STD W/PA BRKT P45-180D	689	SD
1	Floor Stop	1211626	TR	
1	Integral Seals By Frame Mfr.	INTEGRAL SEALS BY FRAME MFR.		B/O

**SET #07**

Doors: 401A

1	Continuous Hinge	661HD UL 83" EPT Prep	AL	ST
1	Power Transfer	EPT-12C	PR	
1	Exit Device	C ELR 2414 X 2914D	630	PR
1	Auto-Operator	MAGIC-FORCE	689	STAN
1	Floor Stop	1211626	TR	
2	Actuator Button	ACTUATOR BUTTON	630	STAN

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

1	Power Supply	ELR151	PR
1	Integral Seals By Frame Mfr.		INTEGRAL SEALS BY
	FRAME MFR.	B/O	

NOTE: Door is equipped with an automatic operator. Pushing on actuator will retract latchbolt of panic device and automatically open door. Free egress at all times.

END OF SECTION

- - - E N D - - -

**SECTION 08 71 13**  
**POWER DOOR OPERATORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies low energy power assisted automatic operation of sliding doors. The door operator system shall be complete including operator, controls, door arm and operator enclosure (header and cover).

**1.2 RELATED WORK**

- A. Sealants; Section 07 92 00, JOINT SEALANTS.
- B. Aluminum frames entrance work; Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Door hardware; Section 08 71 00, DOOR HARDWARE.
- D. Glass and glazing of doors and frames; Section 08 80 00, GLAZING.
- E. Finish Color, Section 09 06 00, SCHEDULE FOR FINISHES.
- F. Electric general wiring, connections and equipment requirements; Division 26, ELECTRICAL.

**1.3 MANUFACTURER'S QUALIFICATIONS**

- A. Power assisted door operators, controls and other equipment shall be products of a manufacturer regularly engaged in manufacturing such equipment for a minimum of three years.
- B. One manufacturer of automatic door equipment shall be used throughout the building.

**1.4 WARRANTY**

Power assisted door operators, controls and other related equipment shall be subject to the terms of the "Warranty of Construction", FAR clause 52.246-21, to include manufacturer's warranty.

**1.5 MAINTENANCE MANUALS**

In accordance with Section 01 00 00, GENERAL REQUIREMENTS Article titled "INSTRUCTIONS," furnish two copies of maintenance manuals and instructions on automatic door operators.

**1.6 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's literature and data describing operators, power units, controls, door hardware and safety devices.
- C. Shop Drawings:

Showing location of controls and safety devices in relationship to each automatically operated door. This includes templates, wiring diagrams, fabrication details, anchorage and other information to providers of related work to coordinate the proper installation of the door operators.

#### **1.7 DESIGN CRITERIA**

- A. Power assisted automatic door equipment shall accommodate normal traffic as well as the weight of the doors.
- B. Equipment: UL approved and comply with applicable codes. Motors shall be rated minimum one-quarter horsepower and shall be single phase and 115 volts.
- C. Electrical Wiring; Provide wiring so that only a single power supply is required. Equipment and wiring shall be as specified in Division 26, ELECTRICAL.

#### **1.8 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):  
ICC/ANSI A117.1-03.....Guideline for Accessible and Usable Buildings  
and Facilities-Providing Accessibility and  
Usability for Physically Handicapped People
- B. Builders Hardware Manufacturers Association, Inc. (BHMA):  
156.19-07.....Power Assist and Low Energy Power Operated  
Doors

### **PART 2 - PRODUCTS**

#### **2.1 OPERATORS**

- A. Door Operators shall be Stanley Technologies to match building standard.
- B. Automatic door operators shall be for commercial doors and shall be electromechanical and surface mounted above the door to the header or transom bar. The opening force shall be generated by a permanent magnet DC motor driving a combination spiral bevel/spur gear reducer and transmitted to the door through a linkage. Opening speed shall be adjustable and feature dual backcheck control allowing adjustment of backcheck speed and position. Adjustable closing speed and fixed latch speed shall control the door in the closing cycle. The doors shall be



operated manually at any time without damage to the operator or components.

- C. All operators shall have checking mechanism providing cushioning action at last part of door travel, in both opening and closing cycle.

Operators shall recycle doors instantaneously to full open position from any point in closing cycle when control switch is reactivated.

- D. Operator shall be sliding type enclosed in housing. Operator shall open door by energizing motor and shall stop by electrically reducing voltage and stalling motor against mechanical stop. Door shall close by automatic energized motor in a similar manner. System shall operate as manual door control in event of power failure. Opening and closing speeds shall be adjustable:

1. Housing: Housing shall be 140 mm (5-1/2 inches) wide by 150 mm (6 inches) high aluminum extrusions with enclosed end caps for application to 100 mm (4 inch) and larger frame systems. All structural sections shall have a minimum thickness of 3.7 mm (0.146 inch) and be fabricated of 6063-T5 aluminum alloy.
2. Power Operator: Completely assembled and sealed unit which shall include gear drive transmission, mechanical spring and bearings, all located in cast aluminum case and filled with special lubricant for extreme temperature conditions. A "DC" shunt-wound permanent magnet motor with sealed ball bearings shall be attached to transmission system. Complete unit shall be rubber mounted with provisions for easy maintenance and replacement, without removing door from slides or frame.
3. Connecting hardware for concealed type power operator shall have drive arm attached to door with a pin linkage rotating in a self-lubricating bearing and adjustable slide block, traveling in an interconnected track and sliding assembly. Top track and sliding assembly shall be fabricated of steel. Door shall not bear on shaft of operator.
4. Electrical Control: Operator shall have a self contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation and switching of power operator. Relays shall be plug-in type for individual replacement and all connecting harnesses shall have interlocking plugs. Control shall also include time delay for normal cycle. Door

control shall include safe-circuit with optional switching which automatically limits power and slows door when approached from the doors motion area.

5. On pairs of doors, operators shall coordinate doors to be opened simultaneously.

## **2.2 MICROPROCESSOR CONTROLS**

- A. The system shall include a multi-function microprocessor control providing adjustable hold open time (1 - 30 sec.), LED indications for actual position unknown, system status, open obstruction shutdown, activation signal, safety mat/sensor signal, Stop-and-Hold signal, and mode selector switches providing a means for easy field selection of the following functions: automatic sensing, push-to-operate, emergency bypass. Control shall be capable of receiving activation signals from any device with normally open dry contact output.
- B. The door shall be held open by at rest. The control shall include an adjustable safety circuit that monitors door operation and bypasses the motor if an open obstruction is sensed. The control shall include a recycle feature the reopens the door if an obstruction is sensed at any point during its closing cycle. The control shall include a standard three position toggle switch with functions for ON, OFF, and HOLD OPEN.

## **2.3 ENCLOSURE**

Operator shall be completely self-contained within an extruded aluminum housing (alloy 6063-T6) to conceal operator mechanism and mounting brackets and with removable access cover with an overall maximum size of 140 mm (5-1/2 inches) wide by 150 mm (6 inches) deep. Header color shall be integral color anodized/painted to match adjacent storefront/frame finish.

## **2.4 ACTIVATION DEVICES**

- A. Automatic: Opening cycle shall be activated by sensing eye and equipment suited for exterior and parking garage use. Switches shall be installed in a standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1. Switches may be wall mounted or mounted on a free standing post or guard rail. Verify function and range of sensors before finalizing installation. Do not allow vehicle traffic or elevator doors to activate the Operator.
- B. Automatic Backup: Push-to-operate; manually pressing switches with international symbol of accessibility and "PRESS TO OPERATE DOOR"

engraved on the faceplate shall activate the automatic opening cycle.

Door shall automatically close after timer delay expires.

B. Manual: Push-to-operate; manually pressing door shall break away in the direction of egress as required by egress and life safety code.

C. Opening and closing force, measured 25 mm (1 inch) out from the stile of the door, shall not exceed 67 N (15 lbf) to stop the door when operating in either direction or cycle.

D. Opening Time: Doors shall be field adjusted so that opening time to back check shall be 3 seconds or longer as required in Table 1.

Total opening time to fully open shall be as in Table II.

E. Closing Time:

Doors shall be field adjusted to close from fully open to sealed in 3 seconds or longer as required in Table 1.

1. Doors shall be field adjusted to remain fully open for not less than 5 seconds.

2. Table 1 provides speed settings for various widths and weights of doors for obtaining results complying with this paragraph.

F. Cycle Tests:

1. Low Energy Power Operated, Low Energy Power Open and Power Assist Operators shall be cycle tested for 300,000 cycles.

2. Use the widest and heaviest door specified as a test specimen. Narrower or lighter doors of the same configurations shall then be considered to meet the cycle test requirements.

**Table 1**

Minimum Opening Time to Backcheck and the Minimum Closing Time from fully open to Latch Check.

"D" Door Leaf Width- mm (inches)	"W" Door Weight in kg (pounds)				
	Matrix Values are in seconds				
	(100) 45.4	(56.7) 125	(68.0) 150	(79.4) 175	(90.7) 200
(762) 30	3.0	3.0	3.0	3.0	3.5
(914) 36	3.0	3.5	3.5	4.0	4.0
(1067) 42	3.5	4.0	4.0	4.5	4.5

Doors of other weights and widths can be calculated using the formula;

$T = DvW/133$  in US units       $T = DvW/2260$  in SI (metric) units

Where:     $T$  = Time, seconds

$D$  = Door width, mm (inches)

$W$  = Door weight, kg (lbs)

The values for " $T$ " time have been rounded up to the nearest half second.

These values are based on a kinetic energy of (1.25 lbf-ft).

## **2.5 POWER UNITS**

Provide separate self-contained electric circuits for automatic operators located on each floor of the building. Interruption or failure of power circuits for operators located on one floor of the building shall not interfere with continuous performance of automatic operated doors located on other floors. Capacity and size of power circuits shall be in accordance with automatic operator manufacturer's specifications.

## **2.6 SAFETY DEVICES**

- A. Time delay switches shall be adjustable between 5 to 60 seconds and shall control closing cycle of doors.
- B. Decals with sign "In" or "Do Not Enter" shall be installed on both faces of each door where shown and shall conform to the requirements of ANSI/BHMA A156.19.
- C. Each door shall have installed a motion sensor to detect any person standing in the door path and prevent the door from opening.
- D. Motion sensors shall consist of detection modules, factory prepared to be attached to each side of the lock/strike stile, an armored flex link power cable and bracket assembly, factory prepared for attachment to the door stile; a logic board and a position encoder which shall mount to the operator. The detection modules shall contain transmitting and receiving diodes and sense multidimensional zones for detection of people and/or objects in the door area. Detection modules shall be high impact, shock resistant zinc castings with tinted lenses. The door sensor system shall provide complete operate and safety zone coverage. These zones shall be fully adjusted to meet specific jobsite conditions (sidewalls, adjacent panels, etc.) The system shall not be affected by ultrasonic, ambient light or radio frequencies within the vicinity of the door.
- E. Each door shall have installed a re-activation sensor mounted on the interior-side door face near the top detect any person standing in the

door sliding path and prevent the door from closing. Wiring for the re-activation sensor between the door and frame shall be concealed in a power transfer device, stiles or housing provided under Section 08 71 00; wire chase in door provided under door section.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Coordinate installation of equipment with other related work. Manual controls and power disconnect switches shall be recessed or semi-flush mounted in partitions. Secure operator components to adjacent construction with suitable fastenings. Conceal conduits, piping, and electric equipment in finish work.
- B. Install power units in locations shown. Where units are to be mounted on walls, provide metal supports or shelves for the units. All equipment, including time delay switches, shall be accessible for maintenance and adjustment.
- C. Operators shall be adjusted and must function properly for the type of traffic (pedestrians) expected to pass through doors. Each door leaf of pairs of doors shall open and close in synchronization. On pairs of doors, operators shall allow either door to be opened manually without the other door opening.
- D. Install controls at positions shown and make them convenient for particular traffic expected to pass through openings. Maximum height of push plate wall switches from finished floors shall be 40 inches unless otherwise approved by the COR.

---- END ----

**SECTION 08 80 00**  
**GLAZING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies glass, related glazing materials and accessories. Glazing products specified apply to factory or field glazed items.

**1.2 RELATED WORK**

- A. Factory glazed by manufacturer in following units:
  - 1. Section 08 41 13, ALUMINUM FRAMED ENTRANCES AND STOREFRONTS.
  - 2. Section 08 44 13, GLAZED ALUMINUM CURTAIN WALLS.
  - 3. Color of spandrel glass and tinted (heat absorbing or light reducing) glass: Section 09 06 00, SCHEDULE FOR FINISHES.
  - 3. Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
  - 4. Section 28 16 11, INTRUSION DETECTION SYSTEM.

**1.3 LABELS**

- A. Temporary labels:
  - 1. Provide temporary label on each light of glass identifying manufacturer or brand and glass type, quality and nominal thickness.
  - 2. Label in accordance with NFRC (National Fenestration Rating Council) label requirements.
  - 3. Temporary labels shall remain intact until glass is approved by Resident Engineer.
- B. Permanent labels:
  - 1. Locate in corner for each pane.
  - 2. Label in accordance with ANSI Z97.1 and SGCC (Safety Glass Certification Council) label requirements.
    - a. Tempered glass.
    - b. Laminated glass or have certificate for panes without permanent label.
    - c. Organic coated glass.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Building Enclosure Vapor Retarder and Air Barrier:
  - 1. Utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
  - 2. Maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

B. Glass Thickness:

1. Select thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with ASCE 7.
2. Test in accordance with ASTM E 1300.
3. Thicknesses listed are minimum. Coordinate thicknesses with framing system manufacturers.

**1.5 SUBMITTALS**

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

B. Manufacturer's Certificates:

1. Certificates stating that wire glass, meets requirements for safety glazing material as specified in ANSI Z97.1.
2. Certificate on shading coefficient.
3. Certificate on "R" value when value is specified, or U-Value when no value is specified.
4. Certificate test reports confirming compliance's with specified bullet resistive rating.
5. Certificate that blast resistant glass meets the requirements of UFC4-010-01.

C. Warranty: Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.

D. Manufacturer's Literature and Data:

1. Glass, each kind required.
2. Insulating glass units.
3. Glazing cushion.
4. Sealing compound.

E. Samples:

1. Size: 150 mm by 150 mm (6 inches by 6 inches).
2. Tinted glass.
3. Opaque or Spandrel glass.

F. Preconstruction Adhesion and Compatibility Test Report: Submit glazing sealant manufacturer's test report indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

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

- A. Delivery: Schedule delivery to coincide with glazing schedules so minimum handling of crates is required. Do not open crates except as required for inspection for shipping damage.
- B. Storage: Store cases according to printed instructions on case, in areas least subject to traffic or falling objects. Keep storage area clean and dry.
- C. Handling: Unpack cases following printed instructions on case. Stack individual windows on edge leaned slightly against upright supports with separators between each.
- D. Protect laminated security glazing units against face and edge damage during entire sequence of fabrication, handling, and delivery to installation location. Provide protective covering on exposed faces of glazing plastics, and mark inside as "INTERIOR FACE" or "PROTECTED FACE":
  - 1. Protect sealed-air-space insulating glazing units from exposure to abnormal pressure changes, as could result from substantial changes in altitude during delivery by air freight. Provide temporary breather tubes which do not nullify applicable warranties on hermetic seals.
  - 2. Temporary protections: The glass front and polycarbonate back of glazing shall be temporarily protected with compatible, peelable, heat-resistant film which will be peeled for inspections and re-applied and finally removed after doors and windows are installed at destination. Since many adhesives will attack polycarbonate, the film used on exposed polycarbonate surfaces shall be approved and applied by manufacturer.
  - 3. Edge protection: To cushion and protect glass clad, polycarbonate, and Noviflex edges from contamination or foreign matter, the four edges shall be sealed the depth of glazing with continuous standard-thickness Santoprene tape. Alternatively, continuous channel shaped extrusion of Santoprene shall be used, with flanges extending into face sides of glazing.
  - 4. Protect "Constant Temperature" units including every unit where glass sheet is directly laminated to or directly sealed with metal-tube type spacer bar to polycarbonate sheet, from exposures to ambient temperatures outside the range of 16 to 24 C, during the



fabricating, handling, shipping, storing, installation, and  
subsequent protection of glazing.

#### **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Field measure openings before ordering tempered glass products. Be responsible for proper fit of field measured products.

#### **1.8 WARRANTY**

- A. Warranty: Conform to terms of "Warranty of Construction", FAR clause 52.246-21, except extend warranty period for the following:
1. Bullet resistive plastic material to remain visibly clear without discoloration for duration of manufacturer's warranty or industry standard, whichever is greater.
  2. Insulating glass units to remain sealed for duration of manufacturer's warranty or industry standard, whichever is greater.
  3. Laminated glass units to remain laminated for duration of manufacturer's warranty or industry standard, whichever is greater.
  4. Polycarbonate to remain clear and ultraviolet light stabilized for duration of manufacturer's warranty or industry standard, whichever is greater.
  5. Insulating plastic to not have more than 6 percent decrease in light transmission and be ultraviolet light stabilized for duration of manufacturer's warranty or industry standard, whichever is greater.

#### **1.9 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):
- Z97.1-09.....Safety Glazing Material Used in Building -  
Safety Performance Specifications and Methods  
of Test.
- C. American Society for Testing and Materials (ASTM):
- C542-05.....Lock-Strip Gaskets
- C716-06.....Installing Lock-Strip Gaskets and Infill  
Glazing Materials.
- C794-10.....Adhesion-in-Peel of Elastomeric Joint Sealants
- C864-05.....Dense Elastomeric Compression Seal Gaskets,  
Setting Blocks, and Spacers

- C920-11.....Elastomeric Joint Sealants
- C964-07.....Standard Guide for Lock-Strip Gasket Glazing
- C1036-06.....Flat Glass
- C1048-12.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated  
and Uncoated Glass.
- C1376-10.....Pyrolytic and Vacuum Deposition Coatings on  
Flat Glass
- D635-10.....Rate of Burning and/or Extent and Time of  
Burning of Self-Supporting Plastic in a  
Horizontal Position
- D4802-10.....Poly (Methyl Methacrylate) Acrylic Plastic  
Sheet
- E84-10.....Surface Burning Characteristics of Building  
Materials
- E119-10.....Standard Test Methods for Fire Test of Building  
Construction and Material
- E2190-10.....Insulating Glass Unit
- D. Commercial Item Description (CID):
- A-A-59502.....Plastic Sheet, Polycarbonate
- E. Code of Federal Regulations (CFR):
- 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; 2010
- F. National Fire Protection Association (NFPA):
- 80-13.....Fire Doors and Windows.
- 252-12.....Standard Method of Fire Test of Door Assemblies
- 257-12.....Standard on Fire Test for Window and Glass  
Block Assemblies
- G. National Fenestration Rating Council (NFRC)
- H. Safety Glazing Certification Council (SGCC) 2012:  
Certified Products Directory (Issued Semi-Annually).
- I. Underwriters Laboratories, Inc. (UL):
- 752-11.....Bullet-Resisting Equipment.
- J. Unified Facilities Criteria (UFC):
- 4-010-01-2012.....DOD Minimum Antiterrorism Standards for  
Buildings
- K. Glass Association of North America (GANA):  
Glazing Manual (Latest Edition)  
Sealant Manual (2009)

- L. American Society of Civil Engineers (ASCE):  
ASCE 7-10.....Wind Load Provisions

**PART 2 - PRODUCT**

**2.1 GLASS**

- A. Use thickness stated unless specified otherwise in assemblies.
- B. Clear Glass:
1. ASTM C1036, Type I, Class 1, Quality q4.
  2. Thickness, 6 mm (1/4 inch).
  3. Coordinate color/tint/coating to accommodate required security monitoring.
- C. Tinted Heat reflective and low emissivity coated glass:
1. ASTM C1036, Type I, Class 2, Quality q3.
  2. Color: Provide glass to match PPG Ideascapes:  
OUTDOOR LITE: Solarban® 70XL (2) on Solargray®  
INDOOR LITE: Solargray®
  3. Thickness, 6 mm (1/4 inch).

**2.2 HEAT-TREATED GLASS**

- A. Clear Heat Strengthened Glass:
1. ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q3.
  2. Thickness, 6 mm (1/4 inch).
- B. Tinted Heat Strengthened Glass:
1. ASTM C1048, Kind HS, Condition A, Type I, Class 2, Quality q3.
  2. Color: blue and bronze to match PPG Ideascapes.
  3. Thickness, 6 mm (1/4 inch).
- C. Clear Tempered Glass:
1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
  2. Thickness, 6 mm (1/4 inch).

**2.3 LAMINATED GLASS**

- A. Two or more lites of glass bonded with an interlayer material for use in building glazing
- B. Colored Interlayer:
1. Use color interlayer ultraviolet light color stabilization.
  2. Option: Use colored interlayer with clear glass in lieu of tinted glass and clear interlayer.
  3. Option: Use white interlayer with clear glass in lieu of obscure glass and clear interlayer.
  4. The interlayer assembly shall have uniform color presenting same appearance as tinted glass assembly.

- C. Use 1.5 mm (0.060 inch) thick interlayer for:
  - 1. Horizontal or Sloped glazing.
  - 2. Acoustical glazing.
  - 3. Heat strengthened or fully tempered glass assemblies.
- D. Use min. 0.75 mm (0.030 inch) thick interlayer for vertical glazing where 1.5 mm (0.060 inch) interlayer is not otherwise shown or required.

#### **2.4 LAMINATED GLAZING ASSEMBLIES**

- A. Clear Glazing:
  - 1. Both panes clear glass ASTM C1036, Type I, Class 1, Quality q3.
  - 2. Thickness: Each pane, 3 mm (1/8 inch) thick.
- B. Clear Tempered Glazing:
  - 1. Both panes ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
  - 2. Thickness: Each pane 4.8 mm (3/16 inch) thick.
- C. Tinted Tempered Glazing:
  - 1. Exterior pane ASTM C1036, Type I, Class 3, Quality q3, 3 mm (1/8 inch) thick.
  - 2. Interior pane ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3, 3 mm (1/8 inch) thick.
- D. Clear Heat Strengthened Glazing:
  - 1. Both panes, ASTM C1048, Kind HS, Condition A, Type I, Class 1, Quality q3.
  - 2. Thickness: Each pane, 3 mm (1/8 inch) thick.
- E. Tinted Heat Strengthened Glazing:
  - 1. Both panes, ASTM C1048, Kind HS, Condition A, Type I, Class 2, Quality q3.
  - 2. Thickness: Each pane, 3 mm (1/8 inch) thick.

#### **2.5 INSULATING GLASS UNITS**

- A. Provide factory fabricated, hermetically sealed glass unit consisting of two panes of glass separated by a dehydrated air space and comply with ASTM E2190.
- B. Assemble units using glass types specified:
- C. Sealed Edge Units (SEU):
  - 1. Insulating Glass Unit Makeup
    - a. Outboard Lite
      - 1. Glass type: Plain

2. Glass Tint: Clear
3. Nominal Thickness: 1/4"
4. Glass Strength: (as indicated)
5. Coating Orientation: (N/A)
- b. Spacer
  1. Nominal Thickness: 1/2"
  2. Gas Fill: Air
- c. Inboard Lite
  1. Glass Type: Plain
  2. Glass Tint: blue or bronze PPG Ideascapes. See architectural drawings for color location
  3. Nominal Thickness: 1/4"
  4. Glass Strength: (as indicated)
  5. Coating Orientation: (N/A)
2. Glass shall be annealed, heat strengthened or tempered as required by codes, or as required to meet thermal stress and wind loads.
3. Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.

## **2.6 GLAZING ACCESSORIES**

- A. As required to supplement the accessories provided with the items to be glazed and to provide a complete installation. Ferrous metal accessories exposed in the finished work shall have a finish that will not corrode or stain while in service.
- B. Setting Blocks: ASTM C864:
  1. Channel shape; having 6 mm (1/4 inch) internal depth.
  2. Shore a hardness of 80 to 90 Durometer.
  3. Block lengths: 50 mm (two inches) except 100 to 150 mm (four to six inches) for insulating glass.
  4. Block width: Approximately 1.6 mm (1/16 inch) less than the full width of the rabbet.
  5. Block thickness: Minimum 4.8 mm (3/16 inch). Thickness sized for rabbet depth as required.
- C. Spacers: ASTM C864:
  1. Channel shape having a 6 mm (1/4 inch) internal depth.
  2. Flanges not less 2.4 mm (3/32 inch) thick and web 3 mm (1/8 inch) thick.

3. Lengths: One to 25 to 76 mm (one to three inches).

4. Shore a hardness of 40 to 50 Durometer.

D. Sealing Tapes:

1. Semi-solid polymeric based material exhibiting pressure-sensitive adhesion and withstanding exposure to sunlight, moisture, heat, cold, and aging.

2. Shape, size and degree of softness and strength suitable for use in glazing application to prevent water infiltration.

E. Glazing Gaskets: ASTM C864:

1. Firm dense wedge shape for locking in sash.

2. Soft, closed cell with locking key for sash key.

3. Flanges may terminate above the glazing-beads or terminate flush with top of beads.

F. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.

G. Glazing Sealants: ASTM C920, silicone neutral cure:

1. Type S.

2. Class 25

3. Grade NS.

4. Shore A hardness of 25 to 30 Durometer.

H. Structural Sealant: ASTM C920, silicone acetoxo cure:

1. Type S.

2. Class 25.

3. Grade NS.

4. Shore a hardness of 25 to 30 Durometer.

I. Color:

1. Color of glazing compounds, gaskets, and sealants used for aluminum color frames shall match color of the finished aluminum and be nonstaining.

2. Color of other glazing compounds, gaskets, and sealants which will be exposed in the finished work and unpainted shall be black, gray, or neutral color.

J. Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units intended for removal for smoke control. Comply with requirements of local Fire Department.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verification of Conditions:
  - 1. Examine openings for glass and glazing units; determine they are proper size; plumb; square; and level before installation is started.
  - 2. Verify that glazing openings conform with details, dimensions and tolerances indicated on manufacturer's approved shop drawings.
- B. Advise Contractor of conditions which may adversely affect glass and glazing unit installation, prior to commencement of installation: Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Verify that wash down of adjacent masonry is completed prior to erection of glass and glazing units to prevent damage to glass and glazing units by cleaning materials.

#### **3.2 PREPARATION**

- A. For sealant glazing, prepare glazing surfaces in accordance with GANA-02 Sealant Manual.
- B. Determine glazing unit size and edge clearances by measuring the actual unit to receive the glazing.
- C. Shop fabricate and cut glass with smooth, straight edges of full size required by openings to provide GANA recommended edge clearances.
- D. Verify that components used are compatible.
- E. Clean and dry glazing surfaces.
- F. Prime surfaces scheduled to receive sealants, as determined by preconstruction sealant-substrate testing.

#### **3.3 INSTALLATION - GENERAL**

- A. Install in accordance with GANA-01 Glazing Manual and GANA-02 Sealant Manual unless specified otherwise.
- B. Glaze in accordance with recommendations of glazing and framing manufacturers, and as required to meet the Performance Test Requirements specified in other applicable sections of specifications.
- C. Set glazing without bending, twisting, or forcing of units.
- D. Do not allow glass to rest on or contact any framing member.
- E. Glaze doors and operable sash, in a securely fixed or closed and locked position, until sealant, glazing compound, or putty has thoroughly set.

F. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.

G. Laminated Glass:

1. Tape edges to seal interlayer and protect from glazing sealants.
2. Do not use putty or glazing compounds.

H. Insulating Glass Units:

1. Glaze in compliance with glass manufacturer's written instructions.
2. When glazing gaskets are used, they shall be of sufficient size and depth to cover glass seal or metal channel frame completely.
3. Do not use putty or glazing compounds.
4. Do not grind, nip, cut, or otherwise alter edges and corners of fused glass units after shipping from factory.
5. Install with tape or gunnable sealant in wood sash.

#### **3.4 INSTALLATION - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)**

- A. Cut glazing tape to length and set against permanent stops, 5 mm (3/16 inch) below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at 1/4 points with edge block no more than 150 mm (6 inches) from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to achieve full contact at perimeter of pane or glass unit.
- E. Install removable stops, with spacer strips inserted between glazing and applied stops, 6 mm (1/4 inch) below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- F. Fill gap between glazing and stop with manufacturer's recommended sealant to depth equal to bite of frame on glazing, but not more than 9 mm (3/8 inch) below sight line.
- G. Apply cap bead of manufacturer's recommended type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.



### **3.5 REPLACEMENT AND CLEANING**

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Resident Engineer.
- B. Replace cracked, broken, and imperfect glass, or glass which has been installed improperly.
- C. Leave glass, putty, and other setting material in clean, whole, and acceptable condition.

### **3.6 PROTECTION**

- A. Protect finished surfaces from damage during erection, and after completion of work. Strippable plastic coatings on colored anodized finish are not acceptable.

### **3.7 GLAZING SCHEDULE**

- A. Tempered Glass:
  - 1. Install in full and half glazed doors unless indicated otherwise.
  - 2. Install in storefront, windows, and door sidelights adjacent to doors.
  - 3. Use tempered glass of color indicated on interior side lights and doors, and on exterior doors and sidelights unless otherwise indicated or specified.
- B. Tinted Glass: Exterior pane of dual glazed windows not receiving tinted tempered glass as indicated in the architectural drawings.
- C. Laminated Glass: Install as specified in doors and interior pane of dual glazed windows where indicated.
  - 1. If laminated glass is required for double glazed windows, provide it for interior panes only.

- - - E N D - - -

**SECTION 08 90 00**  
**LOUVERS AND VENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies fixed and operable wall louvers, door louvers and wall vents.

**1.2 RELATED WORK**

- A. Louvers in steel doors: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Color of finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Louvers in lead lined wood doors: Section 13 49 00, RADIATION PROTECTION.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:  
Each type, showing material, finish, size of members, method of assembly, and installation and anchorage details.
- C. Manufacturer's Literature and Data:  
Each type of louver and vent.

**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. The Master Painters Institute (MPI):  
Approved Product List - September 2011
- C. American Society for Testing and Materials (ASTM):  
A167-99(R2009).....Stainless and Heat-Resisting Chromium - Nickel  
Steel Plate, Sheet, and Strip  
A1008/A1008M-10.....Steel, Sheet, Carbon, Cold Rolled, Structural,  
and High Strength Low-Alloy with Improved  
Formability  
B209/B209M-03(R2007)....Aluminum and Aluminum Alloy, Sheet and Plate  
B221-08.....Aluminum and Aluminum Alloy Extruded Bars,  
Rods, Wire, Shapes, and Tubes

- B221M-07.....Aluminum and Aluminum Alloy Extruded Bars,  
Rods, Wire Shapes, and Tubes
- D. National Association of Architectural Metal Manufacturers (NAAMM):  
AMP 500-06.....Metal Finishes Manual
- E. National Fire Protection Association (NFPA):  
90A-09.....Installation of Air Conditioning and  
Ventilating Systems
- F. American Architectural Manufacturers Association (AAMA):  
2605-11.....High Performance Organic Coatings on  
Architectural Extrusions and Panels
- G. Air Movement and Control Association, Inc. (AMCA):  
500-L-07.....Testing Louvers

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Aluminum, Extruded: ASTM B221/B221M.
- B. Stainless Steel: ASTM A167, Type 302B.
- C. Carbon Steel: ASTM A1008/A1008M.
- D. Aluminum, Plate and Sheet: ASTM B209/B209M.
- E. Fasteners: Fasteners for securing louvers and wall vents to adjoining construction, except as otherwise specified or shown, shall be toggle or expansion bolts, of size and type as required for each specific type of installation and service condition.
1. Where type, size, or spacing of fasteners is not shown or specified, submit shop drawings showing proposed fasteners, and method of installation.
  2. Fasteners for louvers, louver frames, and wire guards shall be of stainless steel or aluminum.
- F. Inorganic Zinc Primer: MPI No. 19.

### **2.2 EXTERIOR WALL LOUVERS**

- A. General:
1. Provide fixed type louvers of size and design shown.
  2. Heads, sills and jamb sections shall have formed caulking slots or be designed to retain caulking. Head sections shall have exterior drip lip, and sill sections an integral water stop.
  3. Furnish louvers with sill extension or separate sill as shown.

4. Frame shall be mechanically fastened or welded construction with welds dressed smooth and flush.

B. Performance Characteristics:

1. Weather louvers shall have a minimum of 55 percent free area and shall pass 980 free area velocity at a pressure drop not exceeding .11 inch water gage and carry not more than .01 ounces of water per square foot of free area for 15 minutes when tested per AMCA Standard 500-L.
2. Louvers shall bear AMCA certified rating seals for air performance and water penetration ratings.

C. Aluminum Louvers:

1. General: Frames, blades, and mullions (sliding interlocking type); 2 mm (0.081-inch) thick extruded aluminum. Blades shall be standard type and have reinforcing bosses.
2. Louvers, fixed: Make frame sizes 13 mm (1/2-inch) smaller than openings. Single louvers frames shall not exceed 1700 mm (66 inches) wide. When openings exceed 1700 mm (66 inches), provide twin louvers separated by mullion members.

**2.5 EXTERIOR DOOR LOUVERS**

- A. Fabricate of 1.6 mm (0.063-inch) thick extruded aluminum. Miter frames at corners and join by concealed corner brackets.
- B. Equip louvers on outside with wire guards, except omit wire guards for louvers in doors located completely below enclosed areaways.

**2.6 AIR INTAKE VENTS**

- A. Fabricate exterior louvered wall ventilators for fresh air intake for air conditioning units from extruded aluminum, ASTM B221. Form with integral horizontal louvers and frame, with drip extending beyond face of wall and integral water stops.
- B. Provide 0.8 mm (0.032-inch) thick aluminum sleeves where shown.

**2.7 BRICK VENTS**

- A. Vents shall be of size shown formed of approximately 3 mm (0.125 inch) thick cast aluminum, or 3 mm (0.125) inch extruded aluminum.
- B. Provide vents complete with aluminum screen frame with corrosion resistant insect screening mounted on back of vent.
- C. Provide vents with required anchors.

## **2.8 FINISH**

- A. In accordance with NAAMM Metal Finishes Manual: AMP 500-505
- B. Aluminum Louvers
  - 1. Anodized finish
    - a. Mill finish, as fabricated.
- C. Aluminum Wall Vents and Brick Vents: Sand blasted satin finish.
- D. Stainless Steel: Mechanical finish No. 4 in accordance with NAAMM Metal Finishes Manual.
- E. Sheet Steel: Baked-on or oven dried shop prime coat.
  - 1. Paint interior surfaces of lightproof louvers with two additional finish shop coats of baked-on flat black enamel.
  - 2. Finish painting of exposed surfaces of shop primed louvers is specified in Section 09 91 00, PAINTING.
- F. Steel: Surfaces of steel work, for which no other finish is specified, shall be cleaned free from scale, rust, oil and grease, and then given a light colored prime paint after fabrication, except ferrous metals concealed in finished work. Paint all contact surfaces of assembled work (except welded contact surfaces) with an additional shop coat of similar paint.

## **2.9 PROTECTION**

- A. Provide protection for aluminum against galvanic action wherever dissimilar materials are in contact, by painting the contact surfaces of the dissimilar material with a heavy coat of bituminous paint (complete coverage), or by separating the contact surfaces with a performed synthetic rubber tape having pressure sensitive adhesive coating on one side.
- B. Isolate the aluminum from plaster, concrete and masonry by coating aluminum with zinc-chromate primer.
- C. Protect finished surfaces from damage during fabrication, erection, and after completion of the work.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Set work accurately, in alignment and where shown. Items shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

- B. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors to be built into masonry construction. Provide temporary bracing for such items until masonry is set.
- C. Provide anchoring devices and fasteners as shown and as necessary for securing louvers and vents to building construction as specified. Power actuated drive pins shall be used, except for removal items and where members would be deformed or substrate damaged by their use.
- D. Generally, set wall louvers and vents in masonry walls during progress of the work. If wall louvers and vents are not delivered to job in time for installation in prepared openings, make provision for later installation. Set in cast-in-place concrete in prepared openings.

### **3.2 CLEANING AND ADJUSTING**

- A. After installation, all exposed prefinished and plated items and all items fabricated from stainless steel and aluminum shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.
- B. All movable parts, including hardware, shall be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components

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Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

**SECTION 09 06 00  
SCHEDULE FOR FINISHES**

**SECTION 09 06 00-SCHEDULE FOR FINISHES**

VAMC: H.H. McGUIRE VAMC  
Location: RICHMOND VA.  
Project no.652-131 and Name: CONSTRUCT NEW PARKING GARAGE  
Submission: 100% DESIGN SUBMISSION, NOT FOR CONSTRUCTION  
Date: September 15, 2014

**SECTION 09 06 00**  
**SCHEDULE FOR FINISHES**

**PART I - GENERAL**

**1.1 DESCRIPTION**

This section contains a coordinated system in which requirements for materials specified in other sections shown are identified by abbreviated material names and finish codes in the room finish schedule or shown for other locations.

**1.2 MANUFACTURERS**

Manufacturer's trade names and numbers used herein are only to identify colors, finishes, textures and patterns. Products of other manufacturer's equivalent to colors, finishes, textures and patterns of manufacturers listed that meet requirements of technical specifications will be acceptable upon approval in writing by contracting officer for finish requirements.

**1.3 SUBMITALS**

Submit in accordance with SECTION 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES—provide quadruplicate samples for color approval of materials and finishes specified in this section.

**1.4 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in text by basic designation only.
- B. MASTER PAINTING INSTITUTE: (MPI)
  - 2001.....Architectural Painting Specification Manual

**PART 2- PRODUCTS**

**2.1 DIGITAL COLOR PHOTOS**

- A. Size 16 Megapixels.
- B. Labeled for:
  - 1. Building Name, Number and view/subject.



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Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

**2.2 DIVISION 31 - EARTHWORK**

A. SECTION 32 17 23, PAVEMENT MARKINGS.

Color	Manufacturer	MFG. Color Name/No.
Blue	AS SPECIFIED	Blue
Yellow	AS SPECIFIED	Yellow
White	AS SPECIFIED	White

B. BOLLARDS

Material	Finish	Style Name/ No.	Manufacturer	Mfg. Color Name/No.
Cast-In-Place concrete	PAINT	AS SPECIFIED	AS SPECIFIED	YELLOW
Steel Pipe Bollard	PAINT	AS SPECIFIED	AS SPECIFIED	YELLOW

**2.3 DIVISION 03 - CONCRETE**

A. SECTION 03 30 00, CAST IN PLACE CONCRETE

Surface	Finish Description
HONED	PENETRATING STAIN, PT-3

B. SECTION 03 45 00, PRECAST ARCHITECTURAL CONCRETE

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Finish Designation	Color	Concrete Color	Texture	Exposure	PCI Color No.
PCL,PCC AND PCF	Light Buff/Tan	70% Gray 30% White	Sandblasted	Medium to Deep	110, 188, 214,223
PCS	Buff/Tan (Medium)	70% Gray 30% White	Sandblasted	Light to Honed	111, 189, 215,224
PCW ("Mortar joints")	Light Buff	70% Gray 30% White	Mortar Joint, Struck or bevel	Light or by Form	111, 189, 215,224
PCW FB (INSET BRICK)	Red Range	n/a	Running Bond Utility Size	Light or by Form	N/A. BASIS OF DESIGN: TAYLOR CLAY BRICK
PAINT (RE.: AS811)	COLOR PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10-SPECIALTIES SINGS, AND WHITE				

1a. For Base Bid: Provide brick units inserts continuous to edge of panel and wrap exposed corners. Brick shall be continuous pattern on three sides of precast concrete unit.

1b. For Deduct Alternate #6: Provide brick units inserts held back 120 mm (5") from the corners of panels or walls. Hold inset brick 60 mm (2 1/2") from joints or edge between panels within the same wall. Brick shall be continuous pattern on the Primary Control Surface of Panel/Precast concrete unit.

#### 2.4 DIVISION 04 - MASONRY

A. Section 04 05 13, MASONRY MORTARING and Section 04 05 16, MASONRY GROUTING

Finish Code	Manufacturer	Mfg. Color Name
CIPF	GLIDDEN	PENETRATING STAIN TO MATCH WHISPER BLUFF #A1765
CMU Wall Joint See Paragraph 2.4 B Section 04 20 00,	CONTRACTOR'S OPTION	Gray, Match CMU

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Unit masonry for Fill and finish		
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PCW ("Mortar joints")	Light Buff	70% Gray 30% White	Mortar Joint, Struck or bevel	Light or by Form	111, 189, 215,224
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B. Section 04 20 00, UNIT MASONRY

1. FACE BRICK (FB)				
Finish Code	Size	Pattern	Manufacturer	Mfg. Color Name/No.
PCW	UTILITY	RUNNING BOND	TAYLOR CLAY BRICK	RED RANGE

3. CONCRETE MASONRY UNIT (CMU)				
Type	Size	Pattern	Finish	Mfg. Color Name/No.
CMU Standard	8 x 8 x 16	RUNNING BOND	FILL, PAINT PT-2	WHISPER BLUFF #A1765
CMU Standard	8 x 8 x 16	RUNNING BOND	FILL, PAINT PT-3	BASIC KHAKI #A1767

2.5 DIVISION 05 - METALS

A. SECTION 05 12 00, STRUCTURAL STEEL FRAMING

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Component	Finish	Color
EXPOSED STRUCTURAL STEEL	PAINT	PT-1, WHITE
EXPOSED GALVANIZED STEEL	G-90 GALVANIZED	n/a

B. SECTION 05 21 00, STEEL JOIST FRAMING

Finish	Color
EXPOSED STRUCTURAL STEEL	PT-1, WHITE
EXPOSED GALVANIZED STEEL	G-90 GALVANIZED

C. SECTION 05 31 00, STEEL DECKING, SECTION 05 36 00, COMPOSITE METAL DECKING

Finish	Color
EXPOSED STRUCTURAL STEEL	PT-1, WHITE
EXPOSED GALVANIZED STEEL	G-90 GALVANIZED

D. SECTION 05 50 00, METAL FABRICATION

Item	Finish
Channel Door Frames	PT-2, WHISPER BLUFF #A1765
Structural Steel Angle Corner Guards	PT-2, WHISPER BLUFF #A1765
Guard Angles for Overhead Doors	PT-2, WHISPER BLUFF #A1765
Edge Guards Angles for Opening in Slabs	PT-1, WHITE
EXPOSED GALVANIZED STEEL	G-90 GALVANIZED
Decorative Metal (DM)	STAINLESS STEEL
MESH WIRE PANEL(MWP-1)	STAINLESS STEEL (ALT #6 PVC Coating to match PT-8, DARK BRONZE)

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

MESH WIRE PANEL (MWP-2)	STAINLESS STEEL (ALT #6 PVC Coating to match PT-8, DARK BRONZE)
Aluminum Plate Door Sill	ANOD. ALUM.
Aluminum Safety Nosing	ANOD. ALUM.
Steel Ladders	PT-1, WHITE
Steel Pipe Railings and Gates (not on Steel Stairs)	COLOR PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10-SPECIALTIES SINGS
Floor Trap Door and Ceiling Hatch	PT-1, WHITE

## 2.7 DIVISION 07 - THERMAL AND MOISTURE PROTECTION

### A. SECTION 07 54 23, THERMOPLASTIC POLYOLEFIN ROOFING (TPO)

Color	Manufacturer	Mfg. Color Name/No.
WHITE	CARLISLE	WHITE

### B. SECTION 07 60 00, FLASHING AND SHEET METAL

Item	Material	Finish
Copings		PT-9, MEDIUM GRAY
	Aluminum	
Hanging Gutters and Downspouts		PT-9, MEDIUM GRAY PT-9, MEDIUM GRAY
	Stainless steel	
	Aluminum	
Roof Insulated Expansion Joint Covers	Vinyl sheet	WHITE
Gravel Stops	Aluminum mill	PT-9, MEDIUM GRAY

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

	Aluminum	PT-9, MEDIUM GRAY
	Stainless steel	PT-9, MEDIUM GRAY
Scuppers	Aluminum	WHITE

C. SECTION 07 71 00 07 72 00, ROOF SPECIALITIES AND ACCESSORIES

Item	Material	Finish	Manufacturer	Manufacturer/Color Name/Number.
Roof Hatch	Aluminum	Mill	PRECISION ROOF HATCH	WHITE
Equipment Support	Galv. Steel	Paint	GLIDDEN	PT-9, MEDIUM GRAY
Copings	Extruded Aluminum	MILL, PRE-FINISHED	KYNAR	PT-9, MEDIUM GRAY
Gravel Stops and Fascia System	Extruded Aluminum	MILL, PRE-FINISHED	KYNAR	PT-9, MEDIUM GRAY
Fascia Systems	Extruded Aluminum	MILL, PRE-FINISHED	KYNAR	PT-9, MEDIUM GRAY
Roof Expansion Joint Covers	Extruded Aluminum ELASTOMERIC HEADER	Mill INTEGRAL	BASF	WHITE WHITE

D. SECTION 07 92 00, JOINT SEALANTS

Location	Color	Manufacturer	Manufacturer Color
Masonry Expansion Joints	MATCH PT-2	BASF	WHISPER BLUFF #A1765
CMU Control Joints	MATCH PT-2	BASF	WHISPER BLUFF #A1765
Precast Concrete Panels	MATCH PT-3	BASF	BASIC KHAKI #A1767
Building Expansion Joints	MATCH PT-2 OR PT-1	BASF	WHISPER BLUFF #A1765 OR WHITE

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Masonry Sealed Joints	MATCH PT-3	BASF	BASIC KHAKI #A1767
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## 2.8 DIVISION 08 - OPENINGS

### A. SECTION 08 11 13, HOLLOW METAL DOORS AND FRAMES

Paint both sides of door and frames same color including ferrous metal louvers, and hardware attached to door				
Component		Color of Paint Type and Gloss		
Door		PT-2, WHISPER BLUFF #A1765		
Frame		PT-3, BASIC KHAKI #A1767		
	Material	Finish	Manufacturer	Mfg. Color Name/No.
Floor Component Cover Plate Frame Casket or Sealant (interior only)	ELASTOMERIC HEADER	STANDARD BLACK	BASF	Wabo Crete Membrane
Wall Component Cover Plate Frame Casket or Sealant	PRE-FINISHES METAL	MATCH PT-2, WHISPER BLUFF #A1765	EMSEAL	Colorseal
Ceiling Component Cover Plate, Gasket or Sealant	PRE-FINISHED METAL AND ELASTOMERIC SEALS	MILL FINISH WHITE AND WHITE	WABCOPR	CORRIDOR WRAP CEILING
Exterior Wall Cover Plate Frame Thermoplastic Joint	PRE-TINTED SILICONE	BEIGE TO MATCH PT-2, WHISPER BLUFF #A1765	EMSEAL	Colorseal
Window frame		ANOD. ALUM.		

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

B. SECTION 08 31 13, ACCESS DOORS AND FRAMES

Material	Finish/Color
Steel	PT-3, BASIC KHAKI #A1767
Stainless steel	PT-3, BASIC KHAKI #A1767

C. SECTION 08 36 13, SECTIONAL DOORS

Finish	Manufacturer	Manufacturer Color Name/No.
PAINT	MILL	PT-3, BASIC KHAKI #A1767

D. SECTION 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

Material	Finish	Manufacturer	Manufacturer Color Name/No.
Aluminum	CLEAR ANOD. ALUM	MILL	CLEAR ANOD.
Glass	GRAY	PPG	SOLARGRAY 70XL

E. SECTION 08 44 13, GLAZED ALUMINUM CURTAIN WALLS

Component	Material	Finish	Manufacturer	Mfg. Color Name/No.
Frame	ALUM.	CLEAR ANOD.	KAWNEER	CLEAR ANOD. ALUM.
Glazing	GL	GRAY	PPG	SOLARGRAY 70XL
Glazing	T	GRAY	PPG	SOLARGRAY 70XL
Glazing	ST	GRAY	PPG	SOLARGRAY 70XL



H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

F. SECTION 08 51 13, ALUMINUM WINDOWS

Type	Finish	Glazing	Manufacturer	Mfg. Color Name/No.
Fixed	ANOD. ALUM	GRAY	PPG	SOLARGRAY 70XL

G. WINDOW SILLS

Room No. and Name	Material	Finish
102,103,202,203,302,303,402,403	Aluminum (With Windows)	ANOD. ALUM.

H. SECTION 08 80 00, GLAZING

Glazing Type	Manufacturer	Mfg. Color Name/No.
G-1	PPG	SOLARGRAY 70XL

I. SECTION 08 90 00, LOUVERS AND WALL VENTS

Item	Material	Finish	Manufacturer	Mfg. Color Name/No.
BRICK VENTS	SHOP PRIMED METAL	PT-2	GLIDDEN	WHISPER BLUFF #A1765
AIR INTAKE VENTS	SHOP PRIMED METAL	PT-3	GLIDDEN	BASIC KHAKI #A1767
EXTERIOR WALL LOUVERS IN U.N.O.	SHOP PRIMED METAL	PT-8	KYNAR	DARK BRONZE
INTERIOR OF LIGHT PROOF VENTS	SHOP PRIMED METAL	BLACK-OUT	GLIDDEN	BLACK
EXTERIOR WALL LOUVERS IN PCW	SHOP PRIMED, FIELD PAINT	PAINT TO MATCH	GLIDDEN	MATCH 'RED RANGE' BRICK

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

## 2.9 DIVISION 09 - FINISHES

### A. SECTION 09 30 13, CERAMIC TILING

Finish Code	Size	Pattern	Manufacturer	Mfg. Color Name/No.
CT	12" X 12" GRID	V2 MOSAIC	CROSSVILLE	ECOCYCLE AMERICANA - AV111 MOTICELLO
CT (TRIM)	4" X 12" BULLNOSE	PERIMETER	CROSSVILLE	ECOCYCLE AMERICANA - AV111 MOTICELLO

2. SECTION 09 30 13, QUARRY TILE GROUT		
Finish Code	Manufacturer	Mfg. Color Name/No.
CT (GROUT)	CROSSVILLE	BEIGE

### B. SECTION 09 54 23, LINEAR METAL CEILINGS (LMC)

Finish Code	Strip Material	Strip Face Size	Manufacturer	Mfg Name/No.
LMS	METAL	8"	ARMSTRONG	METALWORKS EXTERIOR LINEAR - WHITE

### C. SECTION 09 91 00, PAINT AND COATINGS

#### 1. MPI Gloss and Sheen Standards

		Gloss @60	Sheen @85
Gloss Level 1	a traditional matte finish-flat	max 5 units, and	max 10 units
Gloss Level 2	a high side sheen flat-"a velvet-like"	max 10 units, and	

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

	finish		10-35 units
Gloss Level 3	a traditional "egg-shell like" finish	10-25 units, and	10-35 units
Gloss Level 4	a "satin-like" finish	20-35 units, and	min. 35 units
Gloss Level 5	a traditional semi-gloss	35-70 units	
Gloss Level 6	a traditional gloss	70-85 units	
Gloss level 7	a high gloss	more than 85 units	

Paint code	Gloss	Manufacturer	Mfg. Color Name/No.
PT-1	SEMI-GLOSS	GLIDDEN	WHITE
PT-2	SEMI-GLOSS	GLIDDEN	WHISPER BLUFF #A1765
PT-3	SEMI-GLOSS	GLIDDEN	BASIC KHAKI #A1767
PT-4	SEMI-GLOSS	GLIDDEN	RIDING HOOD PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10-SPECIALTIES SINGS
PT-5	SEMI-GLOSS	GLIDDEN	ELEANOR'S EMERALD PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10- SPECIALTIES SINGS
PT-6	SEMI-GLOSS	GLIDDEN	JAZZ PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10-SPECIALTIES SINGS
PT-7	SEMI-GLOSS	GLIDDEN	WARM GOLD PER WAYFINDING COLOR SCHEDULE, See 2.10 DIVISION 10-SPECIALTIES SINGS
PT-8	SEMI-GLOSS	KYNAR	DARK BRONZE
PT-9	SEMI-GLOSS	KYNAR	MEDIUM GRAY

2. GRAPHIC IMAGES: Refer to drawings for indicated Graphic Murals to be painted on concrete walls.
3. Paint and finish all Gypsum surfaces per SECTION 09 26 00, color as indicated.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

## 2.10 DIVISION 10 - SPECIALTIES

### A. SECTION 10 13 00 / 10 14 00, EXTERIOR SIGNS

Component	Material	Manufacturer	Mfg. Color Name/No.
FOUNDATION			
POSTS AND CAP			
PANEL FACE (BOTH SIDES)	Cast Acrylic		COLOR PER VA CAMPUS STANDARD
PANEL BORDER	Cast Acrylic		COLOR PER VA CAMPUS STANDARD
LETTERING	Cast Acrylic		COLOR PER VA CAMPUS STANDARD
SYMBOLS	Cast Acrylic		COLOR PER VA CAMPUS STANDARD

RE.: TO VA TECHNICAL INFORMATION LIBRARY <http://www.cfm.va.gov/til/signs/Signage05-ParkingStruct.pdf>

### B. SECTION 10 13 00 / 10 14 00, INTERIOR SIGNS

Component	Material	Manufacturer	Mfg. Color Name/No.
PANEL FACE	Cast Acrylic		WHITE PER VA CAMPUS STANDARD
PANEL BORDER	Cast Acrylic		COLOR PER WAYFINDING COLOR SCHEDULE
LETTERING	polyamide resin		WHITE PER VA CAMPUS STANDARD OR COLOR WAYFINDING COLOR SCHEDULE
BRAILLE	polyamide resin		COLOR PER WAYFINDING COLOR SCHEDULE
SYMBOLS	polyamide resin		SHAPE/IMAGE SIMILAR TO WAYFINDING GRAPHIC INDICATED, COLOR PER WAYFINDING COLOR SCHEDULE
WAYFINDING COLOR SCHEDULE			

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

LEVEL 1 COLOR	SEMI-GLOSS	GLIDDEN	RIDING HOOD #A0404
LEVEL 2 COLOR	SEMI-GLOSS	GLIDDEN	ELEANOR'S EMERALD #A1027
LEVEL 3 COLOR	SEMI-GLOSS	GLIDDEN	JAZZ #A1391
LEVEL 4 COLOR	SEMI-GLOSS	GLIDDEN	WARM GOLD #A0754

RE.: TO VA TECHNICAL INFORMATION LIBRARY <http://www.cfm.va.gov/til/signs/Signage05-ParkingStruct.pdf>

C. SECTION 10 44 13, FIRE EXTNGUISHER CABINETS

Component	Material	Finish
PRE-FINISHED CABINET	SHEET STEEL	RED, PAINT
GLAZING	ACRYLIC	CLEAR

## 2.11 DIVISION II - EQUIPMENT

A. SECTION 11 12 00, PARKING CONTROL EQUIPMENT

Component	Material	Manufacturer	Mfg. Color Name/No.
Ticket Dispenser			
Gate and Arm			
Booth Exterior			
Booth Interior			
Booth Shelf			

## 2.12 DIVISION 14- EQUIPMENT

A. SECTION 14 21 00, ELECTRIC TRACTION ELEVATORS

Elevator	Component	Material	Finish	Color
Passenger	Hoistway Entrance	STAINLESS STEEL	BRUSHED	

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Elevator No. P-1 and P-2	Hoistway Doors	STAINLESS STEEL	BRUSHED	
	Corridor Position Indicator and Call Buttons	STAINLESS STEEL	AS INDICATED	COLOR PER WAYFINDING COLOR SCHEDULE
	Car Canopy	ALUMINUM FRAME		
	Car Wainscot	STAINLESS STEEL	BRUSHED	
	Panels Above Wainscot	Acrylic Glazing	Opaque	White
	Car Back	Aluminum Storefront	Anodized Aluminum, Glass	Clear, Gray
	Car Floor	PORCELAIN Tile	CROSS-SHEEN	AV111 MONTICELLO
	Car Operating Panel	STAINLESS STEEL	BRUSHED	STAINLESS
	Hoistway Doors	STAINLESS STEEL	BRUSHED	APPLIED GRAPHIC AS INDICATED, COLOR PER WAYFINDING COLOR SCHEDULE

## 2.15 DIVISION 22 - PLUMBING

### A. SECTION 22 40 00, PLUMBING FIXTURES AND TRIM

Item	Color
Service Sink	AS SPECIFIED

## 2.16 DIVISON 26 - ELECTRICAL

### A. SECTION 26 51 00, BUILDING LIGHTING INTERIOR

Fixture Type	Exterior Finish	Color
	ANODIZED ALUMINUM	CLEAR

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

	ANODIZED ALUMINUM	CLEAR
	ANODIZED ALUMINUM	CLEAR
	ANODIZED ALUMINUM	CLEAR

B. SECTION 26 56 00, SITE LIGHTING

Type and Component	Exterior Finish	Manufacturer	Mfg. Name/No.

PART III EXECUTION

3.1 FINISH SCHEDULES & MISCELLANEOUS ABBREVIATIONS

FINISH SCHEDULE & MISCELLANEOUS ABBREVIATIONS	
Term	Abbreviation
Access Flooring	AF
Accordion Folding Partition	AFP
Acoustical Ceiling	AT
Acoustical Ceiling, Special Faced	AT (SP)
Acoustical Metal Pan Ceiling	AMP
Acoustical Wall Panel	AWP
Acoustical Wall Treatment	AWT
Acoustical Wallcovering	AWF
Anodized Aluminum Colored	AAC

Anodized Aluminum Natural Finish	AA
Baked On Enamel	BE
Brick Face	BR
Brick Flooring	BF
Brick Paving	BP
Carpet	CP
Carpet Athletic Flooring	CAF
Carpet Module Tile	CPT
Ceramic Glazed Facing Brick	CGFB
Ceramic Mosaic Tile	FTCT
Concrete	C
Concrete Masonry Unit	CMU
Divider Strips Marble	DS MB
Epoxy Coating	EC
Epoxy Resin Flooring	ERF
Existing	E
Exposed Divider Strips	EXP

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

Exterior	EXT
Exterior Finish System	EFS
Exterior Paint	EXT-P
Exterior Stain	EXT-ST
Fabric Wallcovering	WF
Facing Tile	SCT
Feature Strips	FS
Floor Mats & Frames	FM
Floor Tile, Mosaic	FT
Fluorocarbon	FC
Folding Panel Partition	FP
Foot Grille	FG
Glass Masonry Unit	GUMU
Glazed Face CMU	GCMU
Glazed Structural Facing Tile	SFTU
Granite	GT
Gypsum Wallboard	GWB
High Glazed Coating	SC
Latex Mastic Flooring	LM
Linear Metal Ceiling	LMS
Linear Wood Ceiling	LWC
Marble	MB
Material	MAT
Mortar	M
Multi-Color Coating	MC
Natural Finish	NF
Paint	P
Paver Tile	PVT
Perforated Metal Facing (Tile or Panels)	PMF
Plaster	PL
Plaster High Strength	HSPL
Plaster Keene Cement	KC
Plastic Laminate	HPDL
Polypropylene Fabric	PFW

Wallcovering	
Porcelain Paver Tile	PPT
Quarry Tile	QT
Radiant Ceiling Panel System	RCP
Resilient Stair Tread	RST
Rubber Base	RB
Rubber Tile Flooring	RT
Spandrel Glass	SLG
Stain	ST
Stone Flooring	SF
Structural Clay	SC
Suspension Decorative Grids	SDG
Terrazzo Portland Cement	PCT
Terrazzo Tile	TT
Terrazzo, Thin Set	
Textured Gypsum Ceiling Panel	TGC
Textured Metal Ceiling Panel	TMC
Thin set Terrazzo	TST
Veneer Plaster	VP
Vinyl Base	VB
Vinyl Coated Fabric Wallcovering	W
Vinyl Composition Tile	VCT
Vinyl Sheet Flooring	VSF
Vinyl Sheet Flooring (Welded Seams)	WSF
Wall Border	WB
Wood	WD



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### 3.2 FINISH SCHEDULE SYMBOLS

#### Symbol Definition

\*\* Same finish as adjoining walls  
- No color required  
E Existing  
XX To match existing  
EFTR Existing finish to remain  
RM Remove

### 3.3 ROOM FINISH SCHEDULE

A. Match adjoining or existing similar surfaces colors, textures or patterns where disturbed or damaged by alterations or new work when not scheduled.

B. ROOM FINISH SCHEDULE (SEE AS811)

--- E N D---

**SECTION 09 22 16**  
**NON-STRUCTURAL METAL FRAMING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies steel studs wall systems, shaft wall systems, ceiling or soffit suspended or furred framing, wall furring, fasteners, and accessories for the screw attachment of gypsum board, plaster bases or other building boards.

**1.2 RELATED WORK**

- A. Ceiling suspension systems for Linear Metal Ceiling or panels: Section 09 54 23, LINEAR METAL CEILING (LMS) Section 09 29 00, GYPSUM BOARD.

**1.3 TERMINOLOGY**

- A. Description of terms shall be in accordance with ASTM C754, ASTM C11, ASTM C841 and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by beams, trusses, or bar joists. In interstitial spaces with walk-on floors the underside of the walk-on floor is the underside of structure overhead.
- C. Thickness of steel specified is the minimum bare (uncoated) steel thickness.

**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. Studs, runners and accessories.
  - 2. Hanger inserts.
  - 3. Channels (Rolled steel).
  - 4. Furring channels.
  - 5. Screws, clips and other fasteners.
- C. Shop Drawings:
  - 1. Typical ceiling suspension system.
  - 2. Typical metal stud and furring construction system including details around openings and corner details.
  - 3. Typical shaft wall assembly
  - 4. Typical fire rated assembly and column fireproofing showing details of construction same as that used in fire rating test.
- D. Test Results: Fire rating test designation, each fire rating required for each assembly.

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

In accordance with the requirements of ASTM C754.

## **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 the basic designation only.
- B. American Society For Testing And Materials (ASTM)
  - A641-09.....Zinc-Coated (Galvanized) Carbon Steel Wire
  - C11-10.....Terminology Relating to Gypsum and Related Building Materials and Systems
  - C635-07.....Manufacture, Performance, and Testing of Metal Suspension System for Acoustical Tile and Lay-in Panel Ceilings
  - C636-08.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
  - C645-09.....Non-Structural Steel Framing Members
  - C754-11.....Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
  - C841-03(R2008).....Installation of Interior Lathing and Furring
  - C954-10.....Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
  - E580-11.....Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.

## **PART 2 - PRODUCTS**

### **2.1 PROTECTIVE COATING**

Galvanize steel studs, runners (track), rigid (hat section) furring channels, "Z" shaped furring channels, and resilient furring channels, with coating designation of G-60 minimum, per ASTM 123.

### **2.2 STEEL STUDS AND RUNNERS (TRACK)**

- A. ASTM C645, modified for thickness specified and sizes as shown.
  - 1. Use ASTM A525 steel, 0.8 mm (0.0329-inch) thick bare metal (33 mil).
  - 2. Runners same thickness as studs.
- B. Provide not less than two cutouts in web of each stud, approximately 300 mm (12 inches) from each end, and intermediate cutouts on approximately 600 mm (24-inch) centers.
- C. Studs 3600 mm (12 feet) or less in length shall be in one piece.

## **2.3 FURRING CHANNELS**

- A. Rigid furring channels (hat shape): ASTM C645.
- B. "Z" Furring Channels:
  - 1. Not less than 0.45 mm (0.0179-inch)-thick bare metal, with 32 mm (1-1/4 inch) and 19 mm (3/4-inch) flanges.
  - 2. Web furring depth to suit thickness of insulation with slotted perforations.
- C. Rolled Steel Channels: ASTM C754, cold rolled; or, ASTM C841, cold rolled.

## **2.4 FASTENERS, CLIPS, AND OTHER METAL ACCESSORIES**

- A. ASTM C754, except as otherwise specified.
- B. Fasteners for steel studs thicker than 0.84 mm (0.033-inch) thick. Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- C. Clips: ASTM C841 (paragraph 6.11), manufacturer's standard items. Clips used in lieu of tie wire shall have holding power equivalent to that provided by the tie wire for the specific application.
- E. Concrete ceiling hanger inserts (anchorage for hanger wire and hanger straps): Steel, zinc-coated (galvanized), manufacturers standard items, designed to support twice the hanger loads imposed and the type of hanger used.
- F. Tie Wire and Hanger Wire:
  - 1. ASTM A641, soft temper, Class 1 coating.
  - 2. Gage (diameter) as specified in ASTM C754 or ASTM C841.
- G. Attachments for Wall Furring:
  - 1. Manufacturers standard items fabricated from zinc-coated (galvanized) steel sheet.
  - 2. For concrete or masonry walls: Metal slots with adjustable inserts or adjustable wall furring brackets. Spacers may be fabricated from 1 mm (0.0396-inch) thick galvanized steel with corrugated edges.
- H. Power Actuated Fasteners: Type and size as recommended by the manufacturer of the material being fastened.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION CRITERIA**

- A. Where fire rated construction is required for walls, partitions, columns, beams and floor-ceiling assemblies, the construction shall be same as that used in fire rating test.
- B. Construction requirements for fire rated assemblies and materials shall be as shown and specified, the provisions of the Scope paragraph (1.2)

of ASTM C754 and ASTM C841 regarding details of construction shall not apply.

### **3.2 INSTALLING STUDS**

- A. Install studs in accordance with ASTM C754, except as otherwise shown or specified.
- B. Space studs not more than 610 mm (24 inches) on center.
- C. Cut studs 6 mm to 9 mm (1/4 to 3/8-inch) less than floor to underside of structure overhead when extended to underside of structure overhead.
- D. Where studs are shown to terminate above suspended ceilings, provide bracing as shown or extend studs to underside of structure overhead.
- E. Openings:
  - 1. Frame jambs of openings in stud partitions and furring with two studs placed back to back or as shown.
  - 2. Fasten back to back studs together with 9 mm (3/8-inch) long Type S pan head screws at not less than 600 mm (two feet) on center, staggered along webs.
  - 3. Studs fastened flange to flange shall have splice plates on both sides approximately 50 X 75 mm (2 by 3 inches) screwed to each stud with two screws in each stud. Locate splice plates at 600 mm (24 inches) on center between runner tracks.
- F. Fastening Studs:
  - 1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with two screws through each end of each stud and flange of runner.
  - 2. Do not fasten studs to top runner track when studs extend to underside of structure overhead.
- G. Form control joint, with double studs spaced 13 mm (1/2-inch) apart.

### **3.3 INSTALLING WALL FURRING FOR FINISH APPLIED TO ONE SIDE ONLY**

- A. In accordance with ASTM C754, or ASTM C841 except as otherwise specified or shown.
- B. Wall furring-Stud System:
  - 1. Framed with 63 mm (2-1/2 inch) or narrower studs, 600 mm (24 inches) on center.
  - 2. Brace as specified in ASTM C754 for Wall Furring-Stud System or brace with sections or runners or studs placed horizontally at not less than three foot vertical intervals on side without finish.
  - 3. Securely fasten braces to each stud with two Type S pan head screws at each bearing.
- C. Direct attachment to masonry or concrete; rigid channels or "Z" channels:

1. Install rigid (hat section) furring channels at 600 mm (24 inches) on center, horizontally or vertically.
  2. Install "Z" furring channels vertically spaced not more than 600 mm (24 inches) on center.
  3. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
  4. Ends of spliced furring channels shall be nested not less than 200 mm (8 inches).
  5. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide two fasteners in each flange.
  6. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 100 mm (4 inches) of corner.
- D. Installing Wall Furring-Bracket System: Space furring channels not more than 400 mm (16 inches) on center.

#### **3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES**

- A. Provide for attachment and support of electrical outlets, plumbing, heating fixtures, recessed type plumbing fixture accessories, access panel frames, handrail brackets, recessed fire extinguisher cabinets and other items like auto door buttons and auto door operators supported by stud construction.
- B. Provide additional studs where required. Install metal backing plates, or special metal shapes as required, securely fastened to metal studs.

#### **3.7 TOLERANCES**

- A. Fastening surface for application of subsequent materials shall not vary more than 3 mm (1/8-inch) from the layout line.
- B. Plumb and align vertical members within 3 mm (1/8-inch.)
- C. Level or align ceilings within 3 mm (1/8-inch.)

- - - E N D - - -

**SECTION 09 29 00**  
**GYPSUM BOARD**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies installation and finishing of gypsum board.

**1.2 RELATED WORK**

- A. Installation of steel framing members for walls, partitions, furring, soffits, and ceilings: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Fire Stopping Sealants: Section 07 84 00, FIRE STOPPING.

**1.3 TERMINOLOGY**

- A. Definitions and description of terms shall be in accordance with ASTM C11, C840, and as specified.
- B. Underside of Structure Overhead: In spaces where steel trusses or bar joists are shown, the underside of structure overhead shall be the underside of the floor or roof construction supported by the trusses or bar joists.
- C. "Yoked": Gypsum board cut out for opening with no joint at the opening (along door jamb or above the door).

**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. Cornerbead and edge trim.
  - 2. Finishing materials.
  - 3. Laminating adhesive.
  - 4. Gypsum board, each type.
- C. Shop Drawings:
  - 1. Typical fire rated assembly indicating details of construction same as that used in fire rating test.
- D. Samples:
  - 1. Cornerbead.
  - 2. Edge trim.
- E. Test Results:
  - 1. Fire rating test, each fire rating required for each assembly.
  - 2. Sound rating test.

**1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE**

In accordance with the requirements of ASTM C840.

**1.6 ENVIRONMENTAL CONDITIONS**

In accordance with the requirements of ASTM C840.

## 1.7 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):
- C11-08.....Terminology Relating to Gypsum and Related Building Materials and Systems
  - C475-02.....Joint Compound and Joint Tape for Finishing Gypsum Board
  - C840-08.....Application and Finishing of Gypsum Board
  - C919-08.....Sealants in Acoustical Applications
  - C954-07.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Stud from 0.033 in. (0.84mm) to 0.112 in. (2.84mm) in thickness
  - C1002-07.....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
  - C1047-05.....Accessories for Gypsum Wallboard and Gypsum Veneer Base
  - C1177-06.....Glass Mat Gypsum Substrate for Use as Sheathing
  - C1658-06.....Glass Mat Gypsum Panels
  - C1396-06.....Gypsum Board
  - E84-08.....Surface Burning Characteristics of Building Materials
- C. Underwriters Laboratories Inc. (UL):
- Latest Edition.....Fire Resistance Directory
- D. Inchcape Testing Services (ITS):
- Latest Editions.....Certification Listings

## PART 2 - PRODUCTS

### 2.1 GYPSUM BOARD

- A. Gypsum Board: ASTM C1396, Type X, 16 mm (5/8 inch) thick unless shown otherwise. Shall contain a minimum of 20 percent recycled gypsum.
- B. Coreboard or Shaft Wall Liner Panels.
- 1. ASTM C1396, Type X.
  - 2. ASTM C1658: Glass Mat Gypsum Panels,
  - 3. Coreboard for shaft walls 300, 400, 600 mm (12, 16, or 24 inches) wide by required lengths 25 mm (one inch) thick with paper faces treated to resist moisture.



- C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 16 mm (5/8 inch) thick.
- D. Gypsum cores shall contain maximum percentage of post industrial recycled gypsum content available in the area (a minimum of 95 percent post industrial recycled gypsum content). Paper facings shall contain 100 percent post-consumer recycled paper content.

## **2.2 ACCESSORIES**

- A. ASTM C1047, except form of 0.39 mm (0.015 inch) thick zinc coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 22 mm (7/8 inch) wide with punchouts or deformations as required to provide compound bond.

## **2.3 FASTENERS**

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 0.04 mm (0.33 inch).
- C. Select screws of size and type recommended by the manufacturer of the material being fastened.
- D. For fire rated construction, type and size same as used in fire rating test.
- E. Clips: Zinc-coated (galvanized) steel; gypsum board manufacturer's standard items.

## **2.5 FINISHING MATERIALS AND LAMINATING ADHESIVE**

ASTM C475 and ASTM C840. Free of antifreeze, vinyl adhesives, preservatives, biocides and other VOC. Adhesive shall contain a maximum VOC content of 50 g/l.

## **PART 3 - EXECUTION**

### **3.1 INSTALLING GYPSUM BOARD**

- A. Coordinate installation of gypsum board with other trades and related work.
- B. Install gypsum board in accordance with ASTM C840, except as otherwise specified.
- C. Moisture and Mold-Resistant Assemblies: Provide and install moisture and mold-resistant glass mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C1658 where shown and in locations which might be subject to moisture exposure during construction.
- D. Use gypsum boards in maximum practical lengths to minimize number of end joints.
- E. Bring gypsum board into contact, but do not force into place.
- F. Ceilings:

1. For single-ply construction, use perpendicular application.
2. For two-ply assemblies:
  - a. Use perpendicular application.
  - b. Apply face ply of gypsum board so that joints of face ply do not occur at joints of base ply with joints over framing members.
- G. Electrical and Telecommunications Boxes:
  1. Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.
- H. Accessories:
  1. Set accessories plumb, level and true to line, neatly mitered at corners and intersections, and securely attach to supporting surfaces as specified.
  2. Install in one piece, without the limits of the longest commercially available lengths.
  3. Corner Beads:
    - a. Install at all vertical and horizontal external corners and where shown.
    - b. Use screws only. Do not use crimping tool.
  4. Edge Trim (casings Beads):
    - a. At both sides of expansion and control joints unless shown otherwise.
    - b. Where gypsum board terminates against dissimilar materials and at perimeter of openings, except where covered by flanges, casings or permanently built-in equipment.
    - c. Where gypsum board surfaces of non-load bearing assemblies abut load bearing members.
    - d. Where shown.

### **3.2 FINISHING OF GYPSUM BOARD**

- A. Finish joints, edges, corners, and fastener heads in accordance with ASTM C840. Use Level 4 finish for all finished areas open to public view.
- B. Before proceeding with installation of finishing materials, assure the following:
  1. Gypsum board is fastened and held close to framing or furring.
  2. Fastening heads in gypsum board are slightly below surface in dimple formed by driving tool.
- C. Finish joints, fasteners, and all openings, including openings around penetrations, on that part of the gypsum board extending above suspended ceilings to seal surface of non decorated fire rated gypsum board construction. After the installation of hanger rods, hanger wires, supports, equipment, conduits, piping and similar work, seal remaining

openings and maintain the integrity of the fire rated construction.

Sanding is not required of non decorated surfaces.

### **3.3 REPAIRS**

- A. After taping and finishing has been completed, and before decoration, repair all damaged and defective work, including nondecorated surfaces.
- B. Patch holes or openings 13 mm (1/2 inch) or less in diameter, or equivalent size, with a setting type finishing compound or patching plaster.
- C. Repair holes or openings over 13 mm (1/2 inch) diameter, or equivalent size, with 16 mm (5/8 inch) thick gypsum board secured in such a manner as to provide solid substrate equivalent to undamaged surface.
- D. Tape and refinish scratched, abraded or damaged finish surfaces including cracks and joints in non decorated surface to provide fire protection equivalent to the fire rated construction.

- - - E N D - - -

**SECTION 09 30 13**  
**CERAMIC/PORCELAIN TILING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies ceramic tile, waterproofing membranes for thin-set applications, crack isolation membranes for flooring located in elevator cabs.

**1.2 RELATED WORK**

- A. Sealing of joints where specified: Section 07 92 00, JOINT SEALANTS.
- B. Color, texture and pattern of field tile and trim shapes, size of field tile, and color of grout specified: Section 09 06 00, SCHEDULE FOR FINISHES

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
  - 1. Porcelain tile, each type, color, patterns and size.
- C. Product Data:
  - 1. Porcelain tile, marked to show each type, size, and shape required.
  - 2. Elastomeric membrane and bond coat.
  - 3. Reinforcing tape.
  - 4. Latex-Portland cement mortar and grout.
  - 5. Slip resistant tile.
  - 6. Fasteners.
- D. Certification:
  - 1. Master grade, ANSI A137.1.
  - 2. Manufacturer's certificates indicating that the following materials comply with specification requirements:
    - a. Commercial Portland cement grout.
    - b. Cementitious backer unit.
    - c. Elastomeric membrane and bond coat.
    - d. Reinforcing tape.
    - e. Latex-Portland cement mortar and grout.
    - f. Leveling compound.
    - g. Waterproof isolation membrane.

**1.4 DELIVERY AND STORAGE**

- A. Deliver materials in containers with labels legible and intact and grade-seals unbroken.

B. Store material to prevent damage or contamination.

#### 1.5 APPLICABLE PUBLICATIONS

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

B. American National Standards Institute (ANSI):

A108.1A-11.....Installation of Ceramic Tile in the Wet-Set  
Method with Portland Cement Mortar

A108.1B-11.....Installation of Ceramic Tile on a Cured Portland  
Cement Mortar Setting Bed with dry-Set or latex-  
Portland Cement Mortar

A108.1C-11.....Contractors Option; Installation of Ceramic Tile  
in the Wet-Set method with Portland Cement  
Mortar or Installation of Ceramic Tile on a  
Cured Portland Cement Mortar Setting Bed with  
Dry-Set or Latex-Portland Cement Mortar

A137.1-08.....Ceramic Tile

C. American Society For Testing And Materials (ASTM):

C109/C109M-11.....Standard Test Method for Compressive Strength of  
Hydraulic Cement Mortars (Using 2 inch. or [50-  
mm] Cube Specimens)

C241-09.....Abrasion Resistance of Stone Subjected to Foot  
Traffic

C348-08.....Standard Test Method for Flexural Strength of  
Hydraulic-Cement Mortars

C627-10.....Evaluating Ceramic Floor Tile Installation  
Systems Using the Robinson-Type Floor Tester

C1027-09.....Determining "Visible Abrasion Resistance on  
Glazed Ceramic Tile"

C1028-07.....Determining the Static Coefficient of Friction  
of Ceramic Tile and Other Like Surfaces by the  
Horizontal Dynamometer Pull Meter Method

C1127-09.....Standard Guide for Use of High Solids Content,  
Cold Liquid-Applied Elastomeric Waterproofing  
Membrane with an Integral Wearing Surface

C1178/C1178M-11.....Standard Specification for Coated Glass Mat  
Water-Resistant Gypsum Backing Panel

C1325-08.....Non-Asbestos Fiber-Mat Reinforced Cementitious  
Backer Units

D4397-10.....Standard Specification for Polyethylene Sheeting  
for Construction, Industrial and Agricultural  
Applications

D5109-99(R2004).....Standard Test Methods for Copper-Clad  
Thermosetting Laminates for Printed Wiring  
Boards

D. Marble Institute of America (MIA): Design Manual III-2007

E. Tile Council of America, Inc. (TCA):  
2007.....Handbook for Ceramic Tile Installation

## **PART 2 - PRODUCTS**

### **2.1 TILE**

A. Comply with ANSI A137.1, Standard Grade, except as modified:

1. Inspection procedures listed under the Appendix of ANSI A137.1.

2. Abrasion Resistance Classification:

a. Tested in accordance with values listed in Table 1, ASTM C 1027.

b. Class V, 12000 revolutions for floors in Corridors, Kitchens,  
Storage including Refrigerated Rooms

c. Class IV, 6000 revolutions for remaining areas.

3. Slip Resistant Tile for Floors:

a. Coefficient of friction, when tested in accordance with ASTM  
C1028, required for level of performance:

1) Not less than 0.6, except 0.8 on ramps as stated above, for wet  
and dry conditions for other areas.

B. Porcelain Paver Tile: Nominal 8 mm (5/16 inch) thick, with cushion  
edges. Porcelain tile produced by the dust pressed method shall be made  
of approximately 50% feldspar; the remaining 50% shall be made up of  
various high-quality light firing ball clays yielding a tile with a  
water absorption rate of 0.5% or less and a breaking strength of between  
390 to 400 pounds.

### **2.2 CEMENTITIOUS BACKER UNITS**

A. Use in elevator cab.

B. ASTM C1325.

C. Use Cementitious backer units in maximum available lengths.

### **2.3 JOINT MATERIALS FOR CEMENTITIOUS BACKER UNITS**

A. Reinforcing Tape: Vinyl coated woven glass fiber mesh tape, open weave,  
50 mm (2 inches) wide. Tape with pressure sensitive adhesive backing  
will not be permitted.

B. Tape Embedding Material: Latex-Portland cement mortar complying with  
ANSI A108.1.

- C. Joint material, including reinforcing tape, and tape embedding material, shall be as specifically recommended by the backer unit manufacturer.

#### **2.4 FASTENERS**

- A. Screws for Cementitious Backer Units.
1. Standard screws for gypsum board are not acceptable.
  2. Minimum 11 mm (7/16 inch) diameter head, corrosion resistant coated, with washers.
  3. ASTM C954 for steel 1 mm (0.033 inch) thick.
  4. ASTM C1002 for steel framing less than 0.0329 inch thick.
- B. Washers: Galvanized steel, 13 mm (1/2 inch) minimum diameter.

#### **2.5 GLASS MAT WATER RESISTANT GYPSUM BACKER BOARD**

Confirm to ASTM C1178/C1178M, Optional System for Cementitious Backer Units.

#### **2.6 SETTING MATERIALS OR BOND COATS**

- A. Conform to TCA Handbook for Ceramic Tile Installation.
- B. Portland Cement Mortar: ANSI A108.1.
- C. Latex-Portland Cement Mortar: ANSI A108.1.
1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A108.1.
  2. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of Portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.
- D. Dry-Set Portland Cement Mortar: ANSI A108.1. For wall applications, provide non-sagging, latex-Portland cement mortar complying with ANSI A108.4.
- E. Organic Adhesives: ANSI A108.1, Type 1.
- F. Chemical-Resistant Bond Coat:
1. Epoxy Resin Type: ANSI A108.1.
  2. Furan Resin Type: ANSI A108.1.

#### **2.7 GROUTING MATERIALS**

- A. Coloring Pigments:
1. Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.
  2. Add coloring pigments to grout by the manufacturer.
  3. Job colored grout is not acceptable.
  4. Use is required in Commercial Portland Cement Grout, Dry-Set Grout, and Latex-Portland Cement Grout.
- B. Commercial Portland Cement Grout: ANSI A108.1 color as specified.
- C. Latex-Portland Cement Grout: ANSI A108.1 color as specified.
1. Unsanded grout mixture for joints 3.2 mm (1/8 inch) and narrower.

2. Sanded grout mixture for joints 3.2 mm (1/8 inch) and wider.

## **2.8 PATCHING AND LEVELING COMPOUND**

- A. Portland cement base, polymer-modified, self-leveling compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- B. Shall have minimum following physical properties:
  - 1. Compressive strength - 25 MPa (3500 psig) per ASTM C109/C109M.
  - 2. Flexural strength - 7 MPa (1000 psig) per ASTM C348 (28 day value).
  - 3. Tensile strength - 600 psi per ANSI 118.7.
  - 4. Density - 1.9.
- C. Capable of being applied in layers up to 38 mm (1-1/2 inches) thick without fillers and up to 100 mm (four inches) thick with fillers, being brought to a feather edge, and being trowelled to a smooth finish.
- D. Primers, fillers, and reinforcement as required by manufacturer for application and substrate condition.
- E. Ready for use in 48 hours after application.

## **2.9 WATER**

Clean, potable and free from salts and other injurious elements to mortar and grout materials.

## **2.10 CLEANING COMPOUNDS**

- A. Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- B. Materials containing acid or caustic material not acceptable.

## **2.11 FLOOR MORTAR BED REINFORCING**

ASTM A185 welded wire fabric without backing, MW3 x MW3 (2 x 2-W0.5 x W0.5).

## **2.12 POLYETHYLENE SHEET**

- A. Polyethylene sheet conforming to ASTM D4397.
- B. Nominal thickness: 0.15 mm (six mils).
- C. Use sheet width to minimize joints.

## **PART 3 - EXECUTION**

### **3.1 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperature of work areas at not less than 16 degree C (60 degrees F), without interruption, for not less than 24 hours before installation and not less than three days after installation.
- B. Maintain higher temperatures for a longer period of time where required by manufacturer's recommendation and ANSI Specifications for installation.



- C. Do not install tile when the temperature is above 38 degrees C (100 degrees F).
- D. Do not install materials when the temperature of the substrate is below 16 degrees C (60 degrees F).
- E. Do not allow temperature to fall below 10 degrees C (50 degrees F) after fourth day of completion of tile work.

### **3.2 ALLOWABLE TOLERANCE**

- A. Variation in plane of sub-floor, including concrete fills leveling compounds and mortar beds:
  - 1. Not more than 1 in 500 (1/4 inch in 10 feet) from required elevation where Portland cement mortar setting bed is used.
  - 2. Not more than 1 in 1000 (1/8 inch in 10 feet) where dry-set Portland cement, and latex-Portland cement mortar setting beds and chemical-resistant bond coats are used.

### **3.3 SURFACE PREPARATION**

- A. Patching and Leveling:
  - 1. Mix and apply patching and leveling compound in accordance with manufacturer's instructions.
  - 2. Fill holes and cracks and align concrete floors that are out of required plane with patching and leveling compound.
    - a. Thickness of compound as required to bring finish tile system to elevation shown.
    - b. Float finish.
    - c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

### **3.4 CEMENTITIOUS BACKER UNITS**

- A. Remove polyethylene wrapping from cementitious backer units and separate to allow for air circulation. Allow moisture content of backer units to dry down to a maximum of 35 percent before applying joint treatment and tile.
- B. Install in accordance with ANSI A108.1 except as specified otherwise.
- C. Install units horizontally or vertically to minimize joints with end joints over framing members. Units with rounded edges; face rounded edge away from studs to form a V joint for joint treatment.
- D. Secure cementitious backer units to each framing member with screws spaced not more than 200 mm (eight inches) on center and not closer than 13 mm (1/2 inch) from the edge of the backer unit or as recommended by backer unit manufacturer. Install screws so that the screw heads are flush with the surface of the backer unit.

- E. Where backer unit joins shower pans or waterproofing, lap backer unit over turned up waterproof system. Install fasteners only through top one-inch of turned up waterproof systems.
- F. Do not install joint treatment for seven days after installation of cementitious backer unit.
- G. Joint Treatment:
  - 1. Fill horizontal and vertical joints and corners with latex-Portland cement mortar. Apply fiberglass tape over joints and corners and embed with same mortar.
  - 2. Leave 6 mm (1/4 inch) space for sealant at lips of tubs, sinks, or other plumbing receptors.

### **3.5 GLASS MAT WATER-RESISTANT GYPSUM BACKER BOARD**

- A. Install in accordance with manufacturer's instructions. TCA Systems W245-01.
- B. Treat joints with tape and latex-Portland cement mortar or adhesive.

### **3.6 CERAMIC TILE - GENERAL**

- A. Comply with ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" applicable to methods of installation.
- B. Comply with TCA Installation Guidelines:
- C. Installing Mortar Beds for Floors:
  - 1. Install mortar bed to not damage cleavage or waterproof membrane; 32 mm (1-1/2 inch) minimum thickness.
  - 2. Install floor mortar bed reinforcing centered in mortar fill.
  - 3. Screed finish to level plane or slope to drains where shown, float finish.
  - 4. For thin set systems cure mortar bed not less than seven days. Do not use curing compounds or coatings.
  - 5. For tile set with Portland cement paste over plastic mortar bed coordinate to set tile before mortar bed sets.
- D. Setting Beds or Bond Coats:
  - 1. Where recessed or depressed floor slabs are filled with Portland cement mortar bed, set ceramic mosaic floor tile in either Portland cement paste over plastic mortar bed or latex-Portland cement mortar over cured mortar bed except as specified otherwise, ANSI A108-1C, TCA System F121-02 or F111-02.
  - 2. Use quarry tile in chemical-resistant bond coat, // except in floor of walk-in refrigerator rooms use: TCA system R 612-02. //
    - a. Portland cement paste over plastic mortar bed. ANSI A108.1A.

- b. Dry-set Portland cement mortar over cured mortar bed. ANSI  
A108.1B.

- 4. Set floor tile in elastomeric bond coat over elastomeric membrane  
ANSI 108. 13, TCA System F122 in elevator cab.

E. Workmanship:

- 1. Lay out tile work so that no tile less than one-half full size is  
used. Make all cuts on the outer edge of the field.
- 2. Set tile firmly in place with finish surfaces in true planes. Align  
tile flush with adjacent tile unless shown otherwise.
- 3. Form intersections and returns accurately.
- 4. Cut and drill tile neatly without marring surface.
- 5. Cut edges of tile abutting penetrations, finish, or built-in items:
  - a. Fit tile closely around electrical outlets, piping, fixtures and  
fittings, so that plates, escutcheons, collars and flanges will  
overlap cut edge of tile.
  - b. Seal tile joints water tight as specified in Section 07 92 00,  
JOINT SEALANTS, around electrical outlets, piping fixtures and  
fittings before cover plates and escutcheons are set in place.
- 6. Completed work shall be free from hollow sounding areas and loose,  
cracked or defective tile.
- 7. Remove and reset tiles that are out of plane or misaligned.
- 8. Floors:
  - a. Extend floor tile beneath casework and equipment, except those  
units mounted in wall recesses.
  - b. Align finish surface of new tile work flush with other and  
existing adjoining floor finish where shown.
  - c. In areas where floor drains occur, slope to drains where shown.
  - d. Shove and vibrate tiles over 200 mm (8 inches) square to achieve  
full support of bond coat.
- 9. Joints:
  - a. Keep all joints in line, straight, level, perpendicular and of  
even width unless shown otherwise.
  - b. Make joints 2 mm (1/16 inch) wide for glazed wall tile and mosaic  
tile work.
  - c. Make joints in quarry tile work not less than 6 mm (1/4 inch) nor  
more than 9 mm (3/8 inch) wide. Finish joints flush with surface  
of tile.
  - d. Make joints in Paver tile, porcelain type; maximum 3 mm (1/8 inch)  
wide.

### **3.7 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR**

Due to the denseness of porcelain tile use latex Portland cement bonding mortar that meets the requirements of ANSI A108.1. Bonding mortars shall be mixed in accordance with manufacturer's instructions. Improper liquid ratios and dwell time before placement of bonding mortar and tile shall affect bond.

### **3.8 GROUTING**

#### **A. Grout Type and Location:**

1. Grout for glazed paver tile latex-Portland cement grout or commercial Portland cement grout.

#### **B. Workmanship:**

1. Install and cure grout in accordance with the applicable standard.
2. Portland Cement grout: ANSI A108.1.
3. Epoxy Grout: ANSI A108.1.
4. Furan and Commercial Portland Cement Grout: ANSI A108.1 and in accordance with the manufacturer's printed instructions.
5. Dry-set grout: ANSI A108.1.

### **3.9 MOVEMENT JOINTS**

- A. Prepare tile expansion, isolation, construction and contraction joints for installation of sealant. Refer to Section 07 92 00, JOINT SEALANTS.
- B. TCA details EJ 171-02.
- C. At expansion joints, rake out joint full depth of tile and setting bed and mortar bed. Do not cut waterproof or isolation membrane.
- D. Rake out grout at joints between tile at edge of elevator cab not less than 6 mm (1/4 inch) deep.
- E. Provide expansion joints at edge of elevator cab.

### **3.10 CLEANING**

- A. Thoroughly sponge and wash tile. Polish glazed surfaces with clean dry cloths.
- B. Methods and materials used shall not damage or impair appearance of tile surfaces.
- C. The use of acid or acid cleaners on glazed tile surfaces is prohibited.
- D. Clean tile grouted with epoxy, furan and commercial Portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

### **3.11 PROTECTION**

- A. Keep traffic off tile floor, until grout and setting material is firmly set and cured.
- B. Where traffic occurs over tile floor, cover tile floor with not less than 9 mm (3/8 inch) thick plywood, wood particle board, or hardboard

securely taped in place. Do not remove protective cover until time for final inspection. Clean tile of any tape, adhesive and stains.

**3.12 TESTING FINISH FLOOR**

- A. Test floors in accordance with ASTM C627 to show compliance with codes 1 through 10.
- B. Test kitchen and storage rooms.

- - - E N D - - -

**SECTION 09 54 23**  
**LINEAR METAL CEILINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. Section Includes:

1. Suspended metal grid ceiling system including trim.
2. Decorative, linear, formed metal ceiling panels, mechanically mounted on a ceiling suspension system.
3. Accessories:
  - a. Closures, trim, edge molding and all other items required to provide complete installation.

B. Unit size, texture, finish, and color as specified.

C. Location and extent of acoustical treatment as shown.

**1.2 RELATED WORK**

A. Finish Color: Section 09 06 00, SCHEDULE FOR FINISHES.

B. Interior Lighting: Section 26 51 00, INTERIOR LIGHTING.

**1.3 QUALITY CONTROL**

A. Qualifications:

1. Approval required of products or service of proposed manufacturer, suppliers and installers, and shall be based upon submission by Contractor of certification that:
  - a. Manufacturer regularly and presently, manufactures and installs linear metal ceiling systems and related accessories as one of its principal products and has a record of successful in-service performance.
  - b. Accessories required for linear metal ceiling systems shall be manufacturer's standard or other systems compatible with linear metal ceiling system manufacturer's material. Items shall be of materials and construction which shall provide desired functional service.
2. Installer: Approved in writing by manufacturer.

B. Coordination of Work: Coordinate layout and installation of linear metal ceiling units and suspension system components with other work supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any):

1. HVAC Air Outlets and Inlets: Shall be planned to occur within center of panel systems or provide for equal distance on each side parallel to length of panels

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Product Data:
  - 1. Manufacturer's standard details and fabrication methods.
  - 2. Data on finishing, hardware, components, and accessories.
  - 3. Recommendations for maintenance and cleaning of finish surfaces.
- C. Shop Drawings:
  - 1. Submit complete composite fabrication, and installation shop drawings including associated components.
  - 2. Identify panel sections, baffles, edge trim, lighting trim, air diffuser sections and trim, sprinkler head locations and trim, other component parts, not included in manufacturer's product data, by name and material and showing design, construction, installation, and anchorage.
  - 3. Layout and installation details, including relation to adjacent work such as walls and bulkheads.
  - 4. Composite reflected ceiling plans, at 1:50 (1/4 inch) scale, showing location of all accessories, mechanical and electrical components. \_  
Indicate following:
    - a. Joint pattern.
    - b. Ceiling suspension members.
    - c. Method of attaching hangers to building structure.
    - d. Ceiling-mounted items including light fixtures, air outlets and inlets, speakers, sprinkler heads, and access panels. Any special moldings at walls, column penetrations, and other junctures with adjoining construction.
  - 5. Detail sections of typical composite members, at wall surfaces, mechanical diffusers and grilles, sprinkler heads, and light fixtures.
  - 6. Provisions for expansion and contraction.
  - 7. Anchors and reinforcements.
- D. Samples:
  - 1. Submit pairs of samples of each specified color and finish on 300 mm (12 inch) long sections of extrusions or formed shapes for following:
    - a. Linear metal panel.
    - b. Each exposed molding and trim sections.
    - c. Suspension system members.
    - d. Filler strips.
    - f. End cap.

2. Where normal color variations are anticipated, include 2 units in set indicating extreme limits of color variations.
3. Integrally Colored Anodized or Prefinished Aluminum:
  - a. Sheet not less than 200 mm by 250 mm (eight inches by ten inches).

E. Certificates:

1. Stating that linear metal ceiling system material has been given specified thickness of anodizing or organic coating finish.
2. Indicating manufacturer's and installer's meet qualifications as specified.
3. Submit list of equivalent size installations which have had satisfactory operation.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Materials: Deliver to site in manufacturer's original unopened containers with brand name and type clearly marked.
- B. Materials: Carefully handle and store in dry, watertight enclosures.
- C. Immediately before installation, linear metal ceiling units shall be stored for not less than 48 hours at same temperature and relative humidity as space where they will be installed to assure temperature and moisture conditions in accordance with manufacturer's recommendations.

**1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referred to in text by basic designation only.
- B. American Architectural Manufacturers Association (AAMA):  
2605-11.....High Performance Organic Coatings on  
Architectural Extrusions and Panels.
- C. American Society for Testing and Materials (ASTM):  
A641/641M-09.....Zinc-coated (Galvanized) Carbon Steel Wire.  
A653/A653M-10.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.  
B209/B209M-07.....Aluminum and Aluminum-Alloy Sheet and Plate.  
C635-07.....Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.  
C636-08.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.  
E90-09.....Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.



E580-10.....Application of Ceiling Suspension Systems for  
Acoustical Tile and Lay-in Panels in Areas  
Requiring Seismic Restraint.

D. National Association of Architectural Metal Manufacturers (NAAMM):  
Metal Finishes Manual (2006)

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

Uniform temperature of not less than 16 °C, (60 °F) nor more than 27 °C, (80 °F) and a relative humidity of not more than 70 percent shall be maintained for a period of 48 hours before, during, and for 48 hours after installation of linear metal ceiling units. After above period, room temperature shall not fall below 13 °C (55 °F).

#### **1.8 SCHEDULING**

Interior finish work such as plastering, gypsum board finishing, painting, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

#### **1.9 WARRANTY**

Submit written warranty, in accordance with FAR clause 52.246-21, Warranty of Construction requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

A. Linear Metal Ceiling System, General:

1. Sheet Metal Characteristics: Form metal panels from sheet metal free from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, stains, discolorations, or other imperfections.
2. Fabrication: Die-form linear metal panels into units standard with manufacturer and finished as specified herein.

B. Accessories: Stabilizer bars, clips, splices, hold down clips as required for suspended grid system.

C. Linear Metal Panels:

1. General: Formed to snap on and be securely retained on carriers without separate fasteners.
2. Aluminum Panels: ASTM B209/B209m, roll-formed sheet, alloy 3005-H26, complying with following requirements:
  - a. Minimum Nominal Thickness: 0.40 mm (0.024 inch).

D. Suspension Systems, General:

1. Standard for Metal Suspension Systems: Provide manufacturer's standard types, structural classifications, and finishes indicated that comply with ASTM C635 requirements.
  2. Anchors: Type as recommended by manufacturer. Size for five times design load indicated in ASTM C635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire for Carriers, Hangers, and Ties: ASTM A641/A641m, Class 1, zinc coating, soft temper.
1. Gage: Minimum 12 gage. Shall support a minimum of 1330 N (300 pounds) ultimate vertical load without failure of supporting material or attachment.
- F. Hanger Rods: Mild steel, zinc coated, or protected with rust-inhibitive paint.
- G. Flat Hangers: Mild steel, zinc coated, or protected with rust-inhibitive paint.
- H. Angle Hangers: Angles with legs not less than 22 mm (7/8 inch) wide, formed with 0.82 mm (0.0365 inch) galvanized steel sheet complying with ASTM A653/A653m, Coating Designation G90, with bolted connections and 7.6 mm (5/16 inch) diameter bolts.
- J. Carriers: Comply with ASTM A653/A653m, cold-rolled, electro-galvanized, 0.375 mm (0.0209 inch) (25 gage) minimum nominal thickness steel.

## **2.2 FINISHES**

- A. Comply with NAAMM "Metal Finishes Manual".
- B. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent ceiling units not acceptable. Noticeable variations in same piece not acceptable.
- D. Aluminum Finishes:
  1. Color and Gloss: Refer to Section 09 06 00, SCHEDULE FOR FINISHES.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Ceiling Areas: Conform with details, dimensions and tolerances shown on approved linear metal ceiling system composite reflected ceiling plan shop drawings.
- B. Conditions which may adversely affect linear metal ceiling system installation shall be brought to Contractors attention, for repair, prior to commencement of linear metal ceiling system installation. Do

not start ceiling installation until affected area has been repaired to Installer's satisfaction.

- C. Where linear metal ceiling system is installed adjacent to masonry, washdown of adjacent masonry shall be completed prior to erection of ceiling system to prevent damage to material finish by cleaning materials.

### **3.2 PREPARATION**

Measure each ceiling area and establish layout of linear metal panel units to balance border widths at opposite edges of each ceiling. Avoid using units less than half wide at borders.

### **3.3 INSTALLATION**

- A. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C636 and as applicable to linear metal panel ceiling suspension system.
- B. Suspend ceiling hangers from building structural members and as follows:
1. Install hangers plumb, free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers where required to avoid obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  3. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail because of age, corrosion, and elevated temperatures.
  4. Space hangers not more than 1200 mm (48 inches) on center along each member supported directly from hangers, unless otherwise shown.
- C. Install edge moldings at edge of each linear metal ceiling area and at locations where edge of units would otherwise be exposed after completion of Work. Level moldings with ceiling suspension system to level tolerance of 3 mm (1/8 inch) in 3600 mm (12 feet).
1. Masonry and Concrete: Fasten with machine screws into lead-shield-type anchors drilled into construction.

2. Hollow Masonry or Stud Construction: Fasten with toggle bolts or similar self-expanding screw anchors.

D. Ceiling Access Doors:

1. Ceiling access doors shall be located directly under items which require access.

E. Scribe and cut metal panel units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

F. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions, unless otherwise-shown.

G. Install panels with butt joints using internal concealed panel splices and in joint configurations shown in reflected ceiling plan.

H. Install acoustical insulation blankets at right angle to panels so that they do not hang unsupported.

**3.4 CLEANING**

Following installation, dirty or discolored surfaces of linear metal ceiling units shall be cleaned, in accordance with manufacturer's written recommendations, and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

**3.5 PROTECTION**

Protect linear metal ceiling systems from damage until final inspection and acceptance.

- - - END - - -

**SECTION 09 91 00**  
**PAINTING**

**PART 1-GENERAL**

**1.1 DESCRIPTION**

- A. Section specifies field painting.
- B. Section specifies prime coats which may be applied in shop under other sections.
- C. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.
- D. Section includes staining of exposed concrete surfaces and structure.

**1.2 RELATED WORK**

- A. Shop prime painting of steel and ferrous metals: Division 05 - METALS, Division 08 - OPENINGS, Division 10 - SPECIALTIES, Division 11 - EQUIPMENT, Division 13 - SPECIAL CONSTRUCTION, Division 14 - CONVEYING EQUIPMENT, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY sections.
- B. Type of Finish, Color, and Gloss Level of Finish Coat: Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Asphalt and concrete pavement marking: Section 32 17 23, PAVEMENT MARKINGS.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:  
Before work is started, or sample panels are prepared, submit manufacturer's literature, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Sample Panels:
  - 1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.

2. Precast Mock-Up to show color: Paint Sections, 250 by 250 by 3 mm (10 inch by 10 inch) of Each field paint, accent paint and stain used in the project and a 150 by 1200 by 3 mm (6 inch by 48 inch) of one WAYFINDING COLOR.
3. Panels Composition Board 100 by 250 by 3 mm (4 inch by 10 inch) of 1/8 rigid substrate of each paint not applied to precast or cast in place concrete.
4. Attach labels to samples stating the following:
  - a. Federal Specification Number or manufacturers name and product number of paints used.
  - b. Specification code number specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - c. Product type and color.
  - d. Name of project.
- D. Manufacturers' Certificates indicating compliance with specified requirements:
  1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
  2. High temperature aluminum paint.
  3. Epoxy coating.
  4. Intumescent clear coating or fire retardant paint.
  5. Plastic floor coating.

#### **1.4 DELIVERY AND STORAGE**

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
  1. Name of manufacturer.
  2. Product type.
  3. Batch number.
  4. Instructions for use.
  5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
  1. Federal Specification Number, where applicable, and name of material.
  2. Surface upon which material is to be applied.
  3. If paint or other coating, state coat types; prime, body or finish.
- C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 degrees C (65 and 85 degrees F).

#### 1.5 MOCK-UP PANEL

- A. Before starting application of water paint mixtures, cementitious paint, apply paint as specified to the Precast Mock-Up Panel or an area, not to exceed 2.5 m<sup>2</sup> (68 ft<sup>2</sup>), selected by COR.
- B. Finish and texture approved by COR will be used as a standard of quality for remainder of work.

#### 1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. American Conference of Governmental Industrial Hygienists (ACGIH):  
ACGIH TLV-BKLT-2012.....Threshold Limit Values (TLV) for Chemical  
Substances and Physical Agents and Biological  
Exposure Indices (BEIs)  
ACGIH TLV-DOC-2012.....Documentation of Threshold Limit Values and  
Biological Exposure Indices, (Seventh Edition)
- C. American National Standards Institute (ANSI):  
A13.1-07.....Scheme for the Identification of Piping Systems
- D. American Society for Testing and Materials (ASTM):  
D260-86.....Boiled Linseed Oil
- E. Commercial Item Description (CID):  
A-A-1555.....Water Paint, Powder (Cementitious, White and  
Colors) (WPC) (cancelled)  
A-A-3120.....Paint, For Swimming Pools (RF) (cancelled)
- F. Federal Specifications (Fed Spec):  
TT-P-1411A.....Paint, Copolymer-Resin, Cementitious (For  
Waterproofing Concrete and Masonry Walls) (CEP)
- G. Master Painters Institute (MPI):  
No. 1-12.....Aluminum Paint (AP)  
No. 4-12.....Interior/ Exterior Latex Block Filler  
No. 5-12.....Exterior Alkyd Wood Primer  
No. 7-12.....Exterior Oil Wood Primer  
No. 8-12.....Exterior Alkyd, Flat MPI Gloss Level 1 (EO)  
No. 9-12.....Exterior Alkyd Enamel MPI Gloss Level 6 (EO)  
No. 10-12.....Exterior Latex, Flat (AE)  
No. 11-12.....Exterior Latex, Semi-Gloss (AE)  
No. 18-12.....Organic Zinc Rich Primer  
No. 26-12.....Cementitious Galvanized Metal Primer  
No. 27-12.....Exterior / Interior Alkyd Floor Enamel, Gloss (FE)  
No. 31-12.....Polyurethane, Moisture Cured, Clear Gloss (PV)

- No. 36-12.....Knot Sealer
- No. 58 .....Stain for Concrete Floors (Penetrating Stain)
- No. 60-12.....Interior/Exterior Latex Porch & Floor Paint, Low Gloss
- No. 68-12.....Interior/ Exterior Latex Porch & Floor Paint, Gloss
- No. 71-12.....Polyurethane, Moisture Cured, Clear, Flat (PV)
- No. 74-12.....Interior Alkyd Varnish, Semi-Gloss
- No. 77-12.....Epoxy Cold Cured, Gloss (EC)
- No. 79-12.....Marine Alkyd Metal Primer
- No. 94-12.....Exterior Alkyd, Semi-Gloss (EO)
- No. 95-12.....Fast Drying Metal Primer
- No. 98-12.....High Build Epoxy Coating
- No. 99.....Sealer, Water Based, for Concrete Floors
- No. 101-12.....Epoxy Anti-Corrosive Metal Primer
- No. 108-12.....High Build Epoxy Coating, Low Gloss (EC)
- No. 114-12.....Interior Latex, Gloss (LE) and (LG)
- No. 119-12.....Exterior Latex, High Gloss (acrylic) (AE)
- No. 135-12.....Non-Cementitious Galvanized Primer

H. Steel Structures Painting Council (SSPC):

- SSPC SP 1-04 (R2004)....Solvent Cleaning
- SSPC SP 2-04 (R2004)....Hand Tool Cleaning
- SSPC SP 3-04 (R2004)....Power Tool Cleaning

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Cementitious Paint (CEP): TT-P-1411A [Paint, Copolymer-Resin, Cementitious (CEP)], Type 1 for exterior use, Type II for interior use.
- B. Plastic Tape:
  - 1. Pigmented vinyl plastic film in colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES or specified.
  - 2. Pressure sensitive adhesive back.
  - 3. Widths as shown.
- C. Identity markers options:
  - 1. Pressure sensitive vinyl markers.
  - 2. Snap-on coil plastic markers.
- D. Aluminum Paint (AP): MPI 1.
- E. Interior/Exterior Latex Block Filler: MPI 4.
- F. Exterior Alkyd Wood Primer: MPI 5.
- G. Exterior Alkyd, Flat (EO): MPI 8.



- H. Exterior Alkyd Enamel (EO): MPI 9.
- I. Exterior Latex, Flat (AE): MPI 10.
- J. Exterior Latex, Semi-Gloss (AE): MPI 11.
- K. Cementitious Galvanized Metal Primer: MPI 26.
- L. Exterior/ interior Alkyd Floor Enamel, Gloss (FE): MPI 27.
- M. Knot Sealer: MPI 36.
- N. Interior / Exterior Alkyd Porch & Floor Enamel, Low Gloss (FE): MPI 59.
- O. Interior/ Exterior Latex Porch & Floor Paint, Low Gloss: MPI 60.
- P. Interior/ Exterior Latex Porch & Floor Paint, gloss: MPI 68.
- Q. Epoxy Cold Cured, Gloss (EC): MPI 77.
- R. Marine Alkyd Metal primer: MPI 79.
- S. Exterior Alkyd, Semi-Gloss (EO): MPI 94.
- T. Fast Drying Metal Primer: MPI 95.
- U. High Build Epoxy Coating: MPI 98.
- V. Epoxy Anti-Corrosive Metal Primer: MPI 101.
- W. High Build Epoxy Marine Coating (EC): MPI 108.
- X. Exterior Latex, High Gloss (acrylic) (AE): MPI 119.
- Y. Waterborne Galvanized Primer: MPI 134.
- Z. Non-Cementitious Galvanized Primer: MPI 135.
- AA. Concrete Stain Materials - TYPE 1
  - a. Description: An acrylic, penetrating stain designed to provide long term color uniformity, ultraviolet resistance, alkali and pollution resistance plus water-repellency without disturbing the natural texture of the substrate. For use over vertical, above-grade smooth or textured concrete, exposed aggregate concrete, glass reinforced concrete, brick, stone, stucco and other masonry surfaces.
  - b. Material:
    - 1) Solids by volume shall be a maximum of 30% (+/-2), ASTM D2697
    - 2) Weight per gallon shall be 9.2 lbs (4.2 kg) (+-.2), ASTM D1475
    - 3) Dry time shall be 15 minutes @ 75°F (24°C), 50% R.H.,ASTM D1640
    - 4) Cure time shall be 1 hour @ 75°F (24°C), 50% R.H.,ASTM D1640
    - 5) Gloss (Angular Reflectance) shall be 4 @ 60° Gardner,ASTM D523
    - 6) Adhesion to concrete shall be a minimum of 300 lbs./sq. in. (2.1 MPa), ASTM D3359
    - 7) Temperature limits for service conditions shall range from -70°F to 200°F (-64°C to 93°C)
    - 8) Toning pigments shall be in organic oxides.
    - 9) Stain shall have a minimum 10-year history of successful performance under weather conditions similar to those encountered at the project site.

c. Color: Color of the stain shall be as indicated by the Architect, matched from Stain Manufacturer's available colors.

d. The following concrete stain manufacturers are acceptable:

- 1) H & C Concrete Stain AC1W, Glidden
- 2) Canyon Tone Stain "W", United Coatings
- 3) W-1, Okon Inc.
- 4) Aquastain, Tamms Industries Co.

## **2.2 PAINT PROPERTIES**

- A. Use ready-mixed (including colors), except two component epoxies, polyurethanes, polyesters, paints having metallic powders packaged separately and paints requiring specified additives.
- B. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

## **2.3 REGULATORY REQUIREMENTS/QUALITY ASSURANCE**

- A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
  1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed 50g/l for exterior latex paints and primers.
  2. Lead-Base Paint:
    - a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
    - b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
    - c. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
  3. Asbestos: Materials shall not contain asbestos.
  4. Chromate, Cadmium, Mercury, and Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
  5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
  6. Use high performance acrylic paints in place of alkyd paints, where possible.

7. VOC content for solvent-based paints shall not exceed 250g/l and shall not be formulated with more than one percent aromatic hydro carbons by weight.

### **PART 3 - EXECUTION**

#### **3.1 JOB CONDITIONS**

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
  1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
  2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.
- B. Atmospheric and Surface Conditions:
  1. Do not apply coating when air or substrate conditions are:
    - a. Less than 3 degrees C (5 degrees F) above dew point.
    - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
  2. Maintain interior temperatures until paint dries hard.
  3. Do no exterior painting when it is windy and dusty.
  4. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
  5. Apply only on clean, dry and frost free surfaces except as follows:
    - a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
    - b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
  6. Varnishing:
    - a. Apply in clean areas and in still air.
    - b. Before varnishing vacuum and dust area.
    - c. Immediately before varnishing wipe down surfaces with a tack rag.

#### **3.2 SURFACE PREPARATION**

- A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. General:

1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
3. See other sections of specifications for specified surface conditions and prime coat.
4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter in accordance with SSPC-SP 1 (Solvent Cleaning).
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 (Hand Tool Cleaning) and SSPC-SP 3 (Power Tool Cleaning). Exception: where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with TT-F-322D (Filler, Two-Component Type, For Dents, Small Holes and Blow-Holes). Finish flush with adjacent surfaces.
  - a. This includes flat head countersunk screws used for permanent anchors.
  - b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

D. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.

2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING. Do not fill weep holes. Finish to match adjacent surfaces.
5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

E. Concrete Stain

1. Surfaces to receive concrete stain shall be structurally sound, clean, dry, fully cured, and free from dust, efflorescence, scale or other foreign materials. Methods and materials used for cleaning of substrate shall be as recommended by the Manufacturer of the concrete stain. Materials such as curing agents, form release agents, bond breakers and other concrete production materials shall be completely removed in accordance with the particular manufactures printed instructions for removal prior to coating application.
2. Concrete stain shall be thoroughly mixed in accordance with Manufacturer's directions. Mix all containers thoroughly prior to application. Do not thin the material.

**3.3 PAINT PREPARATION**

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

### **3.4 APPLICATION**

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.
- C. Apply each coat evenly and cover substrate completely.
- D. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by COR .
- E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.
- F. Apply by brush, roller or spray, except as otherwise specified.
  - 1. Apply painting materials specifically required by manufacturer to be applied by spraying.
  - 2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.
- G. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

### **3.5 PRIME PAINTING**

- A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.
- B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.
- C. Additional field applied prime coats over shop or factory applied prime coats are not required except for exterior exposed steel apply an additional prime coat.
- D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.
- F. Metals except boilers, incinerator stacks, and engine exhaust pipes:
  - 1. Steel and iron: MPI 79 (Marine Alkyd Metal Primer).
  - 2. Zinc-coated steel and iron: MPI 135 (Non-Cementitious Galvanized Primer).
  - 3. Aluminum scheduled to be painted: MPI 95 (Fast Drying Metal Primer).
  - 4. Terne Metal: MPI 95 (Fast Drying Metal Primer).
  - 5. Machinery not factory finished: MPI 9 (Exterior Alkyd Enamel (EO)).

- 6. Asphalt coated metal: MPI 1 (Aluminum Paint (AP)).
- 7. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: MPI 22 (High Heat Resistant Coating (HR)).
- G. Concrete Masonry Units except glazed or integrally colored and decorative units: Prime exterior surface as specified for exterior finishes.
- H. Concrete Floors: MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss).

### **3.6 EXTERIOR FINISHES**

- A. Apply following finish coats where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- C. Steel and Ferrous Metal:
  - 1. Two coats of MPI 8 MPI 9 (Exterior Alkyd Enamel (EO)) on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
- D. Machinery without factory finish except for primer: One coat MPI 9 (Exterior Alkyd Enamel (EO)).
- E. Concrete Masonry Units and Concrete:
  - 1. General:
    - a. Where specified in Section 09 06 00, SCHEDULE FOR FINISHES or shown.
    - b. Mix as specified in manufacturer's printed directions.
    - c. Do not mix more paint at one time than can be used within four hours after mixing. Return paint that has started to set to manufacturer.
    - d. Dampen warm surfaces above 24 degrees C (75 degrees F) with fine mist of water before application of paint. Do not leave free water on surface.
    - e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.
  - 2. Use two coats of TT-P-1411 (Paint, Co-polymer-Resin, Cementitious (CEP)), unless specified otherwise.
- F. Precast Concrete Units without integral color.
- G. Cast In Place Concrete as Indicated

### **3.7 INTERIOR FINISHES**

- A. Apply following finish coats over prime coats in spaces or on surfaces specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. Metal Work:
  - 1. Apply to exposed surfaces.
  - 2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
  - 3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
    - a. Two coats of CID-A-A3120 Type E (RP) on exposed surfaces.
    - b. Machinery: One coat MPI 9 (Exterior Alkyd Enamel (EO)).

- c. Asphalt Coated Metal: One coat MPI 1 (Aluminum Paint (AP)).
- C. Masonry and Concrete Walls:
  - 1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
  - 2. Two coats of MPI 114 (Interior Latex, Gloss (LE) and (LG)).
- D. Concrete Floors: One coat of MPI 68 (Interior/ Exterior Latex Porch & Floor Paint, Gloss (FE)).
- E. Miscellaneous:
  - 1. Apply where specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 2. MPI 1 (Aluminum Paint): Two coats of aluminum paint.

### **3.8 PAINT COLOR**

- A. Color and gloss of finish coats is specified in Section 09 06 00, SCHEDULE FOR FINISHES.
- B. For additional requirements regarding color see Articles, REFINISHING EXISTING PAINTED SURFACE and MECHANICAL AND ELECTRICAL FIELD PAINTING SCHEDULE.
- C. Coat Colors:
  - 1. Color of priming coat: Lighter than body coat.
  - 2. Color of body coat: Lighter than finish coat.
  - 3. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework:
  - 1. Paint to match color of casework where casework has a paint finish.
  - 2. Paint to match color of wall where casework is stainless steel, plastic laminate, or varnished wood.

### **3.9 MECHANICAL AND ELECTRICAL WORK FIELD PAINTING SCHEDULE**

- A. Field painting of mechanical and electrical consists of cleaning, touching-up abraded shop prime coats, and applying prime, body and finish coats to materials and equipment if not factory finished in space scheduled to be finished.
- B. In spaces not scheduled to be finish painted in Section 09 06 00, SCHEDULE FOR FINISHES paint as specified under paragraph H, colors.
- C. Paint various systems specified in Division 02 - EXISTING CONDITIONS, Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATION AND AIR-CONDITIONING, Division 26 - ELECTRICAL, Division 27 - COMMUNICATIONS, and Division 28 - ELECTRONIC SAFETY AND SECURITY.
- D. Paint after tests have been completed.
- E. Omit prime coat from factory prime-coated items.
- F. Finish painting of mechanical and electrical equipment is not required when located in interstitial spaces, above suspended ceilings, in



concealed areas such as pipe and electric closets, pipe basements, pipe tunnels, trenches, attics, roof spaces, shafts and furred spaces except on electrical conduit containing feeders 600 volts or more.

G. Omit field painting of items specified in paragraph, Building and Structural WORK NOT PAINTED.

H. Color:

1. Paint items having no color specified in Section 09 06 00, SCHEDULE FOR FINISHES to match surrounding surfaces.

2. Paint colors as specified in Section 09 06 00, SCHEDULE FOR FINISHES except for following:

- a. White .....Exterior unfinished surfaces of enameled plumbing fixtures. Insulation coverings on breeching and uptake inside boiler house, drums and drum-heads, oil heaters, condensate tanks and condensate piping.
- b. Gray: .....Heating, ventilating, air conditioning and refrigeration equipment (except as required to match surrounding surfaces), and water and sewage treatment equipment and sewage ejection equipment.
- c. Aluminum Color: Ferrous metal on outside of boilers and in connection with boiler settings including supporting doors and door frames and fuel oil burning equipment, and steam generation system (bare piping, fittings, hangers, supports, valves, traps and miscellaneous iron work in contact with pipe).
- d. Federal Safety Red: Exposed fire protection piping hydrants, post indicators, electrical conducts containing fire alarm control wiring, and fire alarm equipment.
- e. Federal Safety Orange: .Entire lengths of electrical conduits containing feeders 600 volts or more.
- f. Color to match brickwork sheet metal covering on breeching outside of exterior wall of boiler house.

I. Apply paint systems on properly prepared and primed surface as follows:

1. General Locations:

a. Apply two coats of MPI 94 (Exterior Alkyd, Semi-gloss (EO)) to the following ferrous metal items:

- 1) Vent and exhaust pipes with temperatures under 94 degrees C (200 degrees F), roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.
- 2) Metal under 94 degrees C (200 degrees F) of items such as bare piping, fittings, hangers and supports.

- 3) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
- 4) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.
- b. Apply two coats of MPI 11 (Exterior Latex, Semi Gloss (AE)) to the following metal items:  
Galvanized and zinc-copper alloy metal.
- c. Apply one coat of MPI 22 (High Heat Resistant Coating (HR)), 650 degrees C (1200 degrees F) to incinerator stacks, boiler stacks, and engine generator exhaust.
- d. Paint electrical conduits containing cables rated 600 volts or more using two coats of MPI 94 (Exterior Alkyd, Semi-gloss (EO)) in the Federal Safety Orange color in exposed and concealed spaces full length of conduit.
- 3. Other exposed locations:
  - a. Metal surfaces, except aluminum, of cooling towers exposed to view, including connected pipes, rails, and ladders: Two coats of MPI 1 (Aluminum Paint (AP)).
  - b. Cloth jackets of insulation of ducts and pipes in connection with plumbing, air conditioning, ventilating refrigeration and heating systems: One coat of MPI 50 (Interior Latex Primer Sealer) and one coat of MPI 11 (Exterior Latex Semi-Gloss (AE)).

### **3.10 BUILDING AND STRUCTURAL WORK FIELD PAINTING**

- A. Painting and finishing of interior and exterior work except as specified under paragraph 3.11 B.
  - 1. Painting and finishing of new work including colors and gloss of finish selected is specified in Finish Schedule, Section 09 06 00, SCHEDULE FOR FINISHES.
  - 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
  - 3. Painting of ferrous metal and galvanized metal.
  - 4. Painting of wood with fire retardant paint exposed in attics, when used as mechanical equipment space.
  - 5. Identity painting and safety painting.
- B. Building and Structural Work not Painted:
  - 1. Prefinished items:
    - a. Doors, elevator entrances and cabs, metal panels, wall covering, and similar items specified factory finished under other sections.

- b. Factory finished equipment and pre-engineered metal building components such as metal roof and wall panels.
- 2. Finished surfaces:
  - a. Hardware except ferrous metal.
  - b. Anodized aluminum, stainless steel, chromium plating, copper, and brass, except as otherwise specified.
  - c. Signs, fixtures, and other similar items integrally finished.
- 3. Concealed surfaces:
  - a. Inside dumbwaiter, elevator and duct shafts, interstitial spaces, pipe basements, crawl spaces, pipe tunnels, above ceilings, attics, except as otherwise specified.
  - b. Inside walls or other spaces behind access doors or panels.
  - c. Surfaces concealed behind permanently installed casework and equipment.
- 4. Moving and operating parts:
  - a. Shafts, chains, gears, mechanical and electrical operators, linkages, and sprinkler heads, and sensing devices.
  - b. Tracks for overhead or coiling doors, shutters, and grilles.
- 5. Labels:
  - a. Code required label, such as Underwriters Laboratories Inc., Inchcape Testing Services, Inc., or Factory Mutual Research Corporation.
  - b. Identification plates, instruction plates, performance rating, and nomenclature.
- 6. Galvanized metal:
  - a. Exterior chain link fence and gates, corrugated metal areaways, and gratings.
  - b. Gas Storage Racks.
  - c. Except where specifically specified to be painted.
- 7. Metal safety treads and nosings.
- 8. Gaskets.
- 9. Concrete curbs, gutters, pavements, and interior walls in pits and basements.
- 10. Face brick.
- 11. Structural steel encased in concrete, masonry, or other enclosure.

### **3.11 IDENTITY PAINTING SCHEDULE**

- A. Identify designated service in accordance with ANSI A13.1, unless specified otherwise, on exposed piping, piping above removable ceilings,

piping in accessible pipe spaces, interstitial spaces, and piping behind access panels.

1. Legend may be identified using 2.1 G options or by stencil applications.
2. Apply legends adjacent to changes in direction, on branches, where pipes pass through walls or floors, adjacent to operating accessories such as valves, regulators, strainers and cleanouts a minimum of 12 000 mm (40 feet) apart on straight runs of piping. Identification next to plumbing fixtures is not required.
3. Locate Legends clearly visible from operating position.
4. Use arrow to indicate direction of flow.
5. Identify pipe contents with sufficient additional details such as temperature, pressure, and contents to identify possible hazard. Insert working pressure shown on drawings where asterisk appears for High, Medium, and Low Pressure designations as follows:
  - a. High Pressure - 414 kPa (60 psig) and above.
  - b. Medium Pressure - 104 to 413 kPa (15 to 59 psig).
  - c. Low Pressure - 103 kPa (14 psig) and below.
  - d. Add Fuel oil grade numbers.
6. Legend name in full or in abbreviated form as follows:

PIPING	COLOR OF EXPOSED PIPING	COLOR OF BACKGROUND	COLOR OF LETTERS	LEGEND BBREVIATIONS
Blow-off		Yellow	Black	Blow-off
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Drain Line		Green	White	Drain
Gravity Condensate Return		Yellow	Black	Gravity Cond Ret
Fuel Oil - Grade		Brown	White	Fuel Oil-Grade __*
(Diesel Fuel included under Fuel Oil)				
Pumped Condensate		Black		Pump Cond
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent
Cold Water (Domestic)	White	Green	White	C.W. Dom
Hot Water (Domestic)				
Supply	White	Yellow	Black	H.W. Dom
Return	White	Yellow	Black	H.W. Dom Ret
Tempered Water	White	Yellow	Black	Temp. Wtr

Sanitary Waste	Green	White	San Waste
Sanitary Vent	Green	White	San Vent
Storm Drainage	Green	White	St Drain
Fire Protection Water			
Sprinkler	Red	White	Auto Spr
Standpipe	Red	White	Stand
Sprinkler	Red	White	Drain

7. See Sections for methods of identification, legends, and abbreviations of the following:

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 64 mm (2 1/2 inches) high.
2. Stenciled message: "SMOKE BARRIER" or, "FIRE BARRIER" as applicable.
3. Locate not more than 6100 mm (20 feet) on center on corridor sides of partitions, and with a least one message per room on room side of partition.
4. Use semigloss paint of color that contrasts with color of substrate.

C. Identify columns in pipe basements and interstitial space:

1. Apply stenciled number and letters to correspond with grid numbering and lettering shown.
2. Paint numbers and letters 100 mm (4 inches) high, locate 450 mm (18 inches) below overhead structural slab.
3. Apply on four sides of interior columns and on inside face only of exterior wall columns.
4. Color:
  - a. Use black on concrete columns.
  - b. Use white or contrasting color on steel columns.

**3.12 PROTECTION CLEAN UP, AND TOUCH-UP**

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

**APPENDIX**

Coordinate the following abbreviations used in Section 09 91 00, PAINTING, with other Sections, especially Section 09 06 00, SCHEDULE FOR FINISHES and other COATING SECTIONS listed. Use the same abbreviation and terms consistently.

Paint or coating    Abbreviation

Acrylic Emulsion    AE (MPI 10 - flat/MPI 11 - semigloss/MPI 119 - gloss)

Alkyd Flat    Ak (MPI 49)

Alkyd Gloss Enamel    G (MPI 48)

Alkyd Semigloss Enamel    SG (MPI 47)

Aluminum Paint    AP (MPI 1)

Cementitious Paint    CEP (TT-P-1411)

Exterior Latex    EL (MPI 10 / 11 / 119)

Exterior Oil    EO (MPI 9 - gloss/MPI 8 - flat/MPI 94 - semigloss)

Epoxy Coating    EC (MPI 77 - walls, floors/MPI 108 - CMU, concrete)

Fire Retardant Paint    FR (MPI 67)

Fire Retardant Coating (Clear)    FC (MPI 66, intumescent type)

Floor Enamel    FE (MPI 27 - gloss/MPI 59 - eggshell)

Heat Resistant Paint    HR (MPI 22)

Latex Emulsion    LE (MPI 53, flat/MPI 52, eggshell/MPI 54, semigloss/MPI 114, gloss Level 6

Latex Flat    LF (MPI 138)

Latex Gloss    LG (MPI 114)

Latex Semigloss    SG (MPI 141)

Latex Low Luster    LL (MPI 139)

Plastic Floor Coating    PL

Polyurethane Varnish    PV (MPI 31 - gloss/MPI 71 - flat)

Rubber Paint    RF (CID-A-A-3120 - Paint for Swimming Pools (RF)).

Water Paint, Cement    WPC (CID-A-A-1555 - Water Paint, Powder).

Wood Stain    WS (MPI 90)

Verify abbreviations used in the following coating sections:

Section 09 96 59, HIGH-BUILD GLAZED COATINGS    GC

Section 09 94 19, MULTICOLOR INTERIOR FINISHING    MC

- - - E N D - - -

**SECTION 10 14 10**

**SIGNAGE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies interior signage for room numbers, directional signs, code required signs, telephone identification signs and temporary interior signs.
- B. This section also specifies exterior medical center identification signs, building identification signs, parking and traffic signs.
- C. Installation of Government furnished dedication plaque and VA seal.

**1.2 RELATED WORK**

- A. Electrical: Related Electrical Specification Sections.
- B. Lighted EXIT signs for egress purposes are specified under Division 26, ELECTRICAL.
- C. Section 10 13 00, DIRECTORIES and Section 10 14 00, SIGNAGE.
- D. Color Finish: Section 09 06 00, SCHEDULE FOR FINISHES.

**1.3 MANUFACTURER'S QUALIFICATIONS**

- A. Sign manufacturer shall provide evidence that they regularly and presently manufactures signs similar to those specified in this section as one of their principal products.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 01 33 00, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Samples: Sign panels and frames, with letters and symbols, each type. Submit 2 sets. One set of samples will be retained by Owner, other returned to Contractor.
  - 1. Sign Panel, 200 mm x 250 mm (8 inches x 10 inches), with letters.
  - 2. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.
  - 3. Sample of typeface, arrow and symbols in a typical full size layout.
- C. Manufacturer's Literature:
  - 1. Showing the methods and procedures proposed for the concealed anchorage of the signage system to each surface type.
  - 2. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.
- D. Samples: Sign location plan, showing location, type and total number of signs required.
- E. Shop Drawings: Scaled for manufacture and fabrication of sign types. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes.
- F. Full size layout patterns for dimensional letters.

### 1.5 DELIVERY AND STORAGE

- A. Deliver materials to job in manufacturer's original sealed containers with brand name marked thereon. Protect materials from damage.
- B. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- C. Deliver signs only when the site and mounting services are ready for installation work to proceed.
- D. Store products in dry condition inside enclosed facilities.

### 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 the basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate
  - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and tubes.
- C. Federal Specifications (Fed Spec):
  - MIL-PRF-8184F.....Plastic Sheet, Acrylic, Modified.
  - MIL-P-46144C.....Plastic Sheet, Polycarbonate

### 1.7 MINIMUM SIGN REQUIREMENTS

- A. Permanent Rooms and Spaces:
  - 1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
  - 2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
  - 3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
  - 4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
  - 5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
  - 6. Mounting Location and Height: As shown. Mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.
- B. Overhead Signs:
  - 1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and 1:1. Characters shall have a stroke width-to-height ratio of between 1:5 and 1:10.
  - 2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
  - 3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
  - 4. Mounting Location and Height: As shown.

### 1.8 COLORS AND FINISHES:

- A. Section 09 06 00, SCHEDULE FOR FINISHES.



## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Signs of type, size and design shown on the drawings and as specified.
- B. Signs complete with lettering, framing and related components for a complete installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Engineer to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

### **2.2 PRODUCTS**

- A. Aluminum:
  - 1. Sheet and Plate: ASTM B209.
  - 2. Extrusions and Tubing: ASTM B221.
- B. Cast Acrylic Sheet: MIL-PRF-8184F; Type II, class 1, Water white non-glare optically clear. Matt finish water white clear acrylic shall not be acceptable.
- C. Polycarbonate: MIL-P-46144C; Type I, class 1.
- D. Vinyl: 0.1 mm thick machine cut, having a pressure sensitive adhesive and integral colors.
- E. Electrical Signs:
  - 1. General: Furnish and install all lighting, electrical components, fixtures and lamps ready for use in accordance with the sign type drawings, details and specifications.
  - 2. Refer to Electrical Specifications Section, Division 26, ELECTRICAL, to verify line voltages for sign locations that require electrical signs.
  - 3. Quality Control: Installed electrical components and sign installations are to bear the label and certification of Underwriter's Laboratories, Inc., and are to comply with National Electrical Code as well as applicable federal, state and local codes for installation techniques, fabrication methods and general product safety.
  - 4. Ballast and Lighting Fixtures: See Electrical Specifications.
- F. Concrete Post Footings: See Section 03 30 53, MISCELLANEOUS CAST-IN-PLACE CONCRETE, Cast-in-place Concrete.
- G. Steel: See Section 05 12 00, STRUCTURAL STEEL FRAMING.

## 2.3 SIGN STANDARDS

### A. Typography:

1. Type Style: Helvetica Medium and Helvetica Medium Condensed. Initial caps or all caps as indicated in Sign Message Schedule.
2. Arrow: See graphic standards in drawings.
3. Letter spacing: See graphic standards on drawings.
4. Letter spacing: See graphic standards on drawings.
5. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only; final text for signs is listed in Sign Message Schedule.

### B. Project Colors and Finishes: See Section 09 06 00, SCHEDULE FOR FINISHES.

## 2.4 SIGN TYPES

### A. General:

1. The interior sign system is comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
  - a. IN indicates a component construction based sign.
    1. The exterior sign system shall be comprised of sign types families that are identified by a letter and number which identify a particular group of signs. An additional number identifies a specific type of sign within that family.
    2. EI designation indicates exterior internally illuminated sign.
    3. EN designation indicates exterior non-illuminated sign.

### B. Interchangeable Component System:

1. Sign Type Families: 03, 04, 05, 06, 07, 08, 09 10, 11 12, 13, 14, 15, 16 and 17.
2. Interior sign system capable of being arranged in a variety of configurations with a minimum of attachments, devices and connectors.
  - a. Interchangeable nature of the system shall allow for changes of graphic components of the installed sign, without changing sign in its entirety.
  - b. Component Sign System is comprised of the following primary components:
    - 1) Rail Back utilizing horizontal rails, spaced to allow for uniform, modular sizing of sign types.
    - 2) Rail Insert mounted to back of Copy Panels to allow for attachment to Rail Back.
    - 3) Copy Panels, made of a variety of materials to allow for different graphic needs.
    - 4) End Caps which interlock to Rail Back to enclose and secure changeable Copy Panels.
    - 5) Joiners and Accent Joiners connect separate Rail Backs together.
    - 6) Top Accent Bars which provide decorative trim cap that encloses the top of sign or can connect the sign to a Type 03 Room Number Sign.

- c. Rail Back, Rail Insert and End Caps in anodized extruded aluminum to allow for tight tolerances and consistent quality of fit and finish.
  - d. Signs in system shall be convertible in the field to allow for enlargement from one size to another in height and width through use of Joiners or Accent Joiners, which connect Rail Back panels together blindly, providing a butt joint between Copy Panels. Accent Joiners shall connect Rail Backs together with a visible 3 mm (1/8") horizontal rib, flush to the adjacent copy insert surfaces.
  - e. Sign configurations shall vary in width from 225 mm (9 inches) to 2050 mm (80 inches), and have height dimensions of 50 mm (2 inches), 75 mm (3 inches), 150 mm (6 inches), 225 mm (9 inches) and 300 mm (12 inches). Height shall be increased beyond 300 mm (12 inches), by repeating height module in full or in part.
3. Rail Back functions as internal structural member of sign using 6063T5 extruded aluminum and anodized black.
- a. Shall accept an extruded aluminum or plastic insert on one sign or on both sides, depending upon sign type.
  - b. Shall be convertible in field to allow for connection to other Rail Back panels, so that additive changes can be made to sign unit.
  - c. Rail shall allow for a variety of mounting devices including wall mounting for screw-on applications, using pressure sensitive tape, freestanding mount, ceiling mount and other mounting devices as needed.
4. Rail Insert functions as a mounting device for Copy Panels on to the Rail Back. The Rail Insert mounts to the back of the Copy Panel with adhesive suitable for use with the particular copy insert material.
- a. Shall allow Copy Panels to slide or snap into the horizontal Rail Back for ease of changeability.
  - b. Shall mount to the back of the Copy Panel with adhesive suitable for use with particular Copy Panel material.
5. Copy Panels shall accept various forms of copy and graphics, and attaches to the Rail Back with the Rail Insert. Copy Panels shall be either ABS plastic with integral color or an acrylic lacquer finish; photo polymer; or, acrylic.
- a. Interchangeable by sliding horizontally from either side of sign, and to other signs in system of equal or greater width or height.
  - b. Cleanable without use of special chemicals or cleaning solutions.
  - c. Copy Insert Materials.
    - 1) ABS Inserts - 2.3 mm (.090 inches) extruded ABS plastic core with .07 mm (.003 inches) acrylic cap bonded during extrusion/texturing process. Pressure bonded to extruded Rail Insert using adhesive. Background color is either integral or painted in acrylic lacquer. ABS inserts finished in a chromium industries #HM335RA texture pattern to prevent glare.
    - 2) Photo polymer Inserts - 3 mm (.125 inches) phenolic photo polymer with raised copy etched to 2.3 mm (.0937 inches), bonded to an ABS plastic or extruded aluminum insert with adhesive. Background color is painted in acrylic enamel.
    - 3) Changeable Paper/ Insert Holder - Extruded insert holder with integral Rail Insert for connection with structural back panel in 6063T5 aluminum with a black anodized finish. Inserts into

holder are paper with a clear 0.7 mm (.030 inches) textured cover. Background color is painted in acrylic lacquer.

- 4) Acrylic - 2 mm (.080 inches) non-glare acrylic. Pressure bonded to extruded Rail Insert using adhesive. Background color is painted in acrylic lacquer or acrylic enamel.
- 5) Extruded 6063T5 aluminum with a black anodized finish Insert Holder with integral Rail Insert for connection with Structural Back Panel to hold a 0.7 mm (.030 inches) textured polycarbonate insert and a Sliding Tile which mounts in the Inset Holder and slides horizontally.
- 6) End Caps - Extruded using 6063T5 aluminum with a black anodized. End Caps interlock with Rail Back with clips to form an integral unit, enclosing and securing the changeable Copy Panels, without requiring tools for assembly.
  - a) Shall be interchangeable to either end of sign and to other signs in the system of equal height.
  - b) Mechanical fasteners can be added to the End Caps that will secure it to Rail Back to make sign tamper resistant.
- 7) Joiners - Extruded using 6063T5 aluminum with a black anodized finish. Rail Joiners connect Rail Backs together blindly, providing a butt joint between Copy Inserts.
- 8) Accent Joiners - Extruded using 6063T5 aluminum with a mirror polished finish. Joiner shall connect Rail Backs together with a visible 3 mm (.125 inches) horizontal rib, flush to the adjacent Copy Panel surfaces.
- 9) Top Accent Rail - Extruded using 6063T5 aluminum with a mirror polished finish. Rail shall provide 3 mm (.125 inches) high decorative trim cap, which butts flush to adjacent Copy Panel and encloses top of Rail Back and Copy Panel.
- 10) Typography
  - a) Vinyl First Surface Copy (non-tactile) - Applied Vinyl copy.
  - b) Subsurface Copy Inserts - Textured 1 mm (.030 inches) clear polycarbonate face with subsurface applied Vinyl copy. Face shall be back sprayed with paint and laminated to an extruded aluminum carrier insert.
  - c) Integral Tactile Copy Inserts - phenolic photo polymer etched with 2.3 mm (.0937 inches) raised copy.
  - d) Silk-screened First Surface Copy (non-tactile) - Injection molded or extruded ABS plastic or aluminum insert with first surface applied enamel silk-screened copy.

SPEC. WRITER NOTE: Delete sign types and sign families that are not being used on the project.

C. Sign Type Family 01, 02.01 thru 02.05, 08, 09 and 20:

1. All text and graphics are to be first surface silk-screened.
2. IN-01.12 & IN-01.13: Refer to Sign Type 03 specification for tactile and Braille portion of sign.
3. IN-02.4: All text and graphics are to be first surface vinyl letters.
4. IN-01.1: Preparation of artwork for reproduction of "fire and emergency evacuation maps" is by manufacturer.

D. Sign Type Families 03:

1. Tactile sign is to be made from a material that provides for letters, numbers and Braille to be integral with sign plaque material such as:

photosensitive polyamide resin, etched metal, sandblasted phenolic or embossed material. Do not apply letters, numbers and Braille with adhesive.

2. Numbers, letters and Braille to be raised 0.793 mm (.0312 inches) from the background surface. The draft of the letters, numbers and Braille to be tapered, vertical and clean.
3. Braille dots are to conform with standard dimensions for literary Braille; (a) Dot base diameter: 1.5 mm (.059 inches) (b) Inter-dot spacing: 2.3 mm (.090 inches) (c) Horizontal separation between cells: 6.0 mm (.241 inches) (d) Vertical separation between cells: 10.0 mm (.395 inches)
4. Entire assembly is painted in specified color. After painting, apply white or other specified color to surface of the numbers and letters. Entire sign is to have a protective clear coat sealant applied.
5. Complete sign is to have an eggshell finish (11 to 19 degree on a 60 degree glossmeter).

E. Sign Type Family 04 and 11:

1. All text and graphics are to be first surface applied vinyl letters.
2. IN-04: When a Type IN-04 is to be mounted under a Type IN03, a connecting Accent Joiner is to be used to create a singular integrated sign.

F. Sign Type 05:

1. Text if added to Copy Insert module to be first surface applied vinyl letters.

G. Sign Type Family 06 and 07:

1. All text and graphics are to be first surface applied vinyl letters except for under sliding tile.
2. Protect text, which is covered by sliding tile, so tile does not wear away letters.

H. Sign Type Family 10:

1. Pocket depth is to be 0.3 mm (.0150 inches).

I. Sign Type Family 12 and 13:

1. All text and graphics are to be first surface applied vinyl letters.
2. IN-12: Provide felt, cork or similar material on bottom of desk mounting bracket to protect counter surfaces.

J. Sign Type Family 14, 15, and 16:

1. All text and graphics are to be first surface applied vinyl letters.
2. IN-14.06: When added to top of IN-14.01, IN-14.04, or IN-14.05 a connecting Accent Joiner is to be used to create a singular integrated sign.
3. Ceiling mounted signs required mounting hardware on the sign that allows for sign disconnection, removal and reinstallation and reconnection.

K. Sign Type Family 17:

1. All text and graphics are to be first surface applied vinyl letters.
2. IN-17: Directory constructed using elements of the Component System.

L. Sign Type Family 18:

1. All text and graphics are to be first surface applied stylus cut vinyl letters.
2. Provide in specified typeface, color and spacing, with each message or message group on a single quick release backing sheet.

M. Sign Type Family 19:

1. Dimensional letters are mill or laser cut acrylic in the size and thickness noted in the drawings.
2. Draft of letters is perpendicular to letters face.

3. All corners such as where a letter stem and bar intersect are to be square so the letter form is accurately reproduced.
4. Paint letters with acrylic polyurethane in specified color and finish.

N. Sign Type Family (See Specialty Signs Section) 21:

1. IN-21.01: 57 mm (2.25 inches) polished aluminum tube mounted to weighted 356 mm (14 inches) diameter polished aluminum base. Sign bracket to hold a 6 mm (.25 inches) sign plaque.
2. IN-21.02: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted polished 57 mm (2.25 inches) aluminum tubular base. Rail Back mechanically connected to vertical supports with Copy Panel attached to front and back.
3. IN-21.03 & 21.04: IN-21.02: 57 mm (2.25 inches) polished aluminum tube vertical support mounted to a weighted polished 57 mm (2.25 inches) aluminum tubular base. Rail Back mechanically connected to vertical supports with hinged locking glass door. Black felt covered changeable letter board or tan vinyl impregnated cork tack surface as background within case.

O. Sign Type Family 22:

1. IN-22.01: Extruded aluminum clip anodized black containing rollers to pinch and release paper. End caps are black plastic.
2. IN-22.02: Patient Information holder constructed of 18 gauge formed sheet metal painted in specified color. Polished aluminum connecting rods and buttons. Button covers for mounting screws are to permanently attach and securely conceal screws.

P. Temporary Interior Signs:

1. Fabricated from 50 kg (110 pound) matte finished white paper cut to 100 mm (4 inch) wide by 300 mm (12 inch) long. Punched 3 mm (.125 inch) hole with edge of hole spaced 13 mm (.5 inch) in from edge and centered on 100 mm (4 inch) side. Reinforce hole on both sides with suitable material that prevents tie from pulling through hole. Ties are steel wire 0.3 mm (0.120 inch) thick attached to tag with twist leaving 150 mm (6 inch) long free ends.
2. Mark architectural room number on sign, with broad felt marker in clearly legible numbers or letters that identify room, corridor or space as shown on floor plans.
3. Install temporary signs to all rooms that have a room, corridor or space number. Attach to door frame, door knob or door pull.
  - a. Doors that do not require signs are: corridor doors in corridor with same number, folding doors or partitions, toilet doors, bathroom doors within and between rooms, closet doors within rooms, communicating doors in partitions between rooms with corridor entrance doors.
  - b. Replace and missing damaged or illegible signs.

Q. LED Message Signs - "Spaces Available" Signs

1. Furnish and install an exterior exposure, high intensity LED sign with spaces available messages at the locations indicated on the Drawings.
2. The equipment will be on-line to a central parking facility management computer located at the security station near the ED. The facility signage software on this computer shall control the status of each sign.
3. Signs shall be programmable to provide facility counts as required for each level.

4. Signs shall provide available spaces for each level and parking structure as required by the owner and as shown on the drawings.
5. The sign shall have the following characteristics:
  - a. Bright color for maximum visibility.
  - b. Clearly visible in bright, direct sunlight.
  - c. Minimum 55 degree viewing angle.
6. Sign housing/cabinet is to be constructed of heavy-gauge aluminum for corrosion resistance; spot welded together, and painted flat black.
7. Detector loops, conduit and relays will be used to connect signage to the computer.
8. Provide 110V power for each sign.
9. Installer shall provide all wiring, loops, sensors, and materials necessary for the functionality of each sign.

## 2.5 FABRICATION

- A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.
- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members be true. Assembled so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces be smooth flat and without oil-canning, free of rack and twist. Maximum variation from plane of surface plus or minus 0.3 mm (0.015 inches). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth sulrfaces.
- G. Extruded members to be free from extrusion marks. Square turns and corners sharp, curves true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. Finish hollow signs with matching material on all faces, tops, bottoms and ends. Edge joints tightly mitered to give appearance of solid material.
- J. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, foreign matter and other imperfections.
- K. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding or deformation of members. Doors and covers centered in opening or frame. All contact surfaces fit tight and even without forcing or warping components.
- L. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

- M. No signs are to be manufactured until final sign messages and locations have been approved by the Engineer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Protect products against damage during field handling and installation. Protect adjacent existing and newly placed construction, landscaping and finishes as necessary to prevent damage during installation. Paint and touch up any exposed fasteners and connecting hardware to match color and finish of surrounding surface.
- B. Mount signs in proper alignment, level and plumb according to the sign location plan and the dimensions given on elevation and sign location drawings. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, coordinate with the Engineer.
- C. Contractor shall be responsible for all signs that are damaged, lost or stolen while materials are on the job site and up until the completion and final acceptance of the job.
- D. Remove or correct signs or installation work that is unsafe or unacceptable, as required by the Engineer, Architect, or Owner.
- E. At completion of sign installation, clean exposed sign surfaces. Clean and repair any adjoining surfaces and landscaping that became soiled or damaged as a result of installation of signs.
- F. Locate signs as shown on the Sign Location Plans.
- G. Certain signs may be installed on glass. A blank glass back up is required to be placed on opposite side of glass exactly behind sign being installed. This blank glass back up is to be the same size as sign being installed.
- H. Contractor will be responsible for verifying that behind each sign location there are no utility lines that will be affected by installation of signs. Any damage during installation of signs to utilities will be the sole responsibility of the Contractor to correct and repair.
- I. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings,



H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

templates, instructions and directions for installation of anchorage  
devices which may involve other trades.

---END---

**SECTION 10 44 13**  
**FIRE EXTINGUISHER CABINETS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section covers recessed fire extinguisher cabinets.

**1.2 RELATED WORK**

- A. Acrylic glazing: Section 08 80 00, GLAZING.
- B. Field Painting: Section 09 91 00, PAINTING.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Fire extinguisher cabinet including installation instruction and rough opening required.

**1.4 APPLICATION 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 Testing and Materials (ASTM):  
D4802-10.....Poly (Methyl Methacrylate) Acrylic Plastic Sheet

**PART 2 - PRODUCTS**

**2.1 FIRE EXTINGUISHER CABINET**

Surface mounted type with concealed fasteners, painted red, 12" wide, 8" deep and 30" tall, or similar standard size.

**2.2 FABRICATION**

- A. Form body of cabinet from 0.9 mm (0.0359 inch) thick sheet steel.
- B. Fabricate door and trim from 1.2 mm (0.0478 inch) thick sheet steel with all face joints fully welded and ground smooth.
  - 1. Glaze doors with 6 mm (1/4 inch) thick ASTM D4802, clear acrylic sheet, Category B-1, Finish 1.
  - 2. Design doors to open 180 degrees.
  - 3. Provide continuous hinge, pull handle, and adjustable roller catch.

**2.3 FINISH**

- A. Finish interior of cabinet body with baked-on semigloss white enamel.
- B. Finish door, frame with manufacturer's standard baked-on prime coat suitable for field painting.

**PART 3 - EXECUTION**

- A. Install fire extinguisher cabinets in prepared openings and secure in accordance with manufacturer's instructions.

- B. Install cabinet so that bottom of cabinet is 975 mm (39 inches) above finished floor.

- - - E N D - - -

**SECTION 11 05 12**  
**GENERAL MOTOR REQUIREMENTS FOR EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies the furnishing, installation and connection of motors.

**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 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. Other sections specifying motor driven equipment in Divisions 11 and 14.

**1.3 SUBMITTALS:**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, materials, horsepower, 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 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 Resident Engineer:
  - 1. Certification that the motors have been properly applied, installed, adjusted, lubricated, and tested.

**1.4 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 Electrical Manufacturers Association (NEMA):
  - MG 1-09(R2010).....Motors and Generators

MG 2-01(R2007).....Safety Standard and Guide for Selection,  
Installation and Use of Electric Motors and  
Generators

C. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

## **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. 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: 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: Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.
- C. 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.
- D. Horsepower ratings shall be adequate for operating the connected loads continuously in the prevailing ambient temperatures in areas where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

- E. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.
- F. Motor Enclosures:
1. Shall be the NEMA types shown on the drawings for the motors.
  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.
  3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.
- G. Additional requirements for specific motors, as indicated in other sections, shall also apply.
- H. Energy-Efficient Motors (Motor Efficiencies): All permanently wired polyphase motors of 746 Watts or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. 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.

Minimum Efficiencies Open Drip-Proof				Minimum 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%

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

J. Premium efficiency motors shall be used where energy cost/kW x (hours use/year) > 50.

### **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**

Megger all motors after installation, before start-up. All shall test free from grounds.

- - - E N D - - -

**SECTION 11 12 00**  
**PARKING CONTROL EQUIPMENT**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The work of this Section shall include furnishing all material, equipment, labor, and supervision to install in place a fully-operating Parking Occupancy Count System and Access Control Gates, as specified herein and/or indicated on the Drawings. Included will be supply, delivery, unloading, setting, anchoring, control wiring installation, wiring termination, and start-up of all system equipment.
- B. System Description:
1. Parking Occupancy Count System: System shall maintain total facility differential count and differential count for each level of the garage. Net "Spaces Available" for each level shall be displayed on a variable message sign located near the primary vehicle entry. Counting system shall utilize loops at the entry/exit lanes and interior garage locations on each level to determine the occupancy required for the variable message signage.
  2. Access Control Gates: Barrier gates at vehicle entry and exit lanes on Level 1 to enable VA security forces to block access to the garage, as necessary. Gates shall be raised and lowered remotely from the security desk in the hospital.
  3. A programmable keypad and intercom shall be located at the entry lane for Lane #5. When an emergency vehicle is present and a valid entry code is used, the entry gates shall open in the "UP" position. Upon exiting the entry lane and after a vehicle passes over the closing loop the barrier gate shall automatically close in the down position.
  4. Two-way communication for the intercom system shall be wired and connected to the master station located at security desk in the hospital.

**1.2 RELATED WORK**

- A. The following Work is related to this Section:
1. Alternates, Section 01 23 00
  2. Shop Drawings, Product Data, and Samples, Section 01 33 23
  3. Cast-in-Place Concrete, Section 03 30 00
  4. Precast Concrete, Section 03 40 00
  5. Signage, Section 10 14 10
  6. Electrical, Division 26



- B. The electrical Subcontractor shall furnish and install all conduit and power wiring in proper size and location to the parking control equipment and empty conduit for control wiring as required.
- C. Manufacturer of the Parking Control System shall provide those responsible for related work with:
  - 1. Installation diagrams and details for setting indoor and outdoor mounted equipment.
  - 2. Templates for setting indoor and outdoor mounted equipment.
  - 3. Templates and cast-in inserts to anchor freestanding equipment to curbs and bases.
  - 4. Electrical wiring diagrams and details.
  - 5. Electrical installation requirements.
  - 6. Electrical power requirements.

### **1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the materials conform to the requirements specified.
- B. Submit Shop Drawings for review and approval. Included are equipment wiring diagrams, equipment cut sheets and specifications, and equipment color charts.
- C. Upon request submit for review and approval the names, locations, contacts, and telephone numbers for the five most recently installed completed projects.
- D. Submit for record 30 days prior to installing the Parking Count System Equipment, procedures for testing electrical, mechanical, and program functions of the system.
- E. Provide the Owner with two final copies of each of the following:
  - 1. Maintenance Manual
  - 2. Operating Manual
  - 3. Equipment electrical circuitry diagram
  - 4. As built equipment wiring diagram

### **1.4 TRANSPORTATION AND HANDLING**

- A. Deliver equipment to the site packaged to prevent damage and marked for easy identification.
- B. Store equipment in a clean, dry location protected from damage. Replace damaged materials at no cost to the Owner.
- C. Deliver items required to be built into the concrete promptly to the site so they may be built in as the work progresses.

### **1.5 OPERATING CONDITIONS**

- A. Equipment shall be designed, fabricated, and installed to operate effectively under the climate and exposure conditions for the recorded weather extremes for the equipment location.
- B. It is recognized that certain solid state and computer based parking and revenue control equipment may require special electrical power and grounding considerations. If required by the parking count system equipment, the Manufacturer of the Parking Occupancy Count System shall:
  - 1. Include in the bid amount the cost to provide and install voltage stabilization modules or devices to protect each component from normal voltage variations.
  - 2. Advise the Engineer in writing at the time of the award of contract of any special electrical power, uninterruptible power supplies, and grounding requirements.

### **1.6 WARRANTY**

- A. Provide Manufacturer's Warranty.
- B. Warranty shall be for one year covering all labor and materials.
  - 1. Warranty shall commence when equipment is 100 percent operational and acceptable to the Owner, as approved in writing by the Owner and Engineer.
  - 2. Maintain equipment operational during the warranty period such that, if defective, equipment shall be serviced within eight business hours, following notification by the Owner. Business hours are 8 a.m. to 5 p.m. Monday through Friday, excluding holidays.
  - 3. Warranty shall include preventative maintenance cleaning, testing, and minor repair no less than four times per year.
  - 4. Warranty shall cover all equipment furnished under this specification section - both manufacture and installation, excluding misuse or vandalism.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All equipment colors shall be standard Manufacturer colors except where specifically noted.
- B. All parking control equipment must be compatible with the electrical system as specified in Division 16 and shown on the Drawings.

### **2.2 EQUIPMENT LIST**

- A. The following equipment list consists of basic system components. Provide auxiliary items required for the proper functioning of the system, whether mentioned or not, including but not limited

to, heaters, coolers, wiring, transformers, relays, stands, housings, pedestals, etc. It is the SOLE RESPONSIBILITY of the Parking Control Equipment Subcontractor to provide every component necessary for a complete functioning system.

B. Locate equipment as indicated on the Drawings. Equipment List

1. Provide Parking Control Equipment for each lane as indicated:

Item		Total Required								Total
2.		A	B	C	D	E	F	G	Other	
1.	Gate with automatic safety reverse and 10' folding arm	1	1	1	1	1	1	1		7
2.	Digital self-tuning vehicle detector	2	2	2	2	2	2	2	12**	26
3.	Detector Loop - sawcut*	2	2	2	2	2	2	2	12**	26
4.	Occupancy Count Master Controller								1	1
5.	"Spaces Available" Sign								1	1
6.	Keypad w/post mount					1				1
7.	Intercom					1	1		1	1

Notes:

- \* Equipment manufacturer shall determine quantity, location, and dimension of detector loops.
- \*\* Combined total for bi-directional lanes for each level(4 per level) as required for the parking occupancy count system and variable message signage.

**2.3 GATES**

- A. The parking gate shall provide an effective barrier to vehicles in the entrance and exit lanes. The barrier arm shall retract quickly in a vertical plane on a command signal from the security desk and return to the lower position upon a signal from a security desk. The parking gate shall be installed as located on Drawings and shall incorporate in one housing all necessary components for the functioning of this unit. The assembly shall operate satisfactorily in the environmental conditions stated elsewhere in this specification.
- B. The unit shall be 10 foot arm of wood construction. The barrier arm shall be a break-away design that can be easily and inexpensively replaced when broken. The height of the gate arm or the extended portion of folding arms shall be approximately 36 inches from drive level in the DOWN position. Provide folding gate arms in areas with limited headroom. Gate arms shall have a minimum headroom clearance when in the open(UP)position of 8'-2" for the parking structure. Gate arms used for the emergency entry/exit lanes, shall have a minimum headroom clearance of 14'-

6" when in the open(UP) position. Straight(non-articulating)arm barriers of wood construction shall be acceptable for these designated lanes.

- C. The gate arm shall have a down-strike safety feature. Should any object be struck by the gate arm during its descent, the arm shall immediately reverse and return to the UP position without damage, and remain up from 2 to 60 seconds, until automatically reset by variable control. The sensory function shall be initiated by sensing the internal mechanical action. The external mounting of tubes, wiring, and electrical devices on the gate arm shall not be acceptable
- D. Gates shall be approved by Underwriters Laboratories, Inc. (UL)
- E. Acceptable Manufacturers include:
  - 1. 3M Traffic Safety and Security Division, Austin, TX
  - 2. Amano McGann, Roseville, MN.
  - 3. WPS Parking Systems, Rockville, MD.
  - 4. Skidata, Hillsborough, NJ.
  - 5. Or Approved Equivalent

#### **2.4 PARKING OCCUPANCY COUNT SYSTEM**

- A. Occupancy Count System shall maintain both differential counts, of all vehicular traffic in the facility. Directional logic shall be used to accurately count traffic regardless of directional flow through the counting points.
- B. The Count system shall maintain and provide the following counts:
  - 1. Facility Total Differential Count.
  - 2. Total Differential Count by Level.
- C. The Count system shall continually monitor the number of available spaces in the parking facility by level and control the signs informing patrons of the availability of parking spaces by level.
- D. Acceptable Manufacturers include:
  - 1. Signal Tech - Erie, PA.
  - 2. TCS International - Sudbury, MA.
  - 3. McCain, Inc. - Vista, CA.
  - 4. Or Approved Equivalent

#### **2.5 EMBEDDED LOOPS AND VEHICLE DETECTORS**

- A. The parking equipment detector loops shall be sawcut (maximum ¾" depth) into the slab-on-grade.

- B. Directional logic detection shall be provided for count system accuracy. Provide loops as required for directional detection and counting.
- C. Detectors shall be installed within NEMA housings mounted to walls or columns adjacent to counting locations.
- D. Contractor shall locate embedded reinforcement (post-tensioning tendons) and electrical conduit in the slab prior to saw-cutting for loop detectors. Contractor shall take all necessary precautions to prevent damage to reinforcement and conduit, and shall repair all damage caused by Contractor's work at no cost to the Owner.

## **2.6 INTERCOM SYSTEM**

- A. Intercom shall be mounted on gooseneck stands at the entry lane as indicated in the drawings, and shall include "Press for Assistance" engraved signs and push button operation.
- B. Installation of intercoms shall be ADA compliant.
- C. Intercoms shall be programmable for two-way communication.
- D. Intercoms shall have Ethernet/VOIP capability.
- E. Intercom system shall have an automatic redial feature and roaming feature to connect to the next available telephone number from a host of telephone numbers programmed for assistance.
- F. All wiring, routers, switches, and server components shall be included in the intercom system to allow for communication as indicated above.
- G. System shall provide control commands to "Open" and "Close" barrier gates from the master-station located at the security station in the hospital.
- H. Acceptable manufacturers are:
  - 1. Commend, Mahwah, NJ
  - 2. Viking, Hudson, WI
  - 3. Or Approved Equivalent

## **2.7 "SPACES AVAILABLE" SIGN**

- A. Refer to Specification Section 101410, Signage.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect setting surfaces, power wiring and conduit installation for equipment and report immediately in writing to the Engineer, as required in the General Conditions, any conditions of Related Work which are unsuitable for proper execution of this Work.

#### **3.2 INSTALLATION**

- A. Install Parking Occupancy Count System in accordance with Manufacturer's recommendations and the approved shop drawings. Also see Quality Control requirements.
- B. Installation shall be by factory-trained mechanics experienced in installation of equipment of this type.
- C. Provide and pull control wiring and make final connections of all wiring

#### **3.3 ADJUSTMENT AND SYSTEM START-UP**

- A. Adjust and tune the system as required to assure proper operation. After installation, test all functions of the Parking Occupancy Count System.
- B. Test the operation of all devices.
- C. Demonstrate the satisfactory electrical and functional performance of the entire parking control system by the following operations:
  - 1. The proper operation of the count control system, including directional counting feature.
  - 2. The proper operation of equipment to control "Spaces Available" signage. Refer to Specification Section 101410, Signage for additional information.
  - 3. Proper operation of the gate opening switches both remotely from the security desk and manually at the gate.
  - 4. Proper operation of the intercom system.
- D. Provide on-site instructions to Owner's personnel. Instructions shall include but not be limited to, programming the system, setting thresholds, use and operations of count system and differential counters. Coordinate instruction schedule with Owner.
- E. The Parking Occupancy Count System will be considered acceptable after being 100 percent operational and after having performed satisfactorily for fourteen (14) continuous business days with no down time.

---END---

**SECTION 14 24 00**  
**HYDRAULIC ELEVATORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the engineering, furnishing, and installation of the complete electric hydraulic elevator system as described herein and as indicated on the contract drawings.
- B. Items listed in the singular apply to each and every elevator in this specification except where noted.
- C. Passenger Elevators No. P-1, P-2 (Less P-2 when Deduct Alternate # 11 is accepted), shall be oil hydraulic type with microprocessor based control, single car selective collective automatic operation and power-operated. Provide single-speed side opening car and hoistway doors for P-1 and center opening car and hoistway doors for P-2 as indicated. Elevators shall have Class "A" loading.

**1.2 RELATED WORK**

- A. Section 01 33 23 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- B. Section 07 84 00, FIRESTOPPING: Sealing around penetrations to maintain the integrity of fire-rated construction.
- C. Glass Back frame and mullions: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- D. Glazing: Section 08 80 00, GLAZING.
- E. SECTION 09 06 00, SCHEDULE FOR FINISHES: As a master format for construction projects, to identify interior and exterior material finishes for type, texture, patterns, color and placement.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section.
- G. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low Voltage power and lighting wiring.
- 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.
- I. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for cables and wiring.

- J. Section 26 05 73, OVERCURRENT PROTECTIVE DEVICE STUDY: Requirements for installing the over-current protective devices to ensure proper equipment and personnel protection.
- K. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low voltage transformers.
- L. Section 26 24 16, PANELBOARDS: Low voltage panelboards.
- M. Section 26 51 00, INTERIOR LIGHTING: Fixture and ballast type for interior lighting.
- N. VA Barrier Free Design Handbook (H-18-13)

### **1.3 QUALIFICATIONS**

- A. Approval by the Contracting Officer is required for products or services of proposed manufacturers, suppliers and installers and shall be contingent upon submission by Contractor of a certificate stating the following:
  - 1. Elevator contractor is currently and regularly engaged in the installation of elevator equipment as one of his principal products.
  - 2. Elevator contractor shall have three years of successful experience, trained supervisory personnel, and facilities to install elevator equipment specified herein.
  - 3. The installers shall be Certified Elevator Mechanics with technical qualifications of at least five years of successful experience and Apprentices actively pursuing certified status.
  - 4. Elevator contractor shall submit a list of three or more prior installations where all the elevator equipment he/she proposes to furnish for this project functioned satisfactorily to serve varying traffic and material handling demands. Provide a list of parking garages/facilities that have the equipment in operation for two years preceding the date of this specification. Provide the names and addresses of the facilities and the names and telephone numbers of the Owners/Administrators.
- B. Approval of Elevator Contractor's equipment will be contingent upon coordinating inclusion of the new elevators with the Medical Center's current elevator maintenance service provider after the contract standard 1-year warranty period. The Contractor Shall coordinate inclusion efforts and communications with the COR prior to installation.
- C. Approval requires certification that the quantity and quality of replacement parts stock is sufficient to warranty continued operation



of the elevator installation for an estimated 15 years (industry standard).

- D. Approval will not be given to elevator contractors and manufacturers who have established on prior projects, either government, municipal, or commercial, a record for unsatisfactory elevator installations, have failed to complete awarded contracts within the contract period, and does not have the requisite record of satisfactorily performing elevator installations of similar type and magnitude.
- D. Manufacturers of equipment which include components made by others shall assume complete responsibility for the final assembled unit.
  - 1. Individual components of assembled units shall be products of the same manufacturers.
  - 2. Parts which are alike shall be the product of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
- E. The Contractor shall provide and install only those types of safety devices that have been subjected to tests witnessed and certified compliant with ANSI/ASME A17.1, except where codes having legal jurisdiction include more rigid requirements or conflict with ANSI/ASME A17.1.
- F. Welding at the project site shall be made by welders and welding operators who have previously qualified by test as prescribed in American Welding Society Publications AWS D1.1 to perform the type of work required. VAMC shall require welding certificates be submitted for all workers employed in this capacity. A welding or hot work permit is required for each day and shall be obtained from the COR (Contracting Officer's Representative) of safety department. Request permit one day in advance.

#### **1.4 APPLICABLE PUBLICATIONS**

- A. The publications listed below form a part of this specification. Elevator installation shall meet the requirements of the latest editions published and adopted by the United States Department of Veterans Affairs on the date contract is signed.
- B. Federal Specifications (Fed. Spec.):
  - J-C-30B.....Cable and Wire, Electrical (Power, Fixed Installation)

- W-C-596F.....Connector, Plug, Electrical; Connector,  
Receptacle, Electrical
- W-F-406E.....Fittings for Cable, Power, Electrical and  
Conduit, Metal, Flexible
- HH-I-558C.....Insulation, Blankets, Thermal (Mineral Fiber,  
Industrial Type)
- W-F-408E.....Fittings for Conduit, Metal, Rigid (Thick- Wall  
and Thin-wall (EMT) Type)
- RR-W-410.....Wire Rope and Strand
- TT-E-489J.....Enamel, Alkyd, Gloss, Low VOC Content
- QQ-S-766 .....Steel, Stainless and Heat Resisting, Alloys,  
Plate, Sheet and Strip
- C. International Building Code (IBC)
- D. American Society of Mechanical Engineers (ASME):
- A17.1.....Safety Code for Elevators and Escalators
- A17.2.....Inspectors Manual for Electric Elevators and  
Escalators
- E. National Fire Protection Association:
- NFPA 13.....Standard for the Installation of Sprinkler Systems
- NFPA 70.....National Electrical Code (NEC)
- NFPA 72.....National Fire Alarm and Signaling Code
- NFPA 101.....Life Safety Code
- NFPA 252.....Fire Test of Door Assemblies
- F. American Society for Testing and Materials (ASTM):
- A1008/A1008M-09.....Steel, Sheet, Cold Rolled, Carbon, Structural,  
High-Strength Low-Alloy and High Strength Low-  
Alloy with Improved Formability
- E1042-02.....Acoustically Absorptive Materials Applied by  
Trowel or Spray
- G. Manufacturer's Standardization Society of the Valve and Fittings  
Industry (MSS):
- SP-58.....Pipe Hangers and Supports
- H. Society of Automotive Engineers, Inc. (SAE)
- J517-91.....Hydraulic Hose, Standard
- I. Gages:
- For Sheet and Plate: U.S. Standard (USS)
- For Wires: American Wire Gauge (AWG)

J. American Welding Society (AWS):

D1.1.....Structured Welding Code - Steel

K. National Electrical Manufacturers Association (NEMA):

LD-3.....High-Pressure Decorative Laminates

L. Underwriter's Laboratories (UL):

486A.....Safety Wire Connectors for Copper Conductors

797.....Safety Electrical Metallic Tubing

M. Institute of Electrical and Electronic Engineers (IEEE)

N. Regulatory Standards:

Uniform Federal Accessibility Standards

Americans with Disabilities Act

**1.5 SUBMITTALS**

A. Submit in accordance with Specification Section 01 33 23, SHOP

DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Before execution of work, furnish information to evidence full compliance with contract requirements for proposed items. Such information shall include, as required: Manufacturer's Name, Trade Names, Model or Catalog Number, Nameplate Data (size, capacity, and rating) and corresponding specification reference (Federal or project specification number and paragraph). All submitted drawings and related elevator material shall be forwarded to the Contracting Officer.

C. Shop Drawings:

1. Complete scaled and dimensioned layout in plan and section view showing the arrangement of equipment and all details of each and every elevator unit specified including:

a. Complete layout showing location of storage tank/pump assembly, controller, piping layout, outside diameter of cylinder/plunger assembly, size of car platform, car frame members, and support assembly.

b. Car, guide rails, brackets, buffers, and other components located in hoistway.

c. Rail bracket spacing and maximum vertical forces on guide rails in accordance with ASME A17.1 Section 2.23 and Section 8.4.8.

d. Reactions at points of supports and buffer impact loads.

e. Weights of principal parts.

f. Top and bottom clearances and over travel of the car.

- g. Location of shunt trip circuit breaker, switchboard panel, light switch, and feeder extension points in the machine room.
- 2. Drawings of hoistway entrances and doors showing details of construction and method of fastening to the structural members of the building.
  - a. Sill details including sill support.
- D. Samples:
  - 1. One each of stainless steel, 75 mm x 125 mm (3 in. x 5 in.).
  - 2. One each of acrylic opaque glazing, 75 mm x 125 mm (3 in. x 5 in.).
  - 3. One each of ceramic floor tile.
  - 4. One each of protection pads, 75 mm x 125 mm (3 in. x 5 in.) if used.
  - 5. One each car and hoistway Braille plate sample.
  - 6. One each car and hall button sample.
  - 7. One each car and hall lantern/position indicator sample.
  - 8. One each wall and ceiling material finish sample.
  - 9. One each car lighting sample.
  - 10. No other samples of materials specified shall be submitted unless specifically requested after submission of manufacturer's name. If additional samples are furnished pursuant to request, adjustment in contract price and time will be made as provided in Section 00 72 00, GENERAL CONDITIONS.
- E. Name of manufacturer, type or style designation, and applicable data of the following equipment shall be shown on the elevator layouts:
  - 1. Storage tank/pump assembly.
  - 2. Pump and motor, HP and RPM rating, Voltage, Starting and Full Load Ampere, Number of phases, and Gallons per minute.
  - 3. Controller
  - 4. Starters and Overload Current Protection Devices.
  - 5. Car Safety Device; Rupture Valve and Manual Shut Off Valves.
  - 6. Electric Door Operator; HP rating and RPM of motor.
  - 7. Hoistway Door Interlocks.
  - 8. Car Buffers; maximum and minimum rated load, maximum rated striking speed and stroke.
  - 9. Cab Ventilation Unit; HP rating and CFM rating.
- F. Complete construction drawings of elevator car enclosure, showing dimensioned details of construction, fastenings to platform, car

lighting, ventilation, ceiling framing, top exits, and location of car equipment.

- G. Complete dimensioned detail of vibration isolating foundations for storage tank/pump assembly.
- H. Dimensioned drawings showing details of:
  - 1. All signal and operating fixtures.
  - 2. Car slide guides/roller guides.
  - 3. Hoistway door tracks, hangers, and sills.
  - 4. Door operator, infrared curtain units.
- I. Cuts or drawings showing details of controllers and supervisory panels.
- J. Furnish certificates as required under: Paragraph "QUALIFICATIONS".

#### **1.6 WIRING DIAGRAMS**

- A. Provide three complete sets of field wiring and straight line wiring diagrams showing all electrical circuits in the hoistway, machine room and fixtures. Install one set coated with an approved plastic sealer and mounted in the elevator machine room as directed by the COR.
- B. In the event field modifications are necessary during installation, diagrams shall be revised to include all corrections made prior to and during the final inspection. Corrected diagrams shall be delivered to the COR within 30 days of final acceptance.
- C. Provide the following information relating to the specific type of microprocessor controls installed:
  - 1. Owner's information manual, containing job specific data on major components, maintenance, and adjustment.
  - 2. System logic description.
  - 3. Complete wiring diagrams needed for field troubleshooting, adjustment, repair and replacement of components. Diagrams shall be base diagrams, containing all changes and additions made to the equipment during the design and construction period.
  - 4. Changes made during the warranty period shall be noted on the drawings in adequate time to have the finalized drawings reproduced for mounting in the machine room no later than six months prior to the expiration of the warranty period.

#### **1.7 ADDITIONAL EQUIPMENT**

- A. Additional equipment required to operate the specified equipment manufactured and supplied for this installation shall be furnished and

installed by the contractor. The cost of the equipment shall be included in the base bid.

- B. Special equipment not required by specification, which would improve the operation, may be installed in conjunction with the specified equipment by the contractor at his option at no additional cost to the Government, provided prior approval is obtained from the COR (Contracting Officer's Technical Representative).

#### **1.8 TOOL CABINET**

- A. Provide a metal parts/tool cabinet, having two shelves and hinged doors. Cabinet size shall be 1220 mm (48 in.) high, 762 mm (30 in.) wide, and 457 mm (18 in.) deep.

#### **1.9 PERFORMANCE STANDARDS**

- A. The elevators shall be capable of meeting the standards of the industry and specifically the following:
  - 1. The controlled rate of change of acceleration and retardation of the car shall not exceed 0.1G per second and the maximum acceleration and retardation shall not exceed 0.2G per second.
  - 2. Starting, stopping, and leveling shall be smooth and comfortable without appreciable steps of acceleration and deceleration.
- B. The door operator shall open the car door and hoistway door simultaneously at 2.5-feet per second and close at 1-foot per second. This performance standard is for capability. The actual speed shall be adjusted upon installation for approval by the COR.
- C. Pressure: Fluid system components shall be designed and factory tested for 500 psi operating pressure.
- D. Floor level stopping accuracy shall be within 6 mm (1/4 in.) above or below the floor, regardless of load condition.

#### **1.10 WARRANTY**

- A. Submit all labor and materials furnished in connection with elevator system and installation to terms of "Warranty of Construction" articles of FAR clause 52.246-21. The one year Warranty shall commence after final inspection, completion of performance test, and upon full acceptance of the installation.
- B. During warranty period if a device is not functioning properly or in accordance with specification requirements, or if in the opinion of the COR, excessive maintenance and attention must be employed to keep device operational, device shall be removed and a new device meeting

all requirements shall be installed as part of work until satisfactory operation of installation is obtained. Period of warranty shall start anew for such parts from date of completion of each new installation performed, in accordance with foregoing requirements.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Where stainless steel is specified, it shall be corrosion resisting steel complying with Fed. Spec. QQ-S-766, Class 302 or 304, Condition A with Number 4 finish on exposed surfaces. Stainless steel shall have the grain of belting in the direction of the longest dimension and surfaces shall be smooth and without waves. During installation all stainless steel surfaces shall be protected with a suitable material.
- B. Where cold rolled steel is specified, it shall be low-carbon steel rolled to stretcher leveled standard flatness, complying with ASTM A109.
- C. Acrylic opaque glazing shall be 1/8" thick, frosted and painted on revers side, and glazed into frame for a tight and secure fit.
- D. Ceramic Floor: Section 09 30 13 CERAMIC/PORCELAIN TILING,
- E. Glass Back frame and mullions: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- F. Glazing: Section 08 80 00, GLAZING.

### **2.2 MANUFACTURED PRODUCTS**

- A. Materials, devices and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items. Items not meeting this requirement, but meet technical specifications which can be established through reliable test reports or physical examination of representative samples, will be considered.
- B. Recommended elevator systems to meet the specifications requirements:
  - 1. ThyssenKrupp Machine, Endure Below Ground
  - 2. Schindler 330A Borehold
  - 3. Motion Control Engineering Series, Motion 2000
  - 4. Canton Elevator, Hole Type
  - 5. Approved Equal
- C. When two or more devices of the same class of materials or equipment are required, these units shall be products of one manufacturer.

- D. Manufacturers of equipment assemblies which include components made by others shall assume complete responsibility for the final assembled unit.
1. Individual components of assembled units shall be products of the same manufacturers.
  2. Parts which are alike shall be the product of a single manufacturer.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
- E. Motor nameplates shall state manufacturers' name, rated horsepower, speed, volts, amperes and other characteristics required by NEMA Standards and shall be securely attached to the item of equipment in a conspicuous location.
- F. The elevator equipment, including controllers, door operators, and supervisory system shall be non-proprietary, the product of manufacturers of established reputation, provided such items are capably engineered and produced under coordinated specifications to ensure compatibility with the total operating system. Mixing of manufactures related to a single system or group of components shall be identified in the submittals.
- G. Where key operated switches are furnished in conjunction with any component of this elevator installation, furnish four (4) keys for each individual switch or lock. Provide different key tumblers for different switch and lock functions. Each and every key shall have a tag bearing a stamped or etched legend identifying its purpose. Barrel key switches are not acceptable, except where required by code.
- H. If the elevator equipment to be installed is not known to the COR, the Contractor shall submit drawings in triplicate for approval to the COR, Contracting Officer, and VA CFM Elevator Engineer showing all details and demonstrate that the equipment to be installed is in strict accordance with the specifications.

### **2.3 CAPACITY, SIZE, SPEED, AND TRAVEL**

- A. Each direct-plunger elevator shall have the capacity to lift the live load, including the weight of entire car and plunger, at the speed specified in the following schedule:

ELEVATOR SCHEDULE
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ELEVATOR SCHEDULE	
Elevator Number	P-1 and P-2
Overall Platform Size	3.92 square meters (42.2 square feet)
Rated Load - kg(lb)	4000lbs
Contract Speed - m/s(fpm)	125fpm
Total Travel - (ft - in)	34'-6"
Number of Stops	4
Number of Openings	4
Entrance Type & Size	P-2 Center. 4'-0" x 7'-0" P-1 Left, 4'-0" x 7'-0"
Plunger Size	Per manufacture's standard

#### 2.4 POWER SUPPLY

- A. For power supply in each machine room see Specification 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Electrical drawings.
- B. It shall be the electrical contractor's responsibility to supply the labor and materials for the installation of the following:
  - 1. Feeders from the power source indicated on the drawings to each elevator controller.
  - 2. Shunt Trip Circuit Breaker for each controller shall be located inside machine room at the strike side of the machine room door and lockable in the "Off" position.
  - 3. Provide Power Quality equipment to protect the elevator equipment from surges. Coordinate with motor functions
- C. Power for auxiliary operation of elevator as specified shall be available from auxiliary power generator, including wiring connection to the elevator control system.

#### 2.5 CONDUIT AND WIREWAY

- A. Unless otherwise specified or approved, install electrical conductors, except traveling cable connections to the car, in rigid zinc-coated steel or aluminum conduit, electrical metallic tubing or metal wireways. Rigid conduit smaller than 3/4 inch or electrical metallic tubing smaller than 1/2 inch electrical trade size shall not be used. All raceways completely embedded in concrete slabs, walls, or floor fill shall be rigid steel conduit. Wireway (duct) shall be used in the

hoistway and to the controller and between similar apparatus in the elevator machine room. Fully protect self-supporting connections, where approved, from abrasion or other mechanical injury. Flexible metal conduit not less than 3/8 inch electrical trade size may be used, not exceeding 18 inches in length unsupported, for short connections between risers and limit switches, interlocks, and for other applications permitted by NEC.

- B. All conduit terminating in steel cabinets, junction boxes, wireways, switch boxes, outlet boxes and similar locations shall have approved insulation bushings. Install a steel lock nut under the bushings if they are constructed completely of insulating materials. Protect the conductors at ends of conduits not terminating in steel cabinets or boxes by terminal fittings having an insulated opening for the conductors.
- C. Rigid conduit and EMT fittings using set screws or indentations as a means of attachment shall not be used. All fittings shall be steel or malleable iron.
- D. Connect motors or other items subject to movement, vibration or removal to the conduit or EMT systems with flexible, steel conduits.

## **2.6 CONDUCTORS**

- A. Unless otherwise specified, conductors, excluding the traveling cables, shall be stranded or solid coated annealed copper in accordance with Federal Specification J-C-30B for Type RHW or THW or more stringent requirements. Where 16 and 18 AWG are permitted by NEC, single conductors or multiple conductor cables in accordance with Federal Specification J-C-580 for Type TF may be used provided the insulation of single conductor cable and outer jacket of multiple conductor cable is flame retardant and moisture resistant. Multiple conductor cable shall have color or number coding for each conductor. Conductors for control boards shall be in accordance with NEC. Joints or splices are not permitted in wiring except at outlets. Tap connectors may be used in wireways provided they meet all UL requirements.
- B. Provide all necessary conduit and wiring between machine room and hoistway.

- C. All wiring must test free from short circuits or ground faults.  
Insulation resistance between individual external conductors and between conductors and ground shall be a minimum of one megohm.
- D. Where size of conductors is not given, voltage and amperes shall not exceed limits prescribed by NEC.
- E. Provide equipment grounding. Ground the conduits, supports, controller enclosure, motor, platform and car frame, and all other non-current conducting metal enclosures for electrical equipment in accordance with NEC. The ground wires shall be copper, green insulated and sized as required by NEC. Bond the grounding wires to all junction boxes, cabinets, and wire raceways.
- F. Terminal connections for all conductors used for external wiring between various items of elevator equipment shall be solderless pressure wire connectors in accordance with Federal Specification W-S-610. The Elevator Contractor may, at his option, make these terminal connections on 10 gauge or smaller conductors with approved terminal eyelets set on the conductor with a special setting tool, or with an approved pressure type terminal block. Terminal blocks using pierce-through serrated washers are not acceptable.

## **2.7 TRAVELING CABLES**

- A. All conductors to the car shall consist of flexible traveling cables conforming to the requirements of NEC. Traveling cables shall run from the junction box on the car directly to the controller. Junction boxes on the car shall be equipped with terminal blocks. Terminal blocks having pressure wire connectors of the clamp type that meet UL 486A requirements for stranded wire may be used in lieu of terminal eyelet connections. Terminal blocks shall have permanent indelible identifying numbers for each connection. Cables shall be securely anchored to avoid strain on individual terminal connections. Flame and moisture resistant outer covering must remain intact between junction boxes. Abrupt bending, twisting and distortion of the cables shall not be permitted.
- B. Provide spare conductors equal to 10 percent of the total number of conductors furnished, but not less than 5 spare conductors in each traveling cable.
- C. Provide shielded wires for the auto dial telephone system within the traveling cable. Add 5 pair shielded wires for card reader, 2 RG-6/U

coaxial CCTV cables, and 2 pair 14 gauge wires for CCTV power as needed.

- D. If traveling cables come into contact with the hoistway or elevator due to sway or change in position, provide shields or pads to the elevator and hoistway to prevent damage to the traveling cables.
- E. Hardware cloth wide may be installed from the hoistway suspension point downward to the elevator pit to prevent traveling cables from rubbing or chafing. Hardware cloth shall be securely fastened and tensioned to prevent buckling. Hardware cloth is not required when traveling cable is hung against a flat wall.

## **2.8 CONTROLLER AND SUPERVISORY PANEL**

- A. UL/CSA Labeled Controller: Mount all assemblies, power supplies, chassis switches, and relays on a self-supporting steel frame. Completely enclose the equipment and provide a mean to control the temperature. Solid state components shall be designed to operate between 32 to 104 degrees Fahrenheit, humidity non-condensing up to 85 percent.
- B. All controller switches and relays shall have contacts of design and material to insure maximum conductivity, long life and reliable operation without overheating or excessive wear, and shall provide a wiping action to prevent sticking due to fusion. Switches carrying highly inductive currents shall be provided with arc shields or suppressors.
- C. Where time delay relays are used in the circuits, they shall be of acceptable design, adjustable, reliable, and consistent such as condenser timing or electronic timing circuits.
- D. Properly identify each device on all panels by name, letter, or standard symbol which shall be neatly stencil painted or decaled in an indelible and legible manner. Identification markings shall be coordinated with identical markings used on wiring diagrams. The ampere rating shall be marked adjacent to all fuse holders. All spare conductors to controller and supervisory panel shall be neatly formed, laced, and identified.

## **2.9 MICROPROCESSOR CONTROL SYSTEM**

- A. Provide a microprocessor based system with absolute position/speed feedback encoded tape and electronic motor starter to control the pump motor and signal functions in accordance with these specifications.

Across the line and wye-delta starters are not acceptable. Complete details of the components and printed circuit boards, together with a complete operational description, shall be submitted for approval.

1. All controllers shall be non-proprietary.
  2. Proprietary tools shall not be necessary for adjusting, maintenance, repair, and testing of equipment.
  3. Controller manufacturer shall provide factory training, engineering and technical support, including all manuals and wiring diagrams to the VA Medical Center's designated Elevator Maintenance Service Provider.
  4. Replacement parts shall be shipped overnight within 48 hours of an order being received.
- B. All controller assemblies shall provide smooth, step-less acceleration and deceleration of the elevator, automatically and irrespective of the load in the car. All control equipment shall be enclosed in a metal cabinet with lockable, hinged door(s) and shall be provided with a means of ventilation. All non-conducting metal parts in the machine room shall be grounded in accordance with NEC. Cabinet shall be securely attached to the building structure.
- C. Circuit boards for the control of each and every elevator system; dispatching, signals, door operation and special operation shall be installed in a NEMA Type 1 General Purpose Enclosure. Circuit boards shall be moisture resistant, non-corrosive, non-conductive, fabricated of non-combustible material and adequate thickness to support the components mounted thereon. Mounting racks shall be spaced to prevent accidental contact between individual circuit boards and modules.
- D. Modules shall be of the type that plug into pre-wired mounting racks. Field wiring or alteration shall not be necessary in order to replace defective modules.
- E. Each device, module and fuse (with volt and ampere rating) shall be identified by name, letter or standard symbol in an approved indelible and legible manner on the device or panel. Coordinate identification markings with identical markings on wiring diagrams.
- F. The electrical connections between the printed circuit boards (modules) and the circuit connectors incorporated in the mounting racks shall be made through individual tabs which shall be an integral part of each module. The tabs shall be nickel-gold plated or other approved metal

of equal electrical characteristics. Modules shall be keyed or notched to prevent insertion of the modules in the inverted position.

- G. Light emitting diodes (LED) shall be for visual monitoring of individual modules.
- H. Components shall have interlocking circuits to assure fail-safe operation and to prevent elevator movement should a component malfunction.
- I. Method of wire wrapping from point to point with connections on the mounting racks shall be submitted for approval.
- J. Field wiring changes required during construction shall be made only to the mounting rack connection points and not to the individual module circuitry or components. If it is necessary to alter individual modules they shall be returned to the factory where design changes shall be made and module design records changed so correct replacement units will be available.
- K. All logic symbols and circuitry designations shall be in accordance with ASME and NEC Standards.
- L. Solid state components shall be designed to operate within a temperature range of 32 to 104 degrees Fahrenheit, humidity non-condensing up to 85 percent.
- M. Wiring connections for operating circuits and for external control circuits shall be brought to terminal blocks mounted in an accessible location within the controller cabinet. Terminal blocks using pierce through serrated washers shall not be used.

**2.10A AUXILIARY POWER OPERATION (OMIT WHEN DEDUCT ALTERNATE #5 IS ACCEPTED)**

- A. The control system for Elevators P 1 through P 2 shall provide for the operation of at least one car per elevator bank on auxiliary power upon failure of the normal power supply.
- B. Auxiliary equipment on elevator controllers, wiring between associated elevator controllers and wiring between elevator controllers and remote selector panel as required to permit the elevators to operate as detailed, shall be provided by the Elevator Contractor.
- C. Upon loss of normal power supply there shall be a delay before transferring to auxiliary power of 10 seconds minimum to 45 seconds maximum, the delay shall be accomplished through an adjustable timing device. Following this adjustable delay the associated elevators shall function as follows:

1. Selector switch, Automatic position:
  - a. Not more than one elevator at a time shall be automatically selected and returned to the main floor, at normal speed, cycle its car and hoistway doors and shut down, with "Door Open" button remaining operable.
  - b. As each elevator reaches the designated floor and shuts down, another elevator shall start and return to the designated floor.
  - c. Elevators that have been manually removed from automatic service and are on independent service, fire service or medical emergency shall receive an automatic return signal. Elevators on inspection service or out of service shall not receive a signal.
  - d. When an elevator is given a signal to return and it is unable to start its movement to the designated floor within 30 seconds it shall be by-passed. When an elevator is by-passed, another elevator shall start and return.
  - e. This process shall continue until all elevators have returned to the designated floor and shut down.
  - f. Any elevator or elevators by-passed on initial return signal shall be signaled again.
  - g. When all cars in group have returned to designated floor, one elevator in each group shall be designated for automatic operation. Individual cars in each group shall restart at 5 second intervals.
2. Selector switch, Manual operation:
  - a. Selector switch shall be mechanically and electrically interlocked to prevent the selection of more than one elevator from operating on auxiliary power.
  - b. The selector switch shall have positions marked with the number of each elevator controlled. It shall also have a position marked "Automatic". When the selector switch is set to the automatic position, the medical emergency service car, shall operate on auxiliary power operation, or if none, the last car arriving at the designated floor and be capable of functioning under all design features.

- c. Change in selection of elevators shall be by means of the selection switch and shall occur only when the previous selected elevator is stopped at the designated floor.
  - d. The selector switch shall be locked out of operation when the system is in the normal mode of operation.
  - e. Locate the selector switch above the hall push button station at the designated level in a NEMA 1B flush type enclosure furnished with a brushed finish stainless steel hinged door and frame. The door shall contain a tumbler type lock furnished with four keys. The enclosure faceplate shall be identified "Auxiliary Power Control" with 13 mm (1/2 in.) engraved letters filled with black paint.
3. The inside of the selector panel shall be brushed finish stainless steel with each device identified with 3 mm (1/8 in.) engraving filled with black paint. The panel shall contain:
- a. Selector switches for selecting the elevators shall be toggle type or rotary key switch.
  - b. Pilot lights to indicate normal mode of operation, auxiliary power service available, and which elevator or elevators in each group is connected to auxiliary service.
  - c. A lamp test circuit consisting of a momentary contact push button to test all pilot lights in the circuit.
  - d. Provide a permanently mounted, easy to read, instruction plate which shall include operating instructions for auxiliary power service and instructions for lamp test circuits.
- D. Prior to the return of normal power an adjustable timed circuit shall be activated that will cause all cars to remain at a floor if already there or stop and remain at the next floor if in flight. Actual transfer of power from auxiliary power to normal building power shall take place after all cars are stopped at a floor with their doors open.
- E. Car lighting circuits shall be connected to the auxiliary power panel.
- 2.10B EMERGENCY RESCUE OPERATION (INCLUDE WHEN ALTERNATE #5 IS ACCEPTED)**
- A. Provide a power source to send the elevator to the lowest landing by activating the down valves. After the elevator has leveled at the lowest landing, provide power to open the car and hoistway doors automatically. After a predetermined time the car and hoistway doors shall close. Power shall stay applied to the door open button so the



doors can be opened from the inside of the elevator. The elevator shall remain shut down at the bottom landing until normal power is restored. Install a sign on the controller indicating that the power is applied to the down valve and door operator during loss of normal power.

**2.11 SINGLE CAR SELECTIVE COLLECTIVE AUTOMATIC OPERATION (OMIT IF ALTERNATE #11 IS ACCEPTED)**

- A. Provide single car selective collective automatic operation for passenger elevators.
- B. Operate car without attendant from push buttons inside the car and located at each floor adjacent to the elevator entrance. When car is available, automatically start car and dispatch it to the floor corresponding to registered car or hall call. Once car starts, it shall respond to registered calls in direction of travel in the order floors are reached. Do not reverse car directions until all car calls have been answered or until all hall calls ahead of car and corresponding to direction of car travel have been answered. Slow car and stop automatically at floors corresponding to registered calls, in the order in which they are approached in either direction of travel. As slowdown is initiated, automatically cancel the hall call and car call. Hold car at arrival floor an adjustable time interval to allow passenger transfer. Illuminate appropriate push button to indicate call registration. Extinguish light when call is answered.
- C. When all calls in the system have been satisfied, the elevator shall shut down at the last landing served with the car and hoistway doors closed. Registration of a call at the landing where the car is parked shall automatically open the car and hoistway doors. Provide a predetermined time delay to permit passengers entering the parked car to register the call of their choice and establish direction of travel before the system can respond to landing calls registered to the same time above or below the parked car.
- D. Auxiliary Landing Call Operation: In the event of corridor call button circuit failure, elevators are to service each floor in both directions in a predetermined pattern without registration of a call within the elevator. Provide an illuminated signal in the controller to indicate that emergency dispatch operation is in effect. Restoration of the landing call button system shall cause normal operation to resume.

- E. Car lights and fan in the elevator shall not shut off when elevator is idle. Arrange circuits so that power to lights and outlets on top and bottom of car shall not be interrupted.

## **2.12 FIREFIGHTERS' SERVICE**

- A. Provide Firefighters' Service as per ASME A17.1 Section 2.27.
- B. Smoke Detectors:
  - 1. Smoke detection devices that are designated for actuation of Elevator Phase I "FIRE SERVICE" response in each elevator lobby, top of hoistway, and machine room shall be provided by others.
    - a. Elevator lobby smoke detectors shall activate only the elevators sharing the corresponding or common lobby.
    - b. Top of hoistway smoke detectors shall activate fire recall and the top of hoistway motorized vent.
    - c. Elevator or group of elevators serving separate isolated areas of the same floor shall have an independent smoke detection system.
    - d. Machine room smoke detectors shall activate fire recall for each and every elevator with equipment located in that machine room.
    - e. Hoistway ventilation, provided by others, located at the top of hoistway for elevators that penetrate more than three floors and meets the requirements of ASME A17.1 Section 2.1.4 and IBC Section 3004. The vent shall stay closed under power. When the top of hoistway smoke detector is activated, the power is removed from the vent and the vent shall open. When the smoke detector is reset, the vent shall close by power.

## **2.13 SEISMIC REQUIREMENTS**

- A. Meet the requirements of ASME A17.1 Section 8.4, Elevator Safety Requirements for Seismic Risk Zone 2 and according to VA Seismic Design Manual H-18-8.
- B. Support and maintain pump unit, controller, rails, rail brackets, conduit, buffers, piping, scavenger pumps and jack unit assembly in place as to effectively prevent any part from sliding, rotating or overturning or jumping under conditions imposed by seismic forces not less than that required to produce an acceleration of gravity horizontally and 1/2 gravity vertically acting simultaneously. Design the total system to continue operation without interruption under specified seismic acceleration, as outlined in H-18-8.

- C. Support all vertical conduits and duct systems within the hoistway at points above the center of gravity of riser. Provide lateral guides at regular intervals.
- D. Provide hydraulic equipment mounted on vibration isolators with seismic restraints.
- E. Bolt pump unit and controller to the floor and provide sway braces at top. Secure all electrical components within the panels to the panel frame. Fit doors and hinged panels with positive locking latches.
- F. Car guide rail brackets and rail clip bolts shall be guarded against snagging on the side of the rail adjacent to the point of suspension of the traveling cables.
- G. Provide car guide rails with at least one intermediate bracket between brackets located at each floor so that bracket spacing does not exceed 2400 mm (8 ft). If intermediate brackets cannot be installed because of lack of structural support, reinforce rails with 225 mm (9 in.) channel or approved equal backing.
- H. Guide rails shall not be less than 22.5 kg/m (15 lb/ft).
- I. The stresses in parts of structural members made of steel shall not exceed 88 percent of the minimum elastic strength of the material used in the fastenings.
- J. Provide car enclosure ceiling panels and lighting/lamps with latching devices that shall restrain the panels and lighting/lamps. Devices shall be readily removable for cleaning or replacing panels and relamping.
- K. Submittals are required for all equipment anchors, supports, restraints and detectors. Submittals shall include weight, dimensions, center of gravity, standard connections, calculations, manufacturer's recommendations, behavior problems (vibration, thermal, expansion, etc.,) so that design can be properly reviewed.

#### **2.14 PUMP UNIT ASSEMBLY**

- A. Completely integrate the pump unit for the control of the elevator and self-contain in a unit fabricated of structural steel. The unit shall consist of a hydraulic fluid pump driven by an induction motor together with oil control valves, piping, etc. Enclose unit on four open sides of the power unit frame with not less than 16 gauge steel removable panel sections. Provide a minimum 50 mm (2 in.) air space between the

top of the panels and bottom of tank. Line panels on the interior side with one-inch rigid acoustical insulation board.

- B. Control valves shall be electronically controlled. Hydraulic fluid flow shall be controlled to insure speed variation of not more than five (5) percent under all load conditions.
- C. Hydraulic system working pressure shall not exceed 500 psi under any load condition.
- D. Pump shall be positive displacement, rotary screw type, specifically designed for hydraulic elevator service, having a steady discharge without pulsation to give smooth and quiet operation. Pump output shall be capable of lifting elevator car with rated capacity, with a speed variation of no more than five (5) percent between no load and full load. Pump shall operate under flooded suction in an accurately machined case with the clearance required to assure maximum efficiency. Hydraulic fluid by-pass shall discharge directly into storage tank.
- E. Motor shall be squirrel-cage, drip proof, ball bearing, and induction type, with a synchronous speed not in excess of 1800 RPM. Design motor specifically for elevator service, not to exceed nameplate full load current by more than 10% and be continuously rated 120 starts per hour without exceeding a rise of 40 degrees C. Include closed transition SCR soft start.
- F. Connect motor and pump with multiple V-belt. Size belts and sheaves for duty involved and design to prevent any metallic contact between motor and pump shaft. Provide isolation units of rubber in shear to prevent transmission of pump and motor vibration to the building. Install expanded metal sheave guard that can be easily removed for servicing and inspection.
- G. Hydraulic equipment may be installed within the oil storage tank if applicable for elevator size, speed, and duty rating.
- H. Design motor, pump, tank, and piping to accommodate future travel, if specified.

## **2.15 HYDRAULIC SYSTEM**

- A. Construct the storage tank of sheet steel, welded construction, and a steel cover with suitable means for filling, a minimum one-inch protected vent opening, an overflow connection, and a valve drain connection. Tank shall act as a storage tank only, and sized to pass through machine room door as shown on drawings. Provide marked gauge to

monitor hydraulic fluid level. Tank shall be of capacity to hold volume of hydraulic fluid required to lift elevator to top terminal landing, plus a reserve of not less than ten gallons. Provide a baffle in the bottom of the tank to prevent entry of any sediment or foreign particles into hydraulic system. Baffle shall also minimize aeration of hydraulic fluid. Permissible minimum hydraulic fluid level shall be clearly indicated. Hydraulic fluid shall be of good grade to assure free flow when cool, and have minimum flash point of 400 degrees F. Provide initial supply of hydraulic fluid for operation of elevator.

1. Thermostatically control the viscosity of the hydraulic fluid with thermal cooling unit and temperature thermostat to maintain the fluid temperature in the reservoir, pump and valves at a constant operating viscosity.
  2. Provide a data plate on the tank framing indicating the characteristics of the hydraulic fluid used.
- B. Furnish and install connections between the storage tank, pump, muffler, operating valves, and cylinder complete with necessary valves, pipe supports, and fittings. All connections between the discharge side of the pump, check valve, muffler, cylinder, lowering valves shall be of schedule 40 steel with threaded, flanged, or welded mechanical couplings. Size of pipe and couplings between cylinder and pumping unit shall be such that fluid pressure loss is limited to 10 percent.
- C. Do not subject valves, piping, and fittings to working pressure greater than those recommended by the manufacturer.
- D. Support all horizontal piping. Place hangers or supports within 305 mm (12 in.) on each side of every change of direction of pipe line and space supports not over 3.0 meters (10 ft) apart. Secure vertical runs properly with iron clamps at sufficiently close intervals to carry weight of pipe and contents. Provide supports under pipe to floor.
1. Provide all piping from machine room to hoistway, including necessary supports or hangers. If remote piping is underground or in damp inaccessible areas, install hydraulic piping thru PVC sleeve pipe.
- E. Install pipe sleeves where pipes pass through walls or floors. Set sleeves during construction. After installation of piping, equip the sleeves with snug fitting inner liner of either glass or mineral wool insulation.

- F. Install blowout-proof, non-hammering, oil-hydraulic muffler in the hydraulic fluid supply pressure line near power unit in machine room. Design muffler to reduce to a minimum any pulsation or noises that may be transmitted through the hydraulic fluid into the hoistway.
- G. Arrange control valves to operate so hydraulic fluid flow will be controlled in positive and gradual manner to insure smooth starting and stopping of elevator.
- H. Provide safety check valve between cylinder and pump connection which will hold elevator with specified load at any point when pump stops or pressure drops below minimum operating levels.
- I. Provide an automatic shut-off valve in the oil supply line at the cylinder inlet. Weld pipe protruding from cylinder at inlet and thread to receive shut-off valve. Activate the automatic shut-off valve when there is more than a ten percent increase in high speed in the down direction. When activated, this device shall immediately stop the descent of the elevator, and hold the elevator until it is lowered by use of the manual lowering feature of the valve. Arrange the manual lowering feature of the automatic shut-off valve to limit the maximum descending speed of the elevator to 15 fpm. The exposed adjustments of the automatic shut-off valve shall have their means of adjustment sealed after being set to their correct position.
- J. Provide external tank shut-off valve to isolate hydraulic fluid during maintenance operations.
- K. Provide all pump relief and other auxiliary valves to comply with the requirements of the ASME A17.1 Section 3.19 and to insure smooth, safe, and satisfactory operation of elevator.
- L. Furnish and adjust by-pass and relief valve in accordance with ASME A17.1 Rule 3.19.4.2.
- M. Install check valve to hold the elevator car with rated load at any point when the pump stops.
- N. Provide shut-off valves in the pit near the cylinder and in the machine room capable of withstanding 150 percent of design operating pressure. Each manual valve shall have an attached handle.
- O. Conveniently locate the manual lowering valve, easily accessible, and properly identified with a red arrow and not concealed within the storage tank. Mark the operating handle in red.

- P. Provide a low oil control feature which shall shut off the motor and pump and return the elevator to the lowest landing. Upon reaching the lowest landing, doors will open automatically allowing passengers to leave the car. Then doors shall close. All control buttons, except the door open button, shall be made ineffective.
- Q. Provide oil-tight drip pan for assembled pumping unit, including storage tank. Pan shall be not less than 16 gauge sheet steel, with one-inch sides.
- R. The entire hydraulic system, including muffler, shall be tested to withstand a pressure equal to twice the calculated working pressure. Submit certification that test has been performed.

#### **2.16 HYDRAULIC PLUNGER ASSEMBLY**

- A. Design cylinder and plunger in accordance with ASME A17.1. It shall be of sufficient size to lift gross load the height specified. Factory test at a pressure equal to twice the calculated working pressure, for strength and to insure freedom from leakage. Provide bottom of cylinder head with internal guide bearing and top of cylinder head with removable packing gland. Packing gland shall permit ready replacement of packing. Victaulic type packing gland head will not be permitted.
  - 1. Provide a bleeder valve located below the cylinder flange to release air or other gases from the system.
  - 2. Equip cylinder with drip ring below the packing gland to collect leakage of hydraulic fluid.
  - 3. Bolt the cylinder mounting brackets to continuous footing channels that also support the rails and buffers.
- B. Install a flexible tubing scavenger line with an electrically operated pump between the piston drip ring and oil storage tank. Scavenger line, pump and strainers shall operate independently of hydraulic fluid pressure. Equip scavenger pump with a water float designed to prevent operation of the pump should the pit flood and designed to be manually reset. Strap the pump and reservoir to the pit channels.
- C. Plunger shall be heavy seamless steel tubing, turned smooth and true to within plus or minus .38 mm (0.015 in.) tolerance and no diameter change greater than .07 mm (0.003in.) per-inch of length. Grind the plunger surface to a fine polish finish, 12 micro-inches or finer. Where plunger is multi-piece construction, machine the joints to assure perfectly matching surfaces. No tool marks shall be visible.

1. Secure plunger to underside of platform supporting beams with fastenings capable of supporting four times the weight of the plunger. The platen plate shall incorporate piston car vibration isolator as herein specified.
  2. Provide a stop ring welded or screwed to the bottom of plunger that shall prevent the plunger from leaving its cylinder.
  3. Isolate plunger head from the platen plate to prevent corrosion or electrolysis.
  4. Carefully protect plunger and replace if gouged, nicked or scored.
  5. If conditions beneath the pit floor are not adequate to support the total loading of the elevator, install reinforcing members in the pit floor.
- D. Before installation, clean entire cylinder wall of all traces of oil, grease, moisture, dirt and scale.

#### **2.17 HYDRAULIC CYLINDER CASING**

- A. The casing shall be iron or steel not less than 0.375-inch thick, at least 15.2 mm (6 in.) larger in diameter than the cylinder. The Elevator Contractor shall demonstrate to the COR that the casing has been accurately set, positioned, and plumbed to accept the plunger assembly. Close the bottom with a minimum of 15.2 mm (6 in.) of concrete.
- B. Provide PVC casing liner to fit inside steel casing. Fabricate from schedule 80 PVC pipe with watertight bottom and a top flange gasket to seal plunger flange and form a complete, watertight, electrically non-conductive encasement of the entire unit.
- C. Provide suitable well hole to accommodate casing. Coordinate the drilling of well hole and setting of the cylinder with construction of concrete pit. Provide watertight joint between the casing and the pit floor at bottom of pit.
- D. Base bid on drilling hole in dirt, sand, rock, gravel, loam, boulders, hardpan, water, or other obstacles. Include the removal of all dirt and debris.

#### **2.18 CAR BUFFERS**

- A. Provide a minimum of two spring buffers for each elevator that meet the requirements of ASME A17.1 Section 3.22. Securely fasten buffers and supports to the pit channels and in the alignment with striker plates on elevator. Every installed buffer shall have a permanently attached



metal plate indicating its stroke and load rating. Buffer anchorage shall not puncture pit waterproofing.

- B. Design and install buffers to provide minimum car runby required by ASME A17.1 Rule 3.4.2.
- C. Furnish pipe stanchions and struts as required to properly support the buffer.

#### **2.19 CAR GUIDES**

- A. Install on car frame four flexible sliding swivel guide shoes , each assembled on a substantial metal base, to permit individual self-alignment to the guide rails.
- B. Guide Shoes:
  - 1. Provide each shoe with renewable non-metallic gibs of durable material having low coefficient of friction and long-wearing qualities, when operated on guide rails receiving infrequent, light applications of rail lubricant. Gibs containing graphite or other solid lubricants are not acceptable.
  - 2. Flexible guide shoes of approved design, other than swivel type, may be used provided they are self-aligning on all three faces of the guide rails.
  - 3. Provide spring take-up in car guide shoes for side play between rails.
- D. Equip car with an auxiliary guiding device for each guide shoe which shall prevent the car from leaving the rails in the event that the normal guides are fractured. These auxiliary guides shall not, during normal operation, touch the guiding surfaces of the rails. Fabricate the auxiliary guides from hot rolled steel plate and mount between the normal guide shoes and the car frames. The auxiliary guides may be an extension of the normal guide shoe mounting plate if that plate is fabricated from hot rolled steel. The portion of the auxiliary guide which shall come in contact with the rail guiding surfaces in the event of loss of the normal guides shall be lined with an approved bearing material to minimize damage to the rail guiding surfaces.

#### **2.20 GUIDE RAILS, SUPPORTS, AND FASTENINGS**

- A. Guide rails shall conform to ASME A17.1 Section 2.23.
- B. Guide rails for car shall be planed steel T-sections and weigh 22.5 kg/m (15 lb/ft).

- C. Securely fasten guide rails to the brackets or other supports by heavy duty steel rail clips.
- D. Provide necessary car rail brackets of sufficient size and design to secure substantial rigidity to prevent spreading or distortion of rails under any condition.
  - 1. Slotted or oversized holes shall be fitted with flat washers and shall conform to ASME A17.1 Rule 2.23.10.3.
  - 2. Where fastenings are over 4.2 m (14 ft) apart, rails shall be reinforced with 228 mm (9 in.) channel or approved equal backing to secure the rigidity required.
- E. Rail joints and fishplates shall be in accordance with ASME A17.1 Rule 2.23.7. Rail joints shall not interfere with clamps and brackets. Design rail alignment shims to remain in place if fastenings become loose.
- F. Guide rails shall extend from channels on pit floor to within 76 mm (3 in.) of the underside of the concrete slab or grating at top of hoistway with a maximum deviation of 3.2 mm (1/8 in.) from plumb in all directions. Provide a minimum of 19 mm (3/4 in.) clearance between bottom of rails and top of pit channels.
- G. Guide rail anchorages in pit shall be made in a manner that will not reduce effectiveness of the pit waterproofing.
- H. In the event inserts or bond blocks are required for the attachment of guide rails, the Contractor shall furnish such inserts or bond blocks and shall install them in the forms before the concrete is poured. Use inserts or bond blocks only in concrete or block work where steel framing is not available for support of guide rails. Expansion-type bolting for guide rail brackets will not be permitted.
- I. Guide rails shall be clean and free of any signs of rust, grease, or abrasion before final inspection. Paint the shank and base of the T-section with two field coats of manufacturer's standard enamel.

## **2.21 NORMAL AND FINAL TERMINAL STOPPING DEVICES**

- A. Normal and final terminal stopping devices shall conform to ASME A17.1 Section 2.25.
- B. Mount terminal slowdown switches and direction limit switches on the elevator or in hoistway to reduce speed and bring car to an automatic stop at the terminal landings.

1. Switches shall function with any load up to and including 100 percent of rated elevator capacity at any speed obtained in normal operation.
  2. Switches, when opened, shall permit operation of elevator in reverse direction of travel.
- C. Mount final terminal stopping switches in the hoistway.
1. Switches shall be positively opened should the car travel beyond the terminal direction limit switches.
  2. Switches shall be independent of other stopping devices.
  3. Switches, when opened, shall remove power from pump motor and control valves preventing operation of car in either direction.
- D. After final stopping switches have been adjusted, through bolt switches to guide rail.

#### **2.22 CROSSHEAD DATA PLATE AND CODE DATA PLATE**

- A. Permanently attach a non-corrosive metal Data Plate to car crosshead. Data plate shall bear information required by ASME A17.1 Section 2.16.3 and 2.20.2.1.
- B. Permanently attach a Code Data Plate, in plain view, to the controller, ASME A17.1 Section 8.9.

#### **2.23 WORKMAN'S LIGHTS AND OUTLETS**

- A. Provide duplex GFCI protected type receptacles and lamp, with guards on top of elevator car and beneath platform.
- B. The receptacles shall be in accordance with Fed. Spec. W-C-596 for Type D7, 2-pole, 3-wire grounded type rated for 15 amperes and 125 volts.

#### **2.24 TOP-OF-CAR OPERATING DEVICE**

- A. Provide a cartop operating device that meets the requirements of ASME A17.1 Section 2.26.
- B. The device shall be activated by a toggle switch mounted in the device. The switch shall be clearly marked "INSPECTION" and "NORMAL" on the faceplate, with 6 mm (1/4 in.) letters.
- C. Movement of the elevator shall be accomplished by the continuous pressure on a direction button and a safety button.
- D. Provide an emergency stop toggle type switch.
- E. Provide permanent identification for the operation of all components in the device.

- F. The device shall be permanently attached to the elevator crosshead on the side of the elevator nearest to the hoistway doors used for accessing the top of the car.

#### **2.25 CAR LEVELING DEVICE**

- A. Car shall be equipped with a two-way leveling device to automatically bring the car to within 3 mm (1/8 in.) of exact level with the landing for which a stop is initiated regardless of load in car or direction.
- B. If the car stops short or travels beyond the floor, the leveling device, within its zone shall automatically correct this condition and maintain the car within 3 mm (1/8 in.) of level with the floor landing regardless of the load carried.
- C. Provide encoded steel tape, steel tape with magnets or steel vanes with magnetic switches. Submit design for approval.

#### **2.26 EMERGENCY STOP SWITCHES**

- A. Provide an emergency stop switch for each top-of-car device, pit, machine spaces, service panel and firefighters' control panel inside the elevator. Mount stop switches in the pit adjacent to pit access door, at top of the pit ladder 1220 mm (48 in.) above the bottom landing sill and 1220 mm (48 in.) above the pit floor adjacent to the pit ladder.
- B. Each stop switch shall be red in color and shall have "STOP" and "RUN" positions legibly and indelibly identified.

#### **2.27 MAIN CAR OPERATING PANEL**

- A. Locate the main car operating panel in the car enclosure on the front return panel for passenger/service elevators and the front of the side wall for freight elevators. The top floor car call push button shall not be more than 1220 mm (48 in.) above the finished floor. Car call push buttons and indicator lights shall be round with a minimum diameter of 25 mm (1 in.), LED white light illuminated.
- B. One piece front faceplate, with edges beveled 15 degrees, shall have the firefighters' service panel recessed into the upper section and the service operation panel recessed into the lower section, fitted with hinged doors. Doors shall have concealed hinges, be in the same front plane as the faceplate and fitted with cylinder type key operated locks. Secure the faceplate with stainless steel tamperproof screws.
- C. All terminology on the main car operating panel shall be raised or engraved. Use 6 mm (1/4 in.) letters to identify all devices in upper

section of the main car operating panel. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.

D. The upper section shall contain the following items in order listed from top to bottom:

1. Engrave elevator number, 25 mm (1 in.) high with black paint for contrast.
2. Engrave capacity plate information with black paint for contrast with freight loading class and number of passengers allowed.
3. Emergency car lighting system consisting of a rechargeable battery, charger, controls, and LED illuminated light fixture. The system shall automatically provide emergency light in the car upon failure or interruption of the normal car lighting service, and function irrespective of the position of the light control switch in the car. The system shall be capable of maintaining a minimum illumination of 1.0 foot-candle when measured 1220 mm (48 in.) above the car floor and approximately 305 mm (12 in.) in front of the car operating panel, for not less than four (4) hours.
4. LED illuminated digital car position indicator with direction arrows. Digital display floor numbers and direction arrows shall be a minimum of 50mm (2 in.) high.
5. Firefighters' Emergency Operation Panel shall conform to the requirements of ASME A17.1 Section 2.27. Firefighters' Panel shall be 1676 mm (66 in.) minimum to 1830 mm (72 in.) maximum to the top of the panel above finished floor.
6. Firefighters' Emergency Indicator Light shall be round with a minimum diameter of 25 mm (1 in.).
7. Medical Emergency switch marked "MEDICAL EMERGENCY" with two positions labeled "ON" and "OFF" and Medical Emergency Indicator Light located next to the key switch shall be round with a minimum diameter of 25 mm (1 in.). Instruction for Medical Emergency operation shall be engraved below the key switch and light.
8. Independent Service switch, see Section 2.30 for detailed description.

9. Provide a Door Hold button on the faceplate next to the independent service key switch. It shall have "DOOR HOLD" indelibly marked on the button. Button shall light when activated. When activated, the door shall stay open for a maximum of one minute. To override door hold timer, push a car call button or door close button. Door Hold button is not ADA required and Braille is not needed.
  10. Complete set of round car call push buttons, minimum diameter of 25 mm (1 in.), and LED white light illuminated, corresponding to the floors served. Car call buttons shall be legibly and indelibly identified by a floor number and/or letter not less than 12mm (1/2 in.) high in the face of the call button. Stack buttons in a single vertical column for low rise buildings up to six floors with front openings only.
  11. Door Open and Door Close buttons shall be located below the car call buttons. They shall have "OPEN" and "CLOSE" legibly and indelibly identified by letters in the face of the respective button. The Door Open button shall be located closest to the door jamb as required by ADA.
  12. Red Emergency Alarm button that shall be located below the car operating buttons. Mount the emergency alarm button not lower than 890 mm (35 in.) above the finished floor. It shall be connected to audible signaling devices as required by A17.1 Rule 2.27.1.2. Provide audible signaling devices including the necessary wiring.
  13. Emergency Help push button shall activate two way communications by Auto Dial telephone system as required by ASME A17.1 Rule 2.27.1.1.3. Help button shall be LED white light illuminated and flash when call is acknowledged. Legibly and indelibly label the button "HELP" in the face of the button with 12 mm (1/2 in.) high letters.
  14. Provide a corresponding Braille plate on the left side of each button. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.
- E. The service operation panel, in the lower section shall contain the following items:

1. Light switch labeled "LIGHTS" for controlling interior car lighting with its two positions marked "ON" and "OFF".
2. Inspection switch that will disconnect normal operation and activate hoistway access switches at terminal landings. Switch shall be labeled "INSPECTION" with its two positions marked "ON" and "OFF".
3. Three position switch labeled "FAN" with its positions marked "HIGH", "LOW" and "OFF" for controlling car ventilating blower.
4. Two position, spring return, toggle switch or push button to test the emergency light and alarm device. It shall be labeled "TEST EMERGENCY LIGHT AND ALARM".
5. Two position emergency stop switch, when operated, shall interrupt power supply and stop the elevator independently of regular operating devices. Emergency stop switch shall be marked "PULL TO STOP" and "PUSH TO RUN".

## **2.28 AUXILIARY CAR OPERATING PANEL**

- A. Provide an auxiliary car operating panel in the front return panel opposite the main car operating panel. The auxiliary car operating panel shall contain only those controls essential to passenger (public) operation. The auxiliary car operating panel faceplate shall match the main car operating panel faceplate in material and general design. Secure the faceplate with stainless steel tamperproof screws.
  1. Mount door "OPEN" and door "CLOSE" buttons closest the door jamb and mount the red alarm button no lower than 875 mm (35 in.) above the finished floor. The Door Open button shall be located closest to the door jamb as required by ADA.
  2. Complete set of round car call push buttons, minimum diameter 25 mm (1 in.), and LED white light illuminated, corresponding to the floors served. Car call button shall be legibly and indelibly identified by a floor number and/or letter not less than 12 mm (1/2 in.) high in the face of the call button corresponding to the numbers of the main car operating buttons. Install buttons in a vertical stack on front mounted panel up to six floors and horizontally for side mounted panel.
  3. Cross-connect all buttons in the auxiliary car operating panels to their corresponding buttons in the main car operating panel. Registration of a car call shall cause the corresponding button to illuminate in the main and auxiliary car operating panel.

4. Emergency Help push button shall activate two way communications by Auto Dial telephone system as required by ASME A17.1 Rule 2.27.1.1.3. Help button shall be LED white light illuminated and flash when call is acknowledged. Legibly and indelibly label the button "HELP" in the face of the button with 12 mm (1/2 in.) high letters. Install emergency telephone system in the auxiliary car operating panel.
5. Provide a corresponding Braille plate on the left side of each button. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.

#### **2.29 INDEPENDENT SERVICE**

- A. Provide a legibly and indelibly labeled "INDEPENDENT SERVICE", two-position key operated switch on the face of the main car operating panel that shall have its positions marked "ON" and "OFF". When the switch is in the "ON" position, the car shall respond only to calls registered on its car dispatch buttons and shall bypass all calls registered on landing push buttons. The car shall start when a car call is registered, car call button or door close button is pressed, car and hoistway doors are closed, and interlock circuits are made. When switch is returned to "OFF" position, normal service shall be resumed.

#### **2.30 CAR POSITION INDICATOR**

- A. Provide an alpha-numeric digital car position indicator in the main car operating panel, consisting of numerals and arrows not less than 50 mm (2 in.) high, to indicate position of car and direction of car travel. Locate position indicator at the top of the main car operating panel, illuminated by light emitting diodes.

#### **2.31 AUDIO VOICE SYSTEM**

- A. Provide digitized audio voice system activated by stopping at a floor. Audio voice shall announce floor designations, direction of travel, and special announcements. The voice announcement system shall be a natural sounding human voice that receives messages and shall comply with ADA requirements for audible car position indicators. The voice announcer shall have two separate volume controls, one for the floor designations and direction of travel, and another for special announcements. The



voice announcer shall have a full range loud speaker, located on top of the cab. The audio voice unit shall contain the number of ports necessary to accommodate the number of floors, direction messages, and special announcements. Install voice announcer per manufacturer's recommendations and instructions. The voice announcer units shall be the product of a manufacturer of established reputation. Provide manufacturer literature and list of voice messages.

1. Fire Service Message
2. Medical Emergency Service Message
3. "Please do not block doors."
4. Provide special messages as directed by COR.

#### **2.32 AUTO DIAL TELEPHONE SYSTEM**

- A. Furnish and install a complete ADA compliant intercommunication system.
- B. Provide a two-way communication device in the car with automatic dialing, tracking and recall features with shielded wiring to car controller in machine room. Provide dialer with automatic rollover capability with minimum two numbers.
- C. "HELP" button shall illuminate and flash when call is acknowledged. Button shall match floor push button design.
- D. Provide "HELP" button tactile symbol engraved signage and Braille adjacent to button mounted integral with car operating panels.
- E. The auto dial system shall be located in the auxiliary car operating panel. The speaker and unit shall be mounted on the backside of the perforated stainless steel plate cover.
- F. Each elevator shall have an individual phone number.
- G. If the operator ends the call, the phone shall be able to redial immediately.

#### **2.33 CORRIDOR OPERATING DEVICE FACEPLATES**

- A. Fabricate faceplates for elevator operating and signal devices from not less than 3 mm (1/8 in.) thick flat stainless steel with all edges beveled 15 degrees. Install all faceplates flush with surface on which they are mounted.
- B. Corridor push button faceplates shall be at least 127 mm (5 in.) wide by 305 mm (12 in.) high. The centerline of the landing push buttons shall be 1067 mm (42 in.) above the corridor floor.
- C. Elevator Corridor Call Station Pictograph shall be engraved in the faceplate.

- D. Fasten all car and corridor operating device and signal device faceplates with stainless steel tamperproof screws.
- E. Design corridor push button faceplates so that pressure on push buttons shall be independent of pressure on push button contacts.
- F. Engraved legends in faceplates shall have lettering 6 mm (1/4 in.) high filled with black paint.
- G. Provide a corresponding Braille plate on the left side of each button. The handicapped markings with contrasting background shall be recessed .030 inch in the faceplate, square or rectangular in shape, with the finished face of the 12 mm (1/2 in.) numerals and markings flush with the faceplates. Surface mounted plates are not acceptable.

#### **2.34 CORRIDOR OPERATING DEVICES**

- A. Provide one risers of landing call buttons located as shown on contract drawings.
- B. Fixtures for intermediate landings shall contain "UP" and "DOWN" buttons. Fixtures for terminal landings shall contain a single "UP" or "DOWN" button.
- C. Each button shall contain an integral registration LED white light which shall illuminate upon registration of a call and shall extinguish when that call is answered.
- D. The direction of each button shall be legibly and indelibly identified by arrows not less than 12 mm (1/2 in.) high in the face of each button.
- E. Two or more risers of landing call buttons, if specified, shall be cross-connected so that either "UP" or "DOWN" buttons at a floor shall be capable of registering a call to that floor for the entire elevator group. Registration of a landing call shall illuminate "UP" or "DOWN" buttons simultaneously, and upon satisfaction of that call, both buttons shall be extinguished simultaneously.
- F. Landing push buttons shall not re-open the doors while the car and hoistway doors are closing at that floor, the call shall be registered for the next available elevator. Calls registered shall be canceled if closing doors are re-opened by means of "DOOR OPEN" button or infrared curtain unit.

#### **2.35 CORRIDOR LANTERN/POSITION INDICATOR**

- A. Provide each car with combination corridor lantern/position indicator digital display mounted over the hoistway entrances at each and every

floor. Provide each terminal landing with "UP" or "DOWN", minimum 64 mm (2 1/2 in.) high digital arrow lanterns and each intermediate landing with "UP" and "DOWN" digital arrow lanterns. Each lens shall be LED illuminated of proper intensity, so shielded to illuminate individual lens only. The lenses in each lantern shall be illuminated green to indicate "UP" travel and red to indicate "DOWN" travel. Lanterns shall signal in advance of car arrival at the landing indicating the direction of travel whether or not corridor button has been operated at that floor. Hall calls shall receive immediate assignment to individual cars and hall lantern shall sound and illuminate. Corridor lanterns shall not be illuminated when a car passes a floor without stopping. Each lantern shall be equipped with a clearly audible electronic chime which shall sound once for "UPWARD" bound car and twice for "DOWNWARD" bound car. Audible signal shall not sound when a car passes the floor without stopping. Provide adjustable sound level on audible signal. Car riding lanterns are not acceptable.

- B. Provide alpha-numeric digital position indicators directly over hoistway landing entranceways between the arrival lanterns at each and every floor. Indicator faceplate shall be stainless steel. Numerals shall be not less than 50 mm (2 in.) high with direction arrows. Cover plates shall be readily removable for re-lamping. The appropriate direction arrow shall be illuminated during entire travel of car in corresponding direction.
- C. Provide LED illumination in each compartment to indicate the position and direction the car is traveling by illuminating the proper alpha-numeric symbol. When the car is standing at a landing without direction established, arrows shall not be illuminated.

#### **2.36 HOISTWAY ACCESS SWITCHES**

- A. Provide hoistway access switches for elevator at top terminal landing to permit access to top of car, and at bottom terminal landing to permit access to pit. Elevators with center opening doors, mount the access key switch 1830 mm (6 ft) above the corridor floor next to the hoistway entrance jamb. Exposed portions of each access switch or its faceplate shall have legible, indelible legends to indicate "UP", "DOWN", and "OFF" positions. Submit design and location of access switches for approval. Each access switch shall be a constant pressure cylinder type lock having not less than five pins or five stainless

steel disc combination with key removable only when switch is in the "OFF" position. Lock shall not be operable by any other key which will operate any other lock or device used for any other purpose in the VA Medical Center. When the car is moved down from the top terminal landing, limit the zone of travel to a distance not greater than the top of the crosshead level with the top floor.

- B. Provide emergency access for all hoistway entrances, keyways for passenger elevators.

#### **2.37 HOISTWAY ENTRANCES: PASSENGER ELEVATORS**

- A. Provide entrances of metal construction using cold rolled steel. Door frames shall be constructed of stainless steel. Complete entrances with sills, hanger supports, hangers, tracks, angle struts, unit frames, door panels, fascia plates, toe guards, hardware, bumpers, sight guards, and wall anchors.
- B. Provide one piece extruded aluminum sills with non-slip wearing surface, grooved for door guides and recessed for fascia plates. Sills shall have overall height of not less than 19 mm (3/4 in.) set true, straight, and level, with hoistway edges plumb over each other, and top surfaces flush with finished floor. Grout the sills full length after installation.
- C. Construct hanger supports of not less than 4.5 mm (3/16 in.) thick steel plate, and bolted to strut angles.
- D. Structural steel angles 76 mm x 76 mm x 9 mm (3 in. x 3 in. x 3/8 in.) shall extend from top of sill to bottom of floor beam above, and shall be securely fastened at maximum 457 mm (18 in.) on center and at each end with two bolts.
- E. Provide jambs and head soffits, of not less than 14-gauge stainless steel, for entrances. Jambs and head soffits shall be bolted or welded construction, and provided with three anchors each side. Side jambs shall be curved type. Radius of curvature shall be 89 mm (3 1/2 in.). Head jamb shall be square type, and shall overhang corridor face of side jambs by 6 mm (1/4 in.). Rigidly fasten jambs and head soffits to building structure. Provide jambs with protective covering. After installation, protect jambs and head soffits to prevent damage to finish during construction. Solidly grout jambs.
- F. Provide 14-gauge sheet steel fascia plates in hoistway to extend vertically from head of hanger support housing to sill above. Plates

shall be the same width as the door opening of elevator and adequately reinforced to prevent waves and buckles. Below bottom terminal landing and over upper terminal landing provide shear guards beveled back to and fastened to the wall.

- G. Provide hoistway entrance with flush center opening hoistway doors for Elevators. Door panels shall be not less than 16-gauge stainless steel, flush type construction, and not less than 32 mm (1 1/4 in.) thick. Wrap stainless steel around the leading and trailing edges of the door panel. Top and bottom of door panels shall have continuous stiffener channels welded in place. Reinforcement of the door panels shall be approximately 1.0 mm (0.04 in.) in thickness and of the hat section type. At bottom of each and every panel, provide two removable laminated phenolic gibs or other approved material guides and a separate fire gib. Reinforce each door panel for hangers, interlock mechanism, drive assembly, and closer. One door panel for each entrance shall bear a BOCA label, Underwriters' label, or in lieu of this, labels from other accredited test laboratories may be furnished provided they are based on fire test reports and factory inspection procedures acceptable to the COR. Fasten sight guard of 14-gauge stainless steel, extending full height of panel, to leading edge of each panel of center opening doors.
- H. Provide hangers for hoistway door panels and provide relating devices to transmit motion from one door panel to the other. Fasten the hangers to the door sections. Provide reinforcements at the point of attachment. The hanger shall have provisions for vertical and lateral adjustments. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with rubber or non-metallic sound-reducing tires mounted on malleable iron or steel brackets. The hanger sheaves shall operate at a relatively low rotational speed, and shall roll on a high-carbon, cold-rolled or drawn steel track shaped to permit free movement of sheaves without regard to vertical adjustment of sheave, bracket or housing. Beneath the track and each hanger sheave, provide a hardened steel up-thrust roller capable of withstanding a vertical thrust equal to the carrying capacity of adjacent upper sheave. The up-thrust shall have fine vertical adjustments, and the face of the roller shaped so as to permit free movement of the hanger sheave. The up-thrust roller shall have

ball or roller bearings. Provide the hanger sheaves with steel fire stops to prevent disengagement from tracks.

- I. Do not use hangers that are constructed integrally with the door panels.
- J. Provide raised numerals on cast, rear mounted plates for all openings. Numerals shall be a minimum of 50 mm (2 in.) high, located on each side of entrance frame, with centerline of 1524 mm (5 ft) above the landing sill. The number plates shall contain Braille.
- K. Provide unique car number on every elevator entrance at designated main fire service floor level, minimum 76 mm (3 in.) in height.

#### **2.38 ELECTRIC INTERLOCKS**

- A. Equip each hoistway door with an interlock, functioning as hoistway unit system, to prevent operation of car until all hoistway doors are locked in closed position. Hoistway door interlocks shall not be accepted unless they meet the requirements of ASME A17.1 Section 2.12.
- B. Equip car doors with electric contact that prevents operation of car until doors are closed unless car is operating in leveling zone or hoistway access switch is used. Locate door contact to prevent its being tampered with from inside of car. Car door contact shall not be accepted unless it meets the requirements of ASME A17.1 Section 2.12.
- C. Wiring installed from the hoistway riser to each door interlock shall be NEC type SF-2, or equivalent.
  - 1. Type SF-2 cable terminations in the interlock housing shall be sleeved with glass braid fillers or equivalent.
- D. Provide devices, either mechanical or electrical, that shall prevent operation of the elevator in event of damaged or defective door equipment that has permitted an independent car or hoistway door panel to remain in the "unclosed" and "unlocked" position.

#### **2.39 CAR FRAME: PASSENGER ELEVATORS**

- A. Car frame shall conform to the requirements of ASME A17.1 Section 2.15, constructed of steel plates and structural shapes securely riveted, bolted, or welded together. Iron casting shall not be permitted. The entire assembly shall be rugged construction, and amply braced to withstand unequal loading of platform. Car frame members shall be constructed to relieve the car enclosure of all strains. Balance car front to back and side to side. Provide balancing weights and frames, properly located, to achieve the required true balance.

- B. Provide a bonding wire between frame and plunger.

**2.40 CAR PLATFORM: PASSENGER ELEVATORS**

- A. Construct the car platform to comply with all the requirements of ASME A17.1 Section 2.15.5. The platform shall be designed to withstand the forces developed under the loading conditions specified. Provide car entrances with extruded aluminum sill or better with machined or extruded guide grooves. Cover underside and all exposed edges of wood filled platform with sheet metal of not less than 27-gauge, with all exposed joints and edges folded under. Fire resistant paint is not acceptable. Platform shall have flexible composition flooring not less than 3 mm (1/8 in.) thick. For color, see Section 09 06 00, SCHEDULE FOR FINISHES. Adhesive material shall be type recommended by manufacturer of flooring. Lay flooring flush with threshold plate and base.
- B. Provide a platform guard (toe guard) that meets the requirements of ASME A17.1 Section 2.15.9, of not less than 12-gauge sheet-steel on the entrance side, extend 76 mm (3 in.) beyond each side of entrance jamb. Securely brace platform guard to car platform, and bevel bottom edge at a 60-75 degree angle from horizontal. Install platform in the hoistway, so that the clearance between front edge and landing threshold shall not exceed 32 mm (1 1/4 in.).
- C. Isolate the platform from the car frame by approved rubber pads or other equally effective means.
- D. Provide adjustable diagonal brace rods to hold platform firmly within car suspension frame.
- E. Provide a bonding wire between frame and platform.

**2.41 CAR ENCLOSURE: PASSENGER ELEVATORS**

- A. Car enclosure shall have a dome height inside the cab of 2440 mm (8 ft).
- B. Securely fasten car enclosure to platform by through bolts located at intervals of not more than 457 mm (18 in.) running through an angle at the base of panels to underside of platform. Provide 6 mm (1/4 in.) bolts with nuts and lock washers.
- C. Car enclosure base shall be of 14-gauge stainless steel, 152 mm (6 in.) high. Provide straight type base at front return sides. Vertical face of base at sides and rear shall be flush with, or recessed behind the wainscot directly above the base. There shall be no exposed fastenings

in base. Provide natural ventilation openings divided equally between the bottom and top of the car enclosure that shall provide a minimum 3.5 percent of the inside car floor area.

- D. Construct canopy of not less than 12-gauge steel.
- E. Car top railings shall meet the requirements of ASME A17.1 Rules 2.14.1.7 and 2.10.2.
- F. Front return wall panel, entrance columns, rear corner columns, entrance head-jamb and transom shall be 14-gauge stainless steel full height of car. Side and rear walls from top of base to top of panel shall be constructed of 14-gauge cold rolled steel. Side and rear walls up to 1220 mm (48 in.) above finished floor shall be covered with stainless steel. Side and rear walls from 1220 (48 in.) to the ceiling shall be covered with high pressure stainless steel and acrylic panel. Apply directly to the cab walls or to 13 mm (1/2 in.) plywood/particle board that meets requirements of ASTM E 84, UL 723, or CAN/ULC-S102.2, whichever is applicable. Submit a method of fastening plywood/particle board to steel walls. It shall be flush with the face of the bottom section of the stainless steel. Plastic laminate shall comply with Federal Specification L-P-508, Style Type 1, and Class 1. Color is specified in Section 09 06 00, SCHEDULE FOR FINISHES, Interior shall be flush panel construction with angles welded on exterior to insure adequate rigidity. Coat exterior of panels with mastic sound insulation material approximately 2.5 mm (3/32 in.) thick followed by a prime coat of paint. Mastic material shall conform to ASTM E1042.
  - 1. Smooth and flush all joints with no ragged or broken edges. Plastic laminate shall comply with NEMA LD-3, textured finish, general purpose type, grade designation GP 50, and 0.050 in. thickness, except with a minimum wear resistance of 1200 cycles, and backer sheet, grade designation BK 20, and 0.020 in. thickness.
- G. Provide a hinged top emergency exit cover. Exit shall be unobstructed when open and shall have mechanical stops on the cover. Provide a code approved exit switch to prevent operation of the elevator when the emergency exit is open.
- H. Provide duplex, GFCI protected type receptacle in car. Locate flush-mounted receptacle on the centerline of the main car operating panel, 150 mm (6 in.) above the car floor.
- I. Lighting for passenger elevators:



1. Provide aluminum hanging ceiling frame. Construct frame of 1/8 in. x 1 1/2 in. x 1 1/2 in. "T" and "L" sections, divide ceiling into six panels.
  2. Provide fluorescent or LED illuminated car light fixtures above the ceiling panels. See Specification 265100, Interior Lighting for fixture and ballast type. Maintain a minimum light level of 50-foot candles at 914 mm (36 in.) above the finished floor.
- J. Provide a blower unit arranged to exhaust through an opening in the canopy. Provide a stainless or chrome plated fan grill around the opening. Provide 2-speed fan, capable of rated free delivery air displacement of approximately 380 and 700 cfm at respective speeds. Mount fan on top of car with rubber isolation to prevent transmission of vibration to car structure. Provide screening over intake and exhaust end of blower. Provide a 3-position switch to control the unit in service panel.
- K. Provide car enclosure with two sets of stainless steel handrails.
1. 75 mm (3 in.) wide x 9 mm (3/8 in.) thick flatstock located with centerlines 750 mm and 1050 mm (30 in. and 42 in.) above the car floor.
  2. Locate handrails approximately 38 mm (1 1/2 in.) from cab wall. Install handrails on two side and rear walls. Curve ends of handrails to walls. Conceal all handrail fastenings. Handrails shall be removable from inside the car enclosure.
- L. Provide car entrance with single speed center opening horizontal sliding car doors, of same type as hoistway doors for Elevators. Construct door panels to be flush hollow metal construction, not less than 32 mm (1 1/4 in.) thick, consisting of one continuous piece 16-gauge stainless steel on car side face, leading and trailing edges. Separate two plates by a sound-deadening material, and reinforce by steel shapes welded to the plates at frequent intervals. Reinforce panels as required for installation of hangers, power-operating and door-opening devices. Hang doors on two-point suspension hangers having sealed ball-bearing sheaves not less than 76 mm (3 in.) in diameter, with rubber or non-metallic sound-reducing tires. Equip hangers with adjustable ball-bearing rollers to take upward thrust of panels. Upthrust rollers shall be capable of being locked in position after adjustment to a maximum of .38 mm (1/64 in.) clearance. Provide two

laminated phenolic gibs on each door panel. Gibs shall be replaceable without removal of door panel. Provide door drive assembly, restrictor, gate switch, header, track, arms, and all related door hardware.

**2.42 POWER DOOR OPERATORS: PASSENGER ELEVATORS**

- A. Provide a high-speed heavy duty door operator to automatically open the car and hoistway doors simultaneously when the car is level with the floor, and automatically close the doors simultaneously at the expiration of the door-open time. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Motor shall be of the high-internal resistance type, capable of withstanding high currents resulting from stall without damage to the motor. The door operator shall be capable of opening a car door and hoistway door simultaneously, at a speed of .762 m (2.5 ft) per second. The closing speed of the doors shall be .3 m (1 ft) per second. A reversal of direction of the doors from the closing to opening operation, whether initiated by obstruction of the infrared curtain or the door "OPEN" button, shall be accomplished within 38 mm (1.5 in.) maximum of door movement. Emphasis is placed on obtaining quiet interlock and door operation; smooth, fast, dynamic braking for door reversals, stopping of the door reversal, and stopping of the doors at extremes of travel. Construct all levers and drive arms operating the doors, of heavy steel members, and all pivot points shall have ball or roller bearings. Auxiliary automatic door closers required under ASME A17.1 Section 2.11.3 shall be spring loaded sill mounted type.
- B. Design the door operator so that in case of interruption or failure of the electric power from any cause, it shall permit emergency manual operation of the car door and hoistway door from within the car, only in the door zone. Out of door zone, doors are restricted to 100 mm (4 in.) opening.
1. It shall not be possible for the doors to open by power unless the elevator is within the leveling zone.
  2. Provide infrared curtain unit. The device shall cause the car and hoistway doors to reverse automatically to the fully-open position should the unit be actuated while the doors are closing. Unit shall function at all times when the doors are not closed, irrespective of

all other operating features. The leading edge of the unit shall have an approved black finish.

- C. Should the doors be prevented from closing for more than a predetermined adjustable interval of 20 to 60 seconds by operation of the curtain unit, the doors shall stay open, the audio voice message and a buzzer located on the car shall sound only on automatic operation. **Do not provide door nudging.**
1. If an obstruction of the doors should not activate the photo-electric door control device and prevent the doors from closing for more than a predetermined adjustable interval of 15 to 30 seconds, the doors shall reverse to the fully open position and remain open until the "Door Close" button re-establishes the closing cycle.
- D. Provide door "OPEN" and "CLOSE" buttons. When the door "OPEN" button is pressed and held, the doors, if in the open position, shall remain open and if the doors are closing, they shall stop, reverse and re-open. Momentary pressure of the door "CLOSE" button shall initiate the closing of the doors prior to the expiration of the normal door open time.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Examine work of other trades on which the work of this Section depends. Report defects to the COR in writing which may affect the work of this trade or equipment operation dimensions from site for preparation of shop drawings.
- B. Ensure that shafts and openings for moving equipment are plumb, level and in line, and that pit is to proper depth, waterproofed and drained with necessary access doors, ladder and guard.
- C. Ensure that machine room is properly illuminated, heated and ventilated, and equipment, foundations, beams correctly located complete with floor and access stairs and door.
- D. Before fabrication, take necessary job site measurements, and verify where work is governed by other trades. Check measurement of space for equipment, and means of access for installation and operation. Obtain dimensions from site for preparation of shop drawings.
- E. Ensure the following preparatory work, provided under other sections of the specification has been provided. If the Elevator Contractor requires changes in size or location of trolley beams, or their

supports, trap doors, etc., to accomplish their work, he must make arrangements, subject to approval of the Contracting officer and include cost in their bid. Where applicable, locate controller near and visible to its respective hydraulic pump unit. Work required prior to the completion of the elevator installation:

1. Supply of electric feeder wires to the terminals of the elevator control panel, including circuit breaker.
  2. Provide light and GFCI outlets in the elevator pit and machine room.
  3. Furnish electric power for testing and adjusting elevator equipment.
  4. Furnish circuit breaker panel in machine room for car and hoistway lights and receptacles.
  5. Supply power for cab lighting and ventilation from an emergency power panel specified in Division 26, ELECTRICAL.
  6. Machine room enclosed and protected from moisture, with self closing, self locking door and access stairs.
  7. Provide fire extinguisher in machine room.
- F. Supply for installation, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.

### **3.2 SPACE CONDITIONS**

- A. Attention is called to overhead clearance, pit clearances, overall space in machine room, and construction conditions at building site in connection with elevator work. Addition or revision of space requirements, or construction changes that may be required for the complete installation of the elevators must be arranged for and obtained by the Contractor, subject to approval by COR. Include cost of changes in bid that become a part of the contract. Provide proper, code legal installation of equipment, including all construction, accessories and devices in connecting with elevator, mechanical and electrical work specified.
- B. Where concrete beams, floor slabs or other building construction protrude more than 50 mm (2 in.) into hoistway; bevel all top surfaces of projections to an angle of 75 degrees with the horizontal.

### **3.3 INSTALLATION**

- A. Perform work with competent Certified Elevator Mechanics and Apprentices skilled in this work and under the direct supervision of the Elevator Contractor's experienced foreman.

- B. Set hoistway entrances in alignment with car openings, and true with plumb sill lines.
- C. Erect hoistway sills, headers and frames prior to erection of rough walls and doors. Erect fascias and toe guards after rough walls are finished.
- D. Install machinery, guides, controls, car and all equipment and accessories in accordance with manufacturer's instructions, applicable codes and standards.
- E. Isolate and dampen machine vibration with properly sized sound-reducing anti-vibration pads.
- F. Grout sills and hoistway entrance frames.

### **3.4 ARRANGEMENT OF EQUIPMENT**

- A. Clearance around elevator, mechanical and electrical equipment shall comply with applicable provisions of NEC. Arrange equipment in machine room so that major equipment components can be removed for repair or replacement without dismantling or removing other equipment in the same machine room. Locate controller near and visible to its respective hydraulic pump unit.

### **3.5 WORKMANSHIP AND PROTECTION**

- A. Installations shall be performed by Certified Elevator Mechanics and Apprentices to best possible industry standards. Details of the installation shall be mechanically and electrically correct. Materials and equipment shall be new and without imperfections.
- B. Recesses, cutouts, slots, holes, patching, grouting, refinishing to accommodate installation of equipment shall be included in the Contractor's work. All new holes in concrete shall be core drilled.
- C. Structural members shall not be cut or altered. Work in place that is damaged or defaced shall be restored equal to original condition.
- D. Finished work shall be straight, plumb, level, and square with smooth surfaces and lines. All machinery and equipment shall be protected against dirt, water, or mechanical injury. At final completion, all work shall be thoroughly cleaned and delivered in perfect unblemished condition.
- E. Sleeves for conduit and other small holes shall project 50 mm (2 in.) above concrete slabs.
- F. Exposed gears, sprockets, and sheaves shall be guarded from accidental contact in accordance with ASME A17.1 Section 2.10.

### **3.6 CLEANING**

- A. Clean machine room and equipment.
- B. Perform hoistway clean down.
- C. Prior to final acceptance, remove protective covering from finished or ornamental surfaces. Clean and polish surfaces with regard to type of material.

### **3.7 PAINTING AND FINISHING**

- A. Hydraulic pump assembly shall be factory painted with manufacturer's standard finish and color.
- B. Controllers, car frames and platforms, beams, rails and buffers, except their machined surfaces, cams, brackets and all other uncoated ferrous metal items shall be painted one factory priming coat or approved equal.
- C. Upon completion of installation and prior to final inspection, all equipment shall be thoroughly cleaned of grease, oil, cement, plaster and other debris. All equipment, except that otherwise specified as to architectural finish, shall then be given two coats of paint of approved color, conforming to manufacturer's standard.
- D. Stencil or apply decal floor designations not less than 100 mm (4 in.) high on hoistway doors, fascias or walls within door restrictor areas as required by ASME A17.1 Rule 2.29.2. The color of paint used shall contrast with the color of the surfaces to which it is applied.
- E. Elevator pump units, controllers, main line shunt trip circuit breakers, bolster channels, and cross heads of cars shall be identified by 100 mm (4 in.) high numerals and letters located as directed. Numerals shall contrast with surrounding color and shall be stenciled or decaled.
- F. Hoistway Entrances of Passenger, and Service Elevators:
  - 1. Door panels shall be parkerized or given equivalent rust resistant treatment and a factory finish of one coat of baked-on primer and one factory finish coat of baked-on enamel.
  - 2. Fascia plates, top and bottom shear guards, dust covers, hanger covers, and other metalwork, including built-in or hidden work and structural metal, (except stainless steel entrance frames and surfaces to receive baked enamel finish) shall be given one approved prime coat in the shop, and one field coat of paint of approved color.

G. Elevator Cabs for Passenger and Service Elevators:

1. Interior and exterior steel surfaces shall be parkerized or given equivalent rust resistant treatment before finish is applied.
2. Interior steel surfaces shall be factory finished with one coat of baked on enamel or proxylin lacquer. For color, see Section 09 06 00, SCHEDULE FOR FINISHES.
3. Give exterior faces of car doors one finish coat of paint of medium gray color.

**3.8 PRE-TESTS AND TESTS**

A. Pre-test the elevators and related equipment in the presence of the COR or his authorized representative for proper operation before requesting final inspection. Conduct final inspection at other than normal working hours, if required by COR.

1. Procedure outlined in the Inspectors Manual for Hydraulic Elevators, ASME A17.2 shall apply.
  - a. Final test shall be conducted in the presence of and witnessed by an ASME QEI-1 Certified Elevator Inspector.
  - b. Government shall furnish electric power including necessary current for starting, testing, and operating machinery of each elevator.
2. Contractor shall furnish the following test instruments and materials on-site and at the designated time of inspection: properly marked test weights, oil pressure gauge, voltmeter, amp probe, thermometers, direct reading tachometer, megohm meter, vibration meter, sound meter, light meter, stop watch, and a means of two-way communication.
3. If during the inspection process the Inspector determines the need, the following instruments shall be available within a four-hour period: Megohm meter, vibration meter, sound meter, and a light meter.

B. Inspection of workmanship, equipment furnished, and installation for compliance with specification.

C. Full-Load Run Test: Elevators shall be tested for a period of one hour continuous run with full contract load in the car. The test run shall consist of the elevator stopping at all floors, in either direction of travel, for not less than five or more than ten seconds per floor.

- D. Speed Test: The actual speed of the elevator shall be determined in both directions of travel with full contract load and no load in the elevator. Speed shall be determined by certified tachometer. Full speed runs shall be quiet and free from vibration and sway.
- E. Temperature Rise Test: The temperature rise of the pump motor shall be determined during the full load test run. Temperatures shall be measured by the use of thermometers. Under these conditions, the temperature rise of the equipment shall not exceed 50 degrees Centigrade above ambient temperature. Test shall start when all machine room equipment is within 5 degrees Centigrade of the ambient temperature. Other tests for heat runs on motors shall be performed as prescribed by the Institute of Electrical and Electronic Engineers.
- F. Car Leveling Test: Elevator car leveling devices shall be tested for accuracy of leveling at all floors with no load in car and with contract load in car in both directions of travel. Accuracy of floor level shall be within plus or minus 3 mm (1/8 in.) of level with any landing floor for which the stop has been initiated regardless of load in car or direction of travel. The car leveling device shall automatically correct over travel as well as under travel and shall maintain the car floor within plus or minus 3 mm (1/8 in.) of level with the landing floor regardless of change in load.
- G. Insulation Resistance Test: The elevator's complete wiring system shall be free from short circuits and ground faults and the insulation resistance of the system shall be determined by use of megohm meter, at the discretion of the Elevator Inspector conducting the test.
- H. Safety Devices Tests: Safety devices shall be tested as required by ASME A17.1 Section 8.10.
- I. Overload Devices: Test all overload current protection devices in the system at final inspection.
- J. Limit Stops:
1. The position of the car when stopped by each of the normal limit stops with no load and with contract load in the car shall be accurately measured.
  2. Final position of the elevator relative to the terminal landings shall be determined when the elevator has been stopped by the final limits. The lower limit stop shall be made with contract load in the elevator. Elevator shall be operated at inspection speed for both



tests. Normal limit stopping devices shall be inoperative for the tests.

- K. Working Pressure: Verify working pressure of the hydraulic system by pressure gauge placed in the system line. Take readings with no load and full load in car.
- L. Test automatic shut-off valve for proper operation.
- M. Setting of Car Door Contacts: The position of the car door at which the elevator may be started shall be measured. The distance from full closure shall not exceed that required by ASME A17.1. The test shall be made with the hoistway doors closed or the hoistway door contact inoperative.
- N. Setting of Interlocks: The position of the hoistway door at which the elevator may be started shall be measured and shall not exceed ASME A17.1 requirements.
- O. Operating and Signal System: The elevator shall be operated by the operating devices provided and the operation signals and automatic floor leveling shall function in accordance with requirements specified. Starting, stopping and leveling shall be smooth and comfortable without appreciable steps of acceleration or deceleration.
- P. Performance of the Elevator supervisory system shall be witnessed and approved by the representative of the COR.
- Q. Evidence of malfunction in any tested system or parts of equipment that occurs during the testing shall be corrected, repaired, or replaced at no additional cost to the Government, and the test repeated.
- R. If equipment fails test requirements and a re-inspection is required, the Contractor shall be responsible for the cost of re-inspection; salaries, transportation expenses, and per-diem expenses incurred by the representative of the COR.

### **3.9 INSTRUCTION OF VA PERSONNEL**

- A. Provide competent instruction to VA personnel regarding the operation of equipment and accessories installed under this contract, for a period equal to one eight hour work day. Instruction shall commence after completion of all work and at the time and place directed by the COR.
- B. Written instructions in triplicate relative to care, adjustments and operation of all equipment and accessories shall be furnished and delivered to the COR in independently bound folders. DVD recordings

will also be acceptable. Written instructions shall include correct and legible wiring diagrams, nomenclature sheet of all electrical apparatus including location of each device, complete and comprehensive sequence of operation, complete replacement parts list with descriptive literature, and identification and diagrammatic cuts of equipment and parts. Information shall also include electrical operation characteristics of all circuits, relays, timers, and electronic devices, as well as R.P.M. values and related characteristics for all rotating equipment.

- C. Provide supplementary instruction for any new equipment that may become necessary because of changes, modifications or replacement of equipment or operation under requirements of paragraph entitled "Warranty of Construction".

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**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.
  - 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.
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.
- D. Section 07 84 00, FIRESTOPPING.
- E. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- F. Section 07 92 00, JOINT SEALANTS.
- G. Section 09 91 00, PAINTING.
- H. Section 23 09 23, DIRECT DIGITAL CONTROLS FOR HVAC.
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**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. 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.
  - 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, 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 Officer's 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.
- 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 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 shall 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 drawings and specifications shall be referred to the COR for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided to the COR at least two weeks prior to commencing installation of any item.
  2. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- F. Plumbing Systems: IPC, International Plumbing Code.

#### **1.4 SUBMITTALS**

- A. Submittals 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 shall meet contract requirements.
- D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval shall 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. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who shall 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. Fire stopping materials.
  - 4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  - 5. Wall, floor, and ceiling plates.
- H. 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, 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 until 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.

I. 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. Listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided.
3. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

**1.5 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 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.

B. 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), latest edition. 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 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):  
Boiler and Pressure Vessel Code (BPVC):  
SEC IX-2007.....Boiler and Pressure Vessel Code; Section IX,  
Welding and Brazing Qualifications.
- C. American Society for Testing and Materials (ASTM):  
A36/A36M-2008.....Standard Specification for Carbon Structural  
Steel  
A575-96 (R 2007).....Standard Specification for Steel Bars, Carbon,  
Merchant Quality, M-Grades R (2002)  
E84-2005.....Standard Test Method for Surface Burning  
Characteristics of Building Materials  
E119-2008a.....Standard Test Methods for Fire Tests of  
Building Construction and Materials
- D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:  
SP-58-02.....Pipe Hangers and Supports-Materials, Design and  
Manufacture  
SP 69-2003 (R 2004).....Pipe Hangers and Supports-Selection and  
Application
- E. National Electrical Manufacturers Association (NEMA):  
MG1-2003, Rev. 1-2007...Motors and Generators
- F. International Code Council, (ICC):  
IBC-06, (R 2007).....International Building Code  
IPC-06, (R 2007).....International Plumbing Code

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

##### **2.1 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.

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

## **2.2 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 shall be a complete and fully operational system that conforms to contract requirements.

## **2.3 SAFETY GUARDS**

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 6 mm (1/4-inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

B. All Equipment shall have moving parts protected from personal injury.

## **2.4 LIFTING ATTACHMENTS**

A. Equipment shall be provided 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.

## **2.5 ELECTRIC MOTORS, MOTOR CONTROL, CONTROL WIRING**

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING 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). 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 time or cost 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.
    - b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
    - c. Shielded conductors or wiring in separate conduits for all instrumentation and control systems shall be provided where recommended by manufacturer of equipment.
  4. Motor sizes shall be selected 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-ready" per NEMA Standard, MG1, Part 31.4.4.2.
- C. Motor Efficiency and Power Factor: All motors, when specified as "high efficiency or Premium Efficiency" by the project specifications on driven equipment, shall conform to efficiency and power factor

requirements in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT, with no consideration of annual service hours. Motor manufacturers generally define these efficiency requirements as "NEMA premium efficient" and the requirements generally exceed those of the Energy Policy Act of 1992 (EPACT). Motors not specified as "high efficiency or premium efficient" shall comply with EPACT.

- D. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps shall be split phase or permanent split capacitor (PSC).
- E. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. A time delay (20 seconds minimum) relay shall be provided for switching from high to low speed.
- 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.

## **2.6 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 respective pump manufacturer, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps, shall be product of a single manufacturer.
- C. Motors shall be premium efficient type, "inverter duty", 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, and sensitive medical equipment, nor shall be affected from other devices on the AC power system.

## **2.7 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or 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 shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, and fans, shall be identified.
- 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: 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 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: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 216 mm (8-1/2 inches) by 280 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. A copy of the valve list shall be mounted in picture frames for mounting to a wall.
  - 4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

## **2.8 FIRE STOPPING**

- 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 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION, for pipe insulation.

## **2.9 GALVANIZED REPAIR COMPOUND**

- A. MIL. SPEC. DOD P 21035B, PAINT.

## **2.10 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS**

- A. In lieu of the paragraph which follows, suspended equipment support and restraints shall be designed and installed in accordance with the International Building Code (IBC), latest edition. Submittals based on the International Building Code (IBC), latest edition and the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in a 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 these specifications for lateral force design requirements.
- B. Type Numbers Specified: 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 102 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 102 mm (4 inches) thick when approved by the COR for each job condition.
- D. For Attachment to Steel Construction: MSS SP-58.
1. Welded attachment: Type 22.
  2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp shall be used for individual copper tubing up to 23 mm (7/8-inch) outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in F.
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- F. 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.

- G. Multiple (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. Trapeze hangers are 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 13 mm (1/2-inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
- H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT 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, plastic coated or taped with 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.
  - 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.
- I. Pre-insulated Calcium Silicate Shields:
  1. Provide 360 degree water resistant high density 965 kPa (140 psi) compressive strength calcium silicate shields encased in galvanized metal.
  2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
  3. Shield thickness shall match the pipe insulation.
  4. The type of shield is selected by the temperature of the pipe, the load it shall carry, and the type of support it shall be used with.
    - a. Shields for supporting cold water shall have insulation that extends a minimum of one inch past the sheet metal.
    - b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psi) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36) wear plates welded to the bottom sheet metal jacket.

5. Shields shall be used on steel clevis hanger type supports, roller supports or flat surfaces.

## **2.11 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 fire stopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 25 mm (1 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 shall be installed in concrete beam flanges. Any deviation from these requirements shall 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 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.

## **2.12 TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the COR, 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: metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

## **2.13 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. 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.

## **2.14 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.

Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.

- B. 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 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. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- C. Structural systems necessary for pipe and equipment support shall be coordinated 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. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill shall not be allowed, except as permitted by COR where working area space is limited.
  - 2. 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.
  - 3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but shall be provided.

- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but shall be provided.
- H. 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.
  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.
- I. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment. 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.
- J. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- K. Many plumbing systems interface with the HVAC control system. See the HVAC control points list and section 23 09 23 DIRECT DIGITAL CONTROLS FOR HVAC
- L. 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 shall cause the least interfere with normal operation of the facility.
- M. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.
- N. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumbers putty.
- O. 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.
- 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 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 shall 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 Para. 3.1 shall apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

### **3.3 RIGGING**

- A. Openings in building structures shall be planned to accommodate design scheme.
- B. Alternative methods of equipment delivery shall be offered and shall be considered by Government under specified restrictions of phasing and service requirements as well as structural integrity of the building.
- C. All openings in the building shall be closed 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.
- E. Contractor shall check all clearances, weight limitations and shall provide 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 COR for evaluation prior to actual 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 shall 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 shall 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), latest edition, 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.

**3.5 LUBRICATION**

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. 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 shall be provided. All materials shall be delivered to COR in unopened containers that are properly identified as to application.
- C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- E. All lubrication points shall be extended to one side of the equipment.

### **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 shall 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. Inspections shall 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. 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.

### **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 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 color as utilized by the pump manufacturer
  - 5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats.
  - 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.



### **3.8 IDENTIFICATION SIGNS**

- A. Laminated plastic signs, with engraved lettering not less than 5 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, performance shall be placed on factory built equipment.
- C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

### **3.9 STARTUP AND TEMPORARY OPERATION**

- A. Start up 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.

### **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 system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests such systems respectively during first actual seasonal use of respective systems following completion of work.

### **3.11 OPERATION AND MAINTENANCE MANUALS**

- A. Provide four bound copies. The Operations and maintenance manuals shall be delivered to COR not less than 30 days prior to completion of a phase or final inspection.
- B. All new and temporary equipment and all elements of each assembly shall be included.

- C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
- D. 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.
- E. Lubrication instructions, type and quantity of lubricant shall be included.
- F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
- G. Set points of all interlock devices shall be listed.
- H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.
- I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
- J. Emergency procedures.

**3.12 INSTRUCTIONS TO VA PERSONNEL**

- A. Instructions shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

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**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.

**1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

**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. Valves.
  2. Backflow Preventers.
  3. Pressure Reducing Valves.
  4. Backwater Valves5. 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 Society for Testing and Materials (ASTM):A536-84(R 2004)  
Standard Specification for Ductile Iron Castings
- C. American Society of Sanitary Engineering (ASSE)  
ASSE 1003-01 (R 2003)...Performance Requirements for Water Pressure Reducing Valves  
ASSE 1012-02.....Backflow Preventer with Intermediate Atmospheric Vent  
ASSE 1013-05.....Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
- D. International Code Council (ICC)  
IPC-06 (R 2007).....International Plumbing Code
- E. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):  
SP-25-98.....Standard Marking System for Valves, Fittings, Flanges and UnionsSP-67-02a (R 2004) Butterfly Valve of the Single flange Type (Lug Wafer)

SP-70-06.....Cast Iron Gate Valves, Flanged and Threaded  
Ends.  
SP-72-99.....Ball Valves With Flanged or Butt Welding For  
General Purpose  
SP-80-03.....Bronze Gate, Globe, Angle and Check Valves.  
SP-110-96.....Ball Valve Threaded, Socket Welding, Solder  
Joint, Grooved and Flared Ends

#### **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.
- C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

### **PART 2 - PRODUCTS**

#### **2.1 VALVES**

- 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 meters (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.

E. Ball valves, pressure regulating valves, gate valves, globe valves, and plug valves used to supply potable water shall meet the requirements of NSF 61.

F. Shut-off:

1. Cold, Hot and Re-circulating Hot Water:

a. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-72, 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 4140 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be solder,

b. 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 A 536, ductile iron.

c. 100 mm (DN100) (4 inches) and larger:

1) Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS-SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A 126, grey iron with bolted bonnet, flanged ends, bronze trim, and solid wedge disc. The gate valve shall be gear operated for sizes under 200 mms or DN200 (8 inches) and crank operated for sizes 200 mms or DN200 (8 inches) and above

2) Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.

3) Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The

grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be polyamide coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, EPDM encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated

2. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

G. Balancing:

1. Hot Water Re-circulating, 80 mm or DN80 (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 ( $\frac{1}{4}$ " 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. Larger than 80 mm or DN80 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 862 kPa (125 psi) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1207 kPa (175) at 121 deg C (250 deg F).

H. Check:

1. Check valves less than 80 mm or DN80 (3 inches) and smaller) shall be class 125, bronze swing check valves with non metallic Buna-N disc. 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 B 62, solder joints, and PTFE or TFE disc.
2. Larger than 100 mm or DN100 (4 inches and larger):

- a. Check valves shall be class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A 126, bolted bonnet, flanged ends, bronze trim.
- b. All check valves on the discharge side of submersible sump sumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

I. Globe:

1. 80 mm or DN80 (3 inches) or smaller: Class 150, bronze globe valve with non metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B 62 with solder ends, copper-silicon bronze stem, TPF E or TFE disc, malleable iron hand wheel.
2. Larger than 80 mm or DN80 (3 inches): Similar to above, except with cast iron body and bronze trim, class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A 126 with flanged ends, bronze trim, malleable iron handwheel.

**2.2 WATER PRESSURE REDUCING VALVE AND CONNECTIONS**

- A. 80 mm or DN80 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.
- B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1378-kPa (200-psig). The valve shall have a large Hycar diaphragm for sensitive response.

- C. The regulator shall have a tap for pressure gauge.
- D. The regulator shall have a temperature rating of 100° C (210° F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9-kPa (+/- 1 psig).
- E. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.
- F. Connections Valves and Strainers: shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the low pressure side of the line.

### **2.3 BACKWATER VALVE**

- A. The backwater valve shall have a cast iron body, automatic type ABS valve seat and flapper which are slightly open during periods of non operation. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.
- B. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

### **2.4 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 ASSE 1013 listed and certified.
- B. Reduced pressure backflow preventers shall be installed in the following applications.
  - 1. Deionizers.
  - 2. Sterilizers.
  - 3. Stills.
  - 4. Dialysis, Deionized or Reverse Osmosis Water Systems.
  - 5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
  - 6. Water service entrance from loop system.
  - 7. Dental Equipment



8. Power washer
9. Atmospheric Vacuum Breaker: ASSE 1001
  - a. Hose bibs and sinks w/threaded outlets.
  - b. Disposers.
  - c. Showers (telephone type).
  - d. Hydrotherapy units.
  - e. Autopsy, on each hot and cold water outlet at each table or sink.
  - f. All kitchen equipment, if not protected by air gap.
  - g. Ventilating hoods with wash down system.
  - h. Film processor.
  - i. Detergent system
  - j. Dental equipment
  - k. Fume hoods
  - l. Glassware washers
- C. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated duct iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A276. The seat disc elastomer shall be EPDM. 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.
- D. The atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be either cast bronze. All internal polymers shall be NSF listed. The seat disc elastomer shall be silicone. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable.
- E. The double check detector backflow prevention assembly shall be ASSE listed 1048 and supply with full port OS&Y gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be Noryl (NSF listed). The stem shall be stainless steel conforming to ASTM A 276. The seat disc elastomers shall be EPDM. The first and second check valve shall

be accessible for maintenance without removing the device from the line.

### **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 VALVE 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. Install chain wheels on operators for [ball] [butterfly] [gate] and [globe] valves NPS 100 mm or DN100 (4 inches) and larger and more than [2400 mm (12 feet) above floor. Chains shall be extended to 1500 mm 3600 mm (60 inches) above finished floor.
- 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.

### **3.3 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. Replace valves shall be replaced if persistent leaking occurs.

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**SECTION 22 05 33**  
**HEAT TRACING FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section describes the requirement for supplying, installing, and testing of the electric heat tracing system of the plumbing piping.

**1.2 RELATED WORK**

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Section 23 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. The following product data shall be submitted:
  - 1. Rated capacity
  - 2. Length of cable
  - 3. Cable spacing
  - 4. Electrical power requirements
- C. The shop drawings shall include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.
- D. Field quality control test reports shall be submitted.
- E. Operation and Maintenance data shall be included.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Ten years experience in design, engineering, manufacture and support of specified system and components.
- B. Product Requirements:
  - 1. Pipe or tank tracing cable assembly shall be factory assembled, immersed in water for a minimum of 12 hours, and then tested for insulation resistance, high potential breakdown and continuity before leaving the factory.
  - 2. Factory Mutual approved constant wattage cable.
  - 3. UL Listed, thermostat and contactor panel.
  - 4. UL Listed Control/Monitor Panel

#### **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. International Code Council, (ICC):  
IPC-06, (R 2007).....International Plumbing Code
- C. The Institute of Electrical and Electronic Engineers (IEEE):  
IEEE 515.1, (R 2007)....Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Commercial Applications

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

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments 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 shall be required to employ shall be inserted into the As-Built documentation.

## **PART 2 - PRODUCTS**

### **2.1 SELF REGULATING PARALLEL RESISTANCE HEATING CABLES**

- A. The heating element shall be a pair of parallel No. 16 AWG nickel coated stranded copper bus wires embedded in cross linked conductive polymer core, which varies heat output in response to temperature along its length. Cables shall be terminated with waterproof, factory assembled non heating leads with connects at one end and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.
- B. The electrical insulating jacket shall be flame retardant polyolefin.
- C. The cable cover shall be stainless steel braid.
- D. The maximum power on operating temperature shall be 65°C (150°F).
- E. The maximum power off exposure temperature shall be 85°C (185°F)
- F. The capacities and characteristics shall be:
  - 1. Maximum heat output 5.0 W/foot
  - 2. Pipe Diameter: Varies
  - 3. Number of parallel cables: N/A
  - 4. Spiral wrap pitch: <INSERT VALUE>
  - 5. Volts: 120
  - 6. Phase: 1
  - 7. Hertz: 60
  - 8. Full load amps: <INSERT VALUE>
  - 9. Minimum circuit ampacity: <INSERT VALUE>
  - 10. Maximum over current Protection: <INSERT VALUE>

### **2.2 CONTROLS**

- A. Pipe mounting thermostats for Freeze protection shall have be a remote bulb unit with adjustable temperature range from minus 1 to 10°C (30 to 50°F). The thermostat shall be snap action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable. The thermostat shall be remote bulb on capillary, resistance temperature device, or thermistor for direct sensing of pipe wall temperature. The control enclosure shall be corrosion resistant and waterproof.

- B. The enclosure shall be corrosion resistant and waterproof suitable for outdoor mounted.
- C. A minimum 30 amp contactor shall be provided to indicate operational status, on/off control, and for interface with central energy management and control system.
- D. A programmable timer for domestic hot water temperature maintenance shall have the following features:
  - 1. micro-processor based
  - 2. capable of four separate operation schedules
  - 3. On/off/Auto switch
  - 4. A 365 day calendar with 20 programmable holidays.
  - 5. Relays with contacts to indicate operational status, on/off status, and to interface with the central energy management and control system.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Electric heating cable shall be installed for the following applications:
  - 1. Freeze protection of plumbing piping.
- B. Electric heating cable shall be installed across expansion, construction, and control joints according to the manufacturer's recommendations using cable protection conduit and slack cable to allow for movement without damage to cable.
- C. The installation of electric heating cable for snow and ice melting on roofs, gutters, and roof drain leaders shall be provided with clips furnished by the manufacturer that is compatible.
- D. Electric heating cable for pipe freeze protection shall be installed according to the following:
  - 1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
  - 2. Electric heat cables shall be installed according to IEEE 515.1
  - 3. Insulation shall be installed or applied over piping with electric cables
  - 4. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.

E. Electric heating cable for domestic hot water temperature maintenance shall be installed according to the following:

1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
2. Insulation shall be installed or applied over piping with electric cables
3. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.

F. Field adjustable switches and circuit breaker trip ranges shall be set.

G. Heating cables including leads shall be protected from damage.

H. Equipment shall be grounded according to Division 26.

I. Wiring shall be connected according to Division 26.

### **3.2 TESTS**

A. Tests shall be performed after cable installation but before the application of coverings such as insulation, wall or ceiling construction, or concrete. The cables shall be tested for electrical continuity and insulation integrity before energizing. The cables shall be tested to verify rating and power input. The cables shall be energized and voltage and current measured simultaneously. Test repeatedly after repairing heating cables with new products.

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**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. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  - 5. FSK: Foil-scrim-kraft facing.
  - 6. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
  - 7. Density:  $\text{kg/m}^3$  - kilograms per cubic meter (Pcf - pounds per cubic foot).
  - 8. 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).
  - 9. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
  - 10. 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.
  - 11. CW: Cold water.

12. HW: Hot water.

## 1.2 RELATED WORK

- A. 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.
- B. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.

## 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 shall 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.

#### **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.

#### **1.5 STORAGE AND HANDLING OF MATERIAL**

- A. 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
- E136-09 b.....Standard Test Methods for Behavior of Materials  
in a Vertical Tube Furnace at 750 degrees C  
(1380 F)
- 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  $48 \text{ kg/m}^3$  (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  $16 \text{ kg/m}^3$  (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)
- 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 vapor retarder and all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.
- B. Equipment 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  $120 \text{ kg/m}^3$  (7.5 pcf) nominal,  $k = 0.033$  (0.29) at 24~~0~~ 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**

- A. 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 CALCIUM SILICATE**

- A. Preformed pipe Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- B. Premolded Pipe Fitting Insulation: ASTM C533, Type I and Type II with indicator denoting asbestos-free material.
- C. Equipment Insulation: ASTM C533, Type I and Type II
- D. Characteristics:

Insulation Characteristics		
ITEMS	TYPE I	TYPE II
Temperature, maximum degrees C (degrees F)	649 (1200)	927 (1700)
Density (dry), $\text{Kg/m}^3$ (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)@ mean temperature of 93 degrees C (200 degrees F)	0.059 (0.41)	0.078 (0.540)
Surface burning characteristics:		
Flame spread Index, Maximum	0	0
Smoke Density index, Maximum	0	0

## **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 and piping in ventilated (not air conditioned) spaces) 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 shall 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.
- H. Aluminum Jacket-Piping systems and circular breeching and stacks: 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. Aluminum jacket-Rectangular breaching: ASTM B209, 3003 alloy, H-14 temper, 0.5 mm (0.020 inches) thick with 32 mm (1-1/4 inch) corrugations or 0.8 mm (0.032 inches) thick with no corrugations. System shall be weatherproof if used for outside service.

## **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>	
<b>Nominal Pipe Size mm (inches)</b>	<b>Insert Blocks mm (inches)</b>
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: 13mm (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**

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

#### **2.14 FLAME AND SMOKE**

A. 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 Cor 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 shall fit.
- C. 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).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that shall 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.
- F. 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.
- G. 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.
- H. 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 shall be without insulation for maximum distance of 900 mm (3 feet).
  5. Distilled water piping.
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- J. 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.
- K. 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
- L. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (0.75) 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 where indicated on the drawings as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).
- M. Provide vapor barrier jackets over insulation as follows:
1. All piping exposed to outdoor weather.
  2. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, and ventilated (not air conditioned) spaces) below ambient air temperature in high humidity areas.
- N. Provide metal jackets over insulation as follows:
- a. All plumbing piping exposed to outdoor weather.

- b. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets shall be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
- c. 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.
3. Cold equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
  - a. Water filter, chemical feeder pot or tank.
  - b. Pneumatic, cold storage water and surge tanks.
4. Hot equipment: 40 mm (1-1/2 inch) thick insulation faced with ASJ.
  - a. Domestic water heaters and hot water storage tanks (not factory insulated).

- b. Booster water heaters for dietetics dish and pot washers and for washdown grease-extracting hoods.
- 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 shall 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. Rigid Cellular Phenolic Foam:
  - 1. Rigid closed cell phenolic insulation shall 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. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
  - a. Plumbing piping as follows:
    - 7) Cold water piping.

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. Underground Piping Other than or in lieu of that Specified in Section 22 11 00, FACILITY WATER DISTRIBUTION: Type II, factory jacketed with a 3 mm laminate jacketing consisting of 3000 mm x 3000 mm (10 ft x 10 ft) asphalt impregant4ed glass fabric, bituminous mastic and outside protective plastic film.
  - a. 75 mm (3 inches) thick for hot water piping.
  - b. As scheduled at the end of this section for chilled water piping.
  - c. Underground piping: Apply insulation with joints tightly butted. Seal longitudinal self-sealing lap. Use field fabricated or factory made fittings. Seal butt joints and fitting with jacketing as recommended by the insulation manufacturer. Use 100 mm (4 inch) wide strips to seal butt joints.
  - 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 COR 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. Cold equipment: 50 mm (2 inch) thick insulation faced with ASJ.

E. Polyisocyanurate Closed-Cell Rigid Insulation:

1. Polyisocyanurate closed-cell rigid insulation (PIR) shall be provided for exterior piping and equipment for temperature up to 149 degree C (300 degree F.
2. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention shall be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder 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 retarder shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder shall be used to attach the vapor retarder or jacketing. No wire ties capable of penetrating the vapor retarder 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 retarder on elbows/fittings shall be either mastic-fabric-mastic or 2 mil thick PVDC vapor retarder 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. 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.
10. Minimum thickness in millimeter (inches) specified in the schedule at the end of this section.



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, shall 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.

G. Calcium Silicate:

1. Minimum thickness in millimeter (inches) specified below for piping other than in boiler plant.

Nominal Thickness Of Calcium Silicate Insulation (Non-Boiler Plant)				
Nominal Pipe Size Millimeters (Inches)	Thru 25 (1)	32 to 75 (1-1/4 to 3)	100-200 (4 to 6)	Over 200 (6)
93-260 degrees C(200- 500 degrees F)(HPS, HPR)	100(4)	125(5)	150(6)	150(6)

2. MRI Quench Vent Insulation: Type I, class D, 150 mm (6 inch) nominal thickness.

### 3.3 PIPE INSULATION SCHEDULE

A. 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)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	----	----
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)	----	----
4-16 degrees C (40-60 degrees F)	Rigid Cellular Phenolic Foam (Above ground piping only)	25 (1.0)	25(1.0)	25 (1.0)	25 (1.0)
4-16 degrees C (40-60 degrees F)	Polyiso-cyanurate Closed-Cell Rigid (Exterior Locations only)	25 (1.0)	25(1.0)	25 (1.0)	25 (1.0)
(4-16 degrees C	Flexible Elastomeric	25 (1.0)	25(1.0)	25 (1.0)	25 (1.0)

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
BID Documents  
Project No. 246-13-C-0127

(40-60 degrees F)	Cellular Thermal (Above ground piping only)				
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**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 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. 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

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Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Issued for 100% BID Documents  
Project No. 246-13-C-0127

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

A269-10.....Seamless and Welded Austenitic Stainless Steel  
Tubing for General Service

A312/A312M-12.....Seamless, Welded, and Heavily Cold Worked  
Austenitic Stainless Steel Pipes

A403/A403M-12.....Wrought Austenitic Stainless Steel Piping  
Fittings

A536-84(2009).....Ductile Iron Castings

A733-03(2009)e1.....Welded and Seamless Carbon Steel and Austenitic  
Stainless Steel Pipe Nipples

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

D1785-12.....Poly (Vinyl Chloride) (PVC) Plastic Pipe,  
Schedules 40, 80, and 120

D2000-12.....Rubber Products in Automotive Applications

D4101-11.....Propylene Plastic Injection and Extrusion  
Materials

D2564-04(2009) e1.....Solvent Cements for Poly (Vinyl Chloride) (PVC)  
Plastic Pipe and Fittings

E1120-08.....Liquid Chlorine

E1229-08.....Calcium Hypochlorite

D. American Water Works Association (AWWA):

C110/A21.10-12.....Ductile Iron and Gray Iron  
C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast  
C153/A21.53-11.....Ductile-Iron Compact Fittings  
C203-08.....Coal-Tar Protective Coatings and Linings for  
Steel Water Pipelines - Enamel and Tape - Hot  
Applied  
C213-07.....Fusion Bonded Epoxy Coating for the Interior &  
Exterior of Steel Water Pipelines  
C651-05.....Disinfecting Water Mains

E. American Welding Society (AWS):

A5.8/A5.8M-2011.....Filler Metals for Brazing

F. International Plumbing Code

International Plumbing Code - 2009

G. 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

H. 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, and valve bodies 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 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS**

- A. From inside face of exterior wall to a distance of approximately 5 feet (1500 mm) outside of building and underground inside building, material to be the same for the size specified inside of the building.
- B. Three inches (75 mm) Diameter and Over: Ductile iron, AWWA C151, 125 psi (850 kPa) water steam pressure (WSP), exterior bituminous coating, and cement lined. Provide flanged and anchored connection to interior piping.
- C. Under 3 inch (75 mm) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings as specified under Article 2.2, INTERIOR DOMESTIC WATER PIPING. Use brazing alloys, AWS A5.8, Classification BCuP.
- D. Flexible Expansion Joint: Ductile iron with ball joints rated for 250 psi (1725 kPa) working pressure conforming to ANSI/AWWA C153/A21.53, capable of deflecting a minimum of 20 degrees in each direction and expanding simultaneously to the amount shown on the drawings. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be factory tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The coating and gaskets shall meet NSF/ANSI 61. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

**2.2 ABOVE GROUND (INTERIOR) WATER PIPING**

- A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 6 inches (150 mm) and larger, stainless steel, ASTM A312, schedule 10 shall be used.
- 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, NSF/ANSI 61 approved, 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. Fittings for Stainless Steel:

1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ANSI B16.9.
2. Grooved fittings, stainless steel, Type 316, Schedule 10, conforming to ASTM A403. Segmentally fabricated fittings are not allowed. 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.

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.



G. Re-agent Grade Water Piping and Dialysis Water Piping:

1. Polypropylene, ASTM D4101, Schedule 80 pressure pipe with dimensions in conformance with ASTM D2447, but without additions of modifiers, plasticizers, colorants, stabilizers or lubricants. This virgin unplasticized pipe and fittings shall transport 10 megohm water with no loss of purity. Provide socket fusion joints.
2. Polyethylene, food and medical grade, capable of transporting 10 megohm water with no loss of purity. Processed by continuous compression molding without the addition of fillers, polymer modifiers or processing aids. Uniform color with no cracks, flaws, blisters or other imperfections in appearance. Provide heat fusion butt welded joints. In accordance with manufacturer's recommendations, provide continuous channel support under all horizontal piping.
3. Reverse Osmosis (RO) Water Piping:
  - a. Low Pressure Feed, Reject and Recycle Piping, 75 psi and under: ASTM D 1785, Schedule 80 PVC, socket welded and flanged.
  - b. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 PVC, socket welded and flanged.
  - c. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
  - d. High Pressure Reject and Recycle Piping (above 75 psi): ASTM A269, Type 304 schedule 10 stainless steel with butt welded joints.
  - e. High Pressure Control and Pressure Gage Tubing: 1000 psi burst nylon.

**2.3 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.

#### **2.4 ETHYLENE OXIDE (ETO) STERILIZER WATER SUPPLY PIPING**

A. Stainless steel, ASTM A312, Schedule 10 with stainless steel butt welded fittings. Provide on sterilizer water supply.

#### **2.5 TRAP PRIMER WATER PIPING:**

A. Pipe: Copper tube, ASTM B88, type K, hard drawn.

B. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.

C. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

#### **2.6 STRAINERS**

A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Smaller than 3 inches (80 mm), brass or bronze; 3 inches (80 mm) and larger, cast iron or semi-steel.

#### **2.7 DIELECTRIC FITTINGS**

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

#### **2.8 STERILIZATION CHEMICALS**

A. Hypochlorite: ASTM E1120-08

B. Liquid Chlorine: ASTM E1229-08

#### **2.9 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 shall 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 shall 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 shall 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 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 shall be tested as part of a larger system.

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**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.

**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 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.
- E. Section 07 92 00 Joint Sealants: Sealant products.

**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. Floor Drains.
  - 3. Grease Removal Unit.
  - 4. Cleanouts.
  - 5. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

**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 Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A112.6.3-01 (R 2007)....Standard for Floor and Trench Drains
  - A13.1-07.....Scheme for Identification of Piping Systems

B16.3-06.....Malleable Iron Threaded Fittings, Classes 150  
and 300.

B16.4-06.....Standard for Grey Iron Threaded Fittings  
Classes 125 and 250

B16.12-98 (R 2006).....Cast Iron Threaded Drainage Fittings

B16.15-06.....Cast Bronze Threaded Fittings, Classes 125 and  
250

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

A47/A47M-99 (R 2004)....Standard Specification for Steel Sheet,  
Aluminum Coated, by the Hot Dip Process

A53/A53M-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

A536-84(R 2004).....Standard Specification for Ductile Iron  
Castings

B32-08.....Standard Specification for Solder Metal

B584-06a.....Standard Specification for Copper Alloy Sand  
Castings for General Applications

C564-03a.....Standard Specification for Rubber Gaskets for  
Cast Iron Soil Pipe and Fittings

D2000-08.....Standard Classification System for Rubber  
Products in Automotive Applications

D2564-04E1.....Standard Specification for Solvent Cements for  
Poly (Vinyl Chloride) (PVC) Plastic Pipe and  
Fittings

D2665-08.....*Standard Specification for* Poly (Vinyl  
Chloride) (PVC) Plastic Drain, Waste, and Vent  
Pipe and Fittings

D. International Code Council:

IPC-06.....International Plumbing Code

E. Cast Iron Soil Pipe Institute (CISPI):



301-05.....Hubless Cast Iron Soil Pipe and Fittings for  
Sanitary and Storm Drain, Waste, and Vent  
Piping Applications

310-04.....Coupling for Use in Connection with Hubless  
Cast Iron Soil Pipe and Fittings for Sanitary  
and Storm Drain, Waste, and Vent Piping  
Applications

F. American Society of Sanitary Engineers (ASSE):

1018-01.....Trap Seal Primer Valves - Potable, Water  
Supplied

G. Plumbing and Drainage Institute (PDI):

PDI WH-201.....Water Hammer Arrestor

**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 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 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 lead and  
oakum.

B. Polyvinyl Chloride (PVC)

1. Polyvinyl chloride (PVC) pipe and fittings are permitted, as an alternate to cast iron, where the waste temperature is below 60°C (140°F) and the pipe is buried.
2. PVC piping and fittings shall NOT be used for the following applications:
  - a. Waste collected from steam condensate drains
  - b. Spaces such as mechanical equipment rooms, kitchens, SPD, and sterilizer areas.
  - b. Vertical waste and soil stacks serving more than two floors
  - c. Exposed in mechanical equipment rooms.
  - d. Exposed inside of ceiling return plenums.
  - e. In any location above grade
3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be schedule 40 solid core sewer piping conforming to ASTM D 1785 and ASTM D2665, sewer and drain series with ends for solvent cemented joints.
4. Fittings:
  - a. PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

## **2.2 EXPOSED WASTE PIPING**

- A. Full iron pipe size chrome plated brass piping 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 Fed. Spec. WW-P-351, standard weight.
  2. The Fittings shall conform to ANSI B16.15, cast bronze threaded fittings with chrome finish, (125 and 250).
  3. Nipples shall conform to ASTM B 687, 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.

### **2.3 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. 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 di-electric nipples shall be electroplated steel nipple complying 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); 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 shall use plain end (hubless) blind plug and clamp.

## **2.5 FLOOR DRAINS**

- A. Type B (FD-B) floor drain shall comply with ANSI A112.6.3. The type B floor drain shall be constructed of galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom. The grate shall be 175 mm (7 inches) minimum.
- B. Type Y (FD-Y) floor drain shall comply with ANSI A112.6.3. The type Y floor drain shall be suitable for parking decks and constructed of extra heavy duty, galvanized cast iron body with double drainage pattern. The extra heavy duty polished bronze grate shall be not less than 225 mm (9 inches) in diameter with seepage pan and combination membrane flashing clamp, heavy duty support flange, under deck clamp and vandal proof grate.

## **2.6 TRAPS**

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps shall be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

## **2.7 TRAP SEAL PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS**

- A. Trap Primer (TP-1): The trap seal primer system shall be electronic type conforming to ASSE 1044.
  - 1. The controller shall have a 24 hour programmable timer, solid state, 6 outlet zones, minimum adjustable run time of 1 minute for each zone, 12 hour program battery backup, manual switch for 120VAC power, 120VAC to 24VAC internal transformer, fuse protected circuitry, UL listed, 120VAC input-24VAC output, constructed of enameled steel or plastic.
  - 2. The cabinet shall be recessed mounting with a stainless steel cover.
  - 3. The solenoid valve shall have a brass body, Buna "N" seats, normally closed, 5.98 kPa (125 psi) rated, 24VAC.

4. The control wiring shall be copper in accordance with the latest edition of the National Electric Code, Article 725 and not less than 18 gauge. All wiring shall be in conduit and in accordance with Division 26 of the specifications.
5. The vacuum breaker shall conform to ASSE 1001.
- B. Trap Primer (TP-2): The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 5.98 kPa (125 psig) and conforming to standard ASSE 1018.
  1. The inlet and outlet connections shall be 15 mm or DN15 (NPS ½ inch)
  2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
  3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
  4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
  5. The manifold shall be omitted when serving only one trap.

## **2.8 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 shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall extend through the floor slab. A waterproof 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 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. Unless specifically indicated on the drawings, the minimum slope shall be 2% slope.
- H. The piping shall be installed free of sags and bends.
- I. Seismic restraint shall be installed where required by code.
- J. 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 shall 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 shall 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.
- K. Buried soil and waste drainage and vent piping shall be either cast iron soil piping or PVC 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.
- L. Above ground soil and waste drainage and vent piping shall be cast iron soil piping. 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"
- M. Underground PVC piping shall be installed according to ASTM D2321.

### **3.2 JOINT CONSTRUCTION**

- A. 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.
- B. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

### **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, 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 shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories shall 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. 80 mm or DN 80 (NPS 3 inch): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
  - 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 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 19 mm ( $\frac{3}{4}$  inch) rod.
5. 250 mm or DN250 to 300 mm or DN 300 (NPS 10 inch to NPS 12 inch):  
1500 mm (60 inch) with 22 mm ( $\frac{7}{8}$  inch) rod.
- E. The maximum spacing for plastic pipe 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, 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.
  7. Riser clamps shall be malleable iron or steel.
  8. Rollers shall be cast iron.
  9. 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 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. Piping shall conform to the following:

1. Waste and Vent Drain to main stacks:

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

2. 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 35 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.
3. Final Tests: Either one of the following tests shall 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 (2 ounces) of peppermint into each line or stack.

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**SECTION 22 14 00**  
**FACILITY STORM DRAINAGE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. 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, PLUMBING 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. Roof Drains.  
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
- D2000-08.....Standard Classification System for Rubber  
Products in Automotive Applications
- D4101-07.....Standard Specification for Propylene Plastic  
Injection and Extrusion Materials
- D2447-03.....Standard Specification for Polyethylene (PE)  
Plastic Pipe, Schedule 40 and 80, Based on  
Outside Diameter
- D2564-04e1.....Standard Specification for Solvent Cements for  
Poly (Vinyl Chloride) (PVC) Plastic Pipe and  
Fittings
- D2665-07.....Standard Specification for Poly (Vinyl  
Chloride) (PVC) Plastic Drain, Waste, and Vent  
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. Pipe buried in or in contact with earth.
  - 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.

### **2.2 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 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.

### 2.3 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. 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 where shall be provided where indicated on the drawings and at each building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty.
- 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 shall use plain end (no-hub) blind plug and clamp.

#### **2.4 ROOF DRAINS AND CONNECTIONS**

- A. Roof Drains: Roof Drains (RD) shall be cast iron with clamping device for making watertight connection. Free openings through strainer shall be twice area of drain outlet. For roof drains not installed in connection with a waterproof membrane, a soft copper membrane shall be provided 300 mm (12 inches) in diameter greater than outside diameter of drain collar. An integral gravel stop shall be provided for drains installed on roofs having built up roofing covered with gravel or slag. Integral no-hub, soil pipe gasket or threaded outlet connection shall be provided.

1. Flat Roofs: The roof drain shall have a beehive or dome shaped strainer with integral flange not less than 300 mm (12 inches) in diameter. For an insulated roof, a roof drain with an adjustable drainage collar shall be provided, which can be raised or lowered to meet required insulation heights, sump receiver and deck clamp. The Bottom section shall serve as roof drain during construction before insulation is installed.
2. Canopy Roofs: The roof drain shall have a beehive or dome shaped strainer with the integral flange not larger than 200 mm (8 inches) in diameter. For an insulated roof, the roof drain shall be provided with an adjustable drainage collar, which can be raised or lowered to meet the required insulation heights, sump receiver and deck clamp. Bottom section shall serve as roof drain during construction before insulation is installed.
3. Promenade Decks: the roof drain shall be the same as for canopy roofs, except decks shall have flat, round, loose, non-slip, bronze grate set in square, non-slip, bronze frame.
4. Portico Roofs and Gutters: Roof drains shall be horizontal angle type drain with flat bottom and horizontal outlet at the same

- elevation as the pipe to which it is connected. Strainer shall be removable angle grate type.
5. Protective Roof Membrane Insulation Assembly: The roof drain shall have a perforated stainless steel extension filter, non puncturing clamp ring, large sump with extra wide roof flange and deck clamp.
- a. Non pedestrian Roofs: The roof drain shall have large polypropylene or aluminum locking dome.
- b. Pedestrian Roof: The rood drain shall have a bronze promenade top 350 mm (14 inches) square, set in square secured frame support collar.
6. Roof Drains, Overflow: Roof Drains identified as overflow drains shall have a 50 mm (2 inch) water dam integral to the drain body.
7. Roof drains in areas subject to freezing shall have heat tape and shall be insulated.
- B. Expansion Joints: Expansions joints shall be heavy cast iron with cast brass or copper expansion sleeve having smooth bearing surface working freely against a packing ring held in place and under pressure of a bolted gland ring, forming a water and air tight flexible joint. Asbestos packing is prohibited.
- C. Interior Downspouts: An expansion joint shall be provided, specified above, at top of run on straight, vertical runs of downspout piping 12 m (40 feet) long or more.
- D. Downspout Nozzle: The downspout nozzle fitting shall be of brass, unfinished, with internal pipe thread for connection to downspout.

## **2.5 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 shall extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that shall 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 shall 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".

M. Aboveground PVC piping shall be installed according to ASTM D2665.

Underground PVC piping shall be installed according to ASTM D2321.

### **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. 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.
- F. for PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

### **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, 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 shall 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 shall 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.

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**SECTION 22 33 00**

**ELECTRIC DOMESTIC WATER HEATERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

- A. This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

**1.2 RELATED WORK:**

- A. Section 09 91 00, PAINTING: Preparation and finish painting.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Section 22 07 11, PLUMBING INSULATION: Heater Insulation.
- D. 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING, and 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.

**1.3 QUALITY ASSURANCE:**

- A. Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for efficiency performance:
  - 1. ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings,"for commercial water heaters."
- B. Electrical components, devices and accessories shall be listed and labeled B as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- C. ASME code construction shall be a vessel fabricated in compliance with the ASME boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Fabricate and label equipment components that shall be in contract with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects"

**1.4 SUBMITTALS:**

- A. Submit manufacturer's literature and data pertaining to the water heater in properly bound package, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include the following as a minimum:
  - 1. Water Heaters.
  - 2. Pressure and Temperature Relief Valves.
  - 4. Thermometers.
  - 5. Pressure Gages.



6. Vacuum Breakers.
- B. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
1. Rated Capacities.
  2. Operating characteristics.
  3. Electrical characteristics.
  4. Furnished specialties and accessories.
  5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.
- C. Shop drawings shall include wiring diagrams for power, signal and control functions.
- D. Seismic qualification certificates shall be submitted that details equipment anchorage components, identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.
- E. The domestic water heater shall be certified and labeled by a testing agency.

**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 Sanitary Engineering (ASSE):  
1005.....Performance Requirements for Water Heater Drain Valves, 20 mm (3/4 inch) size
- C. American National Standard Institute (ANSI):  
Z21.22B-2001.....Relief Valves for Hot Water Supply Systems
- D. American Society of Mechanical Engineers (ASME):  
B1.20.1-83(R 2006).....Pipe Threads, General Purpose (Inch)  
B16.5-03.....Standard for Pipe Flanges and Flanged Fittings:  
NPS ½ through NPS 24  
B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500.  
PTC 25.3-02.....Pressure Relief Devices  
Section IV-07.....Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers

Section VIII D1-07.....Boiler and Pressure Vessel Code, Section VIII,  
Pressure Vessels Division 1 -Basic Coverage

E. National Fire Protection Association (NFPA)

70-06.....National Electrical Code

F. Underwriters Laboratories, Inc. (UL):

174-04.....Household Electric Storage Tank Water Heaters

1453-04.....Water Heaters, Electric Booster and Commercial  
Storage Tank

499-05.....Standard for Safety Electric Heating Appliances

#### 1.6 AS-BUILT DOCUMENTATION

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments 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 shall be required to employ shall be inserted into the As-Built documentation.

## **PART 2 - PRODUCTS**

### **2.1 ELECTRIC, TANKLESS, DOMESTIC WATER HEATER**

- A. Electric, Tankless, domestic water heaters shall be constructed with copper piping or tubing complying with NSF 61 barrier materials for potable water without storage capacity.
- B. The pressure rating shall be 1035 kPa (150 psig).
- C. The heating element shall be resistance heating system type.
- D. Temperature control shall be made with thermostat.
- E. The safety control shall be a high temperature limit cutoff device or system.
- F. The heater shall have a bracket for wall mounting and have an aluminum or steel with enameled jacket.

### **2.2 DOMESTIC HOT WATER COMPRESSION TANKS**

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air pre charge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

### **2.3 ELEVATED ELECTRIC WATER HEATER DRAIN PAN**

- A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than 20 millimeter or DN 20 (NPS ¾") with ASME B1.20.7 garden hose threads.

### **2.4 HEAT TRAPS**

- A. Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

### **2.5 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES**

- A. The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as

the heat input and include a pressure setting less than the water heater's working pressure rating.

## **2.6 THERMOMETERS:**

- A. The thermometers shall be straight stem, iron case, red reflecting mercury thermometer or red liquid-filled thermometers, approximately 175 mm (7 inches) high, 4 to 115°C (40 to 240°F).

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains.
- E. Thermometers shall be installed on the water heater inlet and outlet piping.
- F. The thermostatic control shall be set for a maximum setting of 54 degrees C (130 degrees F).
- G. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- H. All manufacturers's required clearances shall be maintained.
- I. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- J. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic hot water heater storage tanks.
- K. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic hot water heaters without integral drains.

### **3.2 LEAKAGE TEST:**

- A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1375 kPa (200 psi) and 1654 kPa (240 psi) for a

unit with a MAWP of 1103 kPa (160 psi). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the VA.

**3.3 PERFORMANCE TEST:**

A. All of the remote water outlets shall have a minimum of 49°C (120°F) and a maximum of 54°C (130°F) water flow at all times. If necessary, make all corrections to balance the return water system or reset the thermostat to make the system comply with design requirements.

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**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. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.  
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. National Sanitation Foundation (NSF)/American National Standards  
Institute (ANSI):  
61-2009 .....Drinking Water System Components-Health Effects
- 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 IPBC 2009.

## **PART 2 - PRODUCTS**

### **2.1 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.

### **2.2 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 CONTRACTING OFFICER'S REPRESENTATIVE.
- 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.

### **2.3 ESCUTCHEONS**

- A. 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.

### **2.4 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 shall 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.

### **2.5 SINKS AND LAUNDRY TUBS**

- A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.
- B. (P-502) Service Sink (Corner, Floor Mounted) stain resistant terrazzo, 711 mm by 711 mm by 305 mm (28 inches by 28 inches by 12 inches) with 152 mm (6 inches) drop front. Terrazzo, composed of marble chips and white Portland cement, shall develop compressive strength of 20684 kPa (3000 psi) seven days after casting. Provide extruded aluminum cap on front side.
1. Faucet: Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, integral stops, mounted on wall above sink. Spout shall have a pail hook, 19 mm (3/4 inch) hose coupling



- threads, vacuum breaker, and top or bottom brace to wall. Four-arm handles on faucets shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish. Provide 914 mm (36 inches) hose with wall hook. Centerline of rough in is 1219 mm (48 inches) above finished floor.
2. Drain: Seventy six millimeter (3 inches) cast brass drain with nickel bronze strainer.
  3. Trap: P-trap, drain through floor.

## **2.6 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES**

- A. (P-801) Wall Hydrant: Cast bronze non-freeze hydrant with detachable T-handle. Brass operating rod within casing of bronze pipe of sufficient length to extend through wall and place valve inside building. Brass valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer removable through face of hydrant; 19 mm (3/4 inch) hose thread on spout; 19 mm (3/4 inch) pipe thread on inlet. Finish shall be rough; exposed surfaces shall be chrome plated. Set not less than 457 mm (18 inches) nor more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker which automatically drains when shut off.

## **3.0 CLEANING**

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

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**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. COR: Contracting Officer's 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. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout
- E. Section 07 84 00, FIRESTOPPING
- F. Section 07 92 00, JOINT SEALANTS
- G. Section 09 91 00, PAINTING
- H. Section 23 34 00, HVAC FANS
- I. Section 23 81 00, DECENTRALIZED UNITARY HVAC EQUIPMENT
- J. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

**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. 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 Contracting Officer's Representative.
  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.
- C. 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.
- D. HVAC Mechanical Systems 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 has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.

E. 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 Contracting Officer's Representative for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Contracting Officer's Representative at least two weeks prior to commencing installation of any item. Installation of the item shall 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.

- F. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who shall 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 shall 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 shall 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. 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.
    - c. Hangers, inserts, supports, and bracing.
    - d. Pipe sleeves.
    - e. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- G. 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 Contracting Officer's Representative.
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.

H. 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.

- I. 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. American Society of Mechanical Engineers (ASME):

Boiler and Pressure Vessel Code (BPVC):

Section I-2007.....Power Boilers

Section IX-2007.....Welding and Brazing Qualifications

Code for Pressure Piping:

B31.1-2007.....Power Piping

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 Contracting Officer's Representative. 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. Clean interior of all tanks prior to delivery for beneficial use by the Government.
4. Boilers shall be left clean following final internal inspection by Government insurance representative or inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.



## **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, shall be the same make and model. Exceptions shall be permitted if performance requirements cannot be met.

### **2.2 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 shall 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 shall 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 or fixed-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 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 and Boiler Plant: Provide for all valves other than for equipment in Section 23 82 00, CONVECTION HEATING AND COOLING UNITS.
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.

## **2.5 FIRESTOPPING**

A. 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, PLUMBING, AND BOILER PLANT INSULATION, for firestop pipe and duct insulation.

## **2.6 GALVANIZED REPAIR COMPOUND**

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

## **2.7 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 Contracting Officer's Representative 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 Contracting Officer's Representative 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 shall be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- F. Attachment to Wood Construction: Wood screws or lag bolts.
- G. 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.
- H. 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.

I. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping.

Refer to Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT 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.

## 2.8 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 shall be installed in concrete beam flanges. Any deviation from these requirements shall receive prior approval of Contracting Officer's Representative.
- 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.

## **2.9 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.

## **2.10 SPECIAL TOOLS AND LUBRICANTS**

- A. Furnish, and turn over to the Contracting Officer's Representative, 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 Contracting Officer's Representative.
- 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.

## **2.11 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.

## **2.12 ASBESTOS**

- A. 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 shall not be allowed, except as permitted by Contracting Officer's Representative 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 Contracting Officer's Representative. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Contracting Officer's Representative for approval.
  3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but shall be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but shall be provided.
- H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but shall 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 Contracting Officer's Representative. Damaged or defective items in the opinion of the Contracting Officer's Representative, 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. 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).
- N. 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 shall 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 shall be offered by Contractor and shall 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 shall 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 Contracting Officer's Representative 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 shall 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 Contracting Officer's Representative.

- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above shall 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 shall 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.

### **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 Contracting Officer's Representative 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 STARTUP AND TEMPORARY OPERATION**

- A. 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.

### **3.11 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 Contracting Officer's Representative.
- B. Shall 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.

### **3.12 INSTRUCTIONS TO VA PERSONNEL**

- A. Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS, and Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.

- - - 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, vibration tolerance and vibration isolation for HVAC and plumbing work.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION:  
General mechanical requirements and items, which are common to more than one section of Division 23.
- B. SECTION 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC:  
requirements for sound and vibration tests.
- C. SECTION 23 34 00, HVAC FANS: sound and vibration isolation requirements for fans.

**1.3 QUALITY ASSURANCE**

- A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- 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
Audio Speech Pathology	25
Audio Suites	25
Auditoriums, Theaters	35-40
Bathrooms and Toilet Rooms	40
Chapels	35
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40
Dining Rooms, Food Services/ Serving	40
Examination Rooms	35
Gymnasiums	50
Kitchens	50
Laboratories (With Fume Hoods)	45 to 55
Laundries	50



Lobbies, Waiting Areas	40
Locker Rooms	45
Offices, Large Open	40
Offices, Small Private	35
Operating Rooms	40
Patient Rooms	35
Phono/Cardiology	25
Recreation Rooms	40-45
Shops	50
SPD (Decontamination and Clean Preparation)	45
Therapeutic Pools	45
Treatment Rooms	35
Warehouse	50
X-Ray and General Work Rooms	40

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.
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 100 percent of the weight of the equipment furnished.

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

- C. 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.
  - 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.

#### **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 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.
- 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).
- 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.
- 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.

## **2.3 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.

### **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.

- - - 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>REFRIGERATION MACHINES</b>															
ABSORPTION	---	D	0.3	---	SP	0.8	---	SP	1.5	---	SP	1.5	---	SP	2.0
PACKAGED HERMETIC	---	D	0.3	---	SP	0.8	---	SP	1.5	---	SP	1.5	R	SP	2.5
OPEN CENTRIFUGAL	B	D	0.3	B	SP	0.8	---	SP	1.5	B	SP	1.5	B	SP	3.5
RECIPROCATING:															
ALL	---	D	0.3	---	SP	0.8	R	SP	2.0	R	SP	2.5	R	SP	3.5
<b>COMPRESSORS AND VACUUM PUMPS</b>															
UP THROUGH 1-1/2 HP	---	D,L, W	0.8	----	D,L, W	0.8	---	D,L, W	1.5	---	D,L, W	1.5	---	D,L, W	---
2 HP AND OVER:															
500 - 750 RPM	---	D	0.8	---	S	0.8	---	S	1.5	---	S	1.5	---	S	2.5
750 RPM & OVER	---	D	0.8	---	S	0.8	---	S	1.5	---	S	1.5	---	S	2.5
<b>PUMPS</b>															
CLOSE COUPLED	UP TO 1-1/2 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W
	2 HP & OVER	---	---	---	I	S	0.8	I	S	1.5	I	S	1.5	I	S

H.H. McGuire VAMC  
Construct New Parking Garage  
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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
LARGE INLINE	Up to 25 HP	---	---	---	---	S	0.75	---	S	1.50	---	S	1.50	---	---	NA
	26 HP THRU 30 HP	---	---	---	---	S	1.0	---	S	1.50	---	S	2.50	---	---	NA
BASE MOUNTED	UP TO 10 HP	---	---	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---	---	D,L, W	---
	15 HP THRU 40 HP	I	S	1.0	I	S	1.0	I	S	2.0	I	S	2.0	I	S	2.0
	50 HP & OVER	I	S	1.0	I	S	1.0	I	S	2.0	I	S	2.5	I	S	2.5
<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

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
60 HP & OVER:															
UP TO 300 RPM	B	S	2.0	I	S	2.5	I	S	3.5	I	S	3.5	I	S	3.5
301 - 500 RPM	B	S	2.0	I	S	2.0	I	S	2.5	I	S	3.5	I	S	3.5
501 RPM & OVER	B	S	1.0	I	S	2.0	I	S	2.0	I	S	2.5	I	S	2.5
COOLING TOWERS															
UP TO 500 RPM	---	---	---	---	SP	2.5	---	SP	2.5	---	SP	2.5	---	SP	3.5
501 RPM & OVER	---	---	---	---	SP	0.75	---	SP	0.75	---	SP	1.5	---	SP	2.5
INTERNAL COMBUSTION ENGINES															
UP TO 25 HP	I	N	0.75	I	N	1.5	I	S	2.5	I	S	3.5	I	S	4.5
30 THRU 100 HP	I	N	0.75	I	N	1.5	I	S	2.5	I	S	3.5	I	S	4.5
125 HP & OVER	I	N	0.75	I	N	1.5	I	S	2.5	I	S	3.5	I	S	4.5
AIR HANDLING UNIT PACKAGES															
SUSPENDED:															
UP THRU 5 HP	---	---	---	---	H	1.0	---	H	1.0	---	H	1.0	---	H	1.0
7-1/2 HP & OVER:															
UP TO 500 RPM	---	---	---	---	H, THR	1.5	---	H, THR	2.5	---	H, THR	2.5	---	H, THR	2.5
501 RPM & OVER	---	---	---	---	H, THR	0.8	---	H, THR	0.8	---	H,TH R	0.8	---	H,TH R	2.0

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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
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
HEAT PUMPS															
ALL	---	S	0.75	---	S	0.75	---	S	0.75	CB	S	1.5	---	---	NA
CONDENSING UNITS															
ALL	---	SS	0.25	---	SS	0.75	---	SS	1.5	CB	SS	1.5	---	---	NA
IN-LINE CENTRIFUGAL AND VANE AXIAL FANS, FLOOR MOUNTED: (APR 9)															
UP THRU 50 HP:															
UP TO 300 RPM	---	D	---	R	S	2.5	R	S	2.5	R	S	2.5	R	S	3.5
301 - 500 RPM	---	D	---	R	S	2.0	R	S	2.0	R	S	2.5	R	S	2.5
501 - & OVER	---	D	---	---	S	1.0	---	S	1.0	R	S	2.0	R	S	2.5
60 HP AND OVER:															
301 - 500 RPM	R	S	1.0	R	S	2.0	R	S	2.0	R	S	2.5	R	S	3.5
501 RPM & OVER	R	S	1.0	R	S	2.0	R	S	2.0	R	S	2.0	R	S	2.5

**NOTES:**

1. Edit the Table above to suit where isolator, other than those shown, are used, such as for seismic restraints and position limit stops.
2. For suspended floors lighter than 100 mm (4 inch) thick concrete, select deflection requirements from next higher span.
3. For separate chiller building on grade, pump isolators may be omitted.
4. Direct bolt fire pumps to concrete base. Provide pads (D) for domestic water booster pump package.
5. For projects in seismic areas, use only SS & DS type isolators and snubbers.
6. For floor mounted in-line centrifugal blowers (ARR 1): use "B" type in lieu of "R" type base.
7. Suspended: Use "H" isolators of same deflection as floor mounted.

**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. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
6. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

**1.2 RELATED WORK**

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.
- B. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.
- C. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings.
- D. Section 23 82 00, CONVECTION HEATING AND COOLING UNITS
- E. Section 23 34 00, HVAC FANS

### 1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC,
- 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 Contracting Officer's Representative (COR) 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 COR 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 COR. 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. Exhaust hoods/cabinets: 0 percent to plus 10 percent.
- 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 pumps and hot water coils: Minus 5 percent to plus 5 percent.
- g. Chilled water and condenser water pumps: Minus 0 percent to plus 5 percent.
- 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 COR for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the COR) 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 COR, 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**

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

#### **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**

- A. The TAB Specialist shall review the Contract Plans and specifications and advise the COR 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**

- A. 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 COR.
- B. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to COR in standard format.
- 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 Contracting Officer's Representative.

### **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 Contracting Officer's Representative 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 Contracting Officer's Representative.

### **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. Allow 7 days time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- D. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, computer room AC units, and laboratory fume hoods and biological safety cabinets.
  - 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. Record final measurements for air handling equipment performance data sheets.

### 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 centrifugal/screw compressors, cooling towers, pumps, fans and motors.
- B. Record initial measurements for each unit of equipment on test forms and submit a report to the Contracting Officer's Representative. 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 COR.

### 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.
- 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), as in Section 23 65 00, COOLING TOWERS, 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 Contracting Officer's Representative 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 Contracting Officer's Representative based on the recorded sound data.

### **3.10 MARKING OF SETTINGS**

- A. 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 Contracting Officer's Representative.

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

- A. 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.

- - E N D - - -

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

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide integration with the existing direct-digital control system as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications. Include all engineering, programming, controls and installation materials, installation labor, verification and start-up, training, final project documentation and warranty.
1. The indicated temperature sensors shall be integrated with the existing Johnson Controls Metasys direct-digital control system. The existing ECC is located in the Boiler plant, Building 501.
  2. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, and power supplies. 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.
- 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. 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. The following systems have limited control (as individually noted below) from the ECC:
  - a. Constant temperature rooms: temperature out of acceptable range and status alarms.

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
All control system nodes, equipment, housings, enclosures and panels.	23 09 23	23 09 23	23 09 23	26
A/C Unit field-mounted controls	23	23	16	26
Control system interface with A/C controls	23 09 23	23 09 23	23 09 23	26
A/C unit controls interface with control system	23	23 09 23	23 09 23	26

F. This facility's existing direct-digital control system is manufactured by Johnson Controls and its ECC is located at Building 501. The contractor administered by this Section of the technical specifications shall observe the capabilities, communication network, services, spare capacity of the existing control system and its ECC prior to beginning work.

G. This campus has standardized on an existing Metasys 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 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 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 Metasys network(s) with the Control System Integrator's area control through an Ethernet connection provided by the Control System Integrator.
3. 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, Cabinet Unit Heaters, Fan Coil Units, Base Board Heaters, thermal comfort ventilation fans, and similar units for control of room environment conditions shall 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. Light-switch-operated toilet exhaust
2. Vestibule heater
3. Exterior stair heater
4. Attic heating and ventilation
5. Mechanical or electrical room heating and ventilation.

## **1.2 RELATED WORK**

- A. Section 23 81 00, Decentralized Unitary HVAC Equipment.
- B. Section 26 05 33, Raceway and Boxes for Electrical Systems.

## **1.3 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. ARCNET: ANSI/ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it's possible to determine the maximum delay before a device is able to transmit a message.
- 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 shall 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 shall 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. MS/TP: Master-slave/token-passing (ISO/IEC 8802, Part 3). It is not an acceptable LAN option for VA health-care facilities. It uses twisted-pair wiring for relatively low speed and low cost communication.
- 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 shall 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 shall 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 verification 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 shall 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 shall 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 shall 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.

SPEC WRITER NOTE: Edit the following  
Table to suit Project.

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	$\pm 0.5^{\circ}\text{C}$ ( $\pm 1^{\circ}\text{F}$ )

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
Space Temperature	$\pm 1.0^{\circ}\text{C}$ ( $\pm 2.0^{\circ}\text{F}$ )	

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.

#### **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.
  - 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 shall clearly reference the specification and/or drawings that it supposed to represent.
- 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. 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.
- 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.

F. Submit Performance Report to COR prior to final inspection.

**1.8 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)**

- A. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

**1.9 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.

**2.3 COMMUNICATION**

A. Indicated temperature sensors shall be compatible with the existing  
Johnson Controls Metasys system.

**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 COR 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.

B. 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.
1. 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 shall 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 form 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.

### **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. Shall random sampling indicate improper operation, 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. The following witnessed demonstrations of field control equipment shall be included:
  - b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
  - d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.

**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 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

**1.3 QUALITY ASSURANCE**

- A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- 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. Centrifugal fans, motors, drives, accessories and coatings.
    - a. In-line centrifugal fans.
    - b. Tubular Centrifugal Fans.
    - c. Up-blast kitchen hood exhaust fans.
    - d. Industrial fans.
    - e. Utility fans and vent sets.
  3. Prefabricated roof curbs.
  4. Power roof and wall ventilators.
  5. Centrifugal ceiling fans.
  6. Propeller fans.
  7. Packaged hood make-up air units.
  8. Vane axial fans.
  9. Tube-axial fans.
  10. Air curtain units.
- 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)**

A. 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. SWS1 fans: Arrangement 1, 3, 9 or 10,

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 AND STEAM GENERATION for controller/motor combination requirements.
- D. In-line Centrifugal Fans: In addition to the requirements of paragraphs A and 2.2.C3 thru 2.2.C9, provide minimum 18 Gauge galvanized steel housing with inlet and outlet flanges, backward inclined aluminum centrifugal fan wheel, bolted access door and supports as required. Motors shall be factory pre-wired to an external junction box.
- E. Tubular Centrifugal Fans: In addition to the requirements of paragraphs A and 2.2.C2 thru 2.2.C9 provide;
1. Housings: Hot rolled steel, one-piece design, incorporating integral guide vanes, motor mounts, bolted access hatch and end flanges. Provide spun inlet bell and screen for unducted inlet and screen for unducted outlet. 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.
- F. Industrial Fans: Use where scheduled or in lieu of centrifugal fans for low volume high static service. Construction specifications paragraphs A and C for centrifugal fans shall apply. Provide material handling flat blade type fan wheel.

G. Utility Fans, Vent Sets and Small Capacity Fans: Class 1 design, arc welded housing, spun intake cone. Applicable construction specification, paragraphs A and C, for centrifugal fans shall apply for wheel diameters 300 mm (12 inches) and larger. Requirement for AMCA seal is waived for wheel diameters less than 300 mm (12 inches) and housings shall be cast iron.

H. Spark Resistant/Explosion Proof Fans: If flammable gas, vapor or combustible dust is present in concentrations above 20% of the Lower Explosive Limit (LEL), provide AMCA construction option: A, B or C as indicated. Drive set shall be comprised of non-static belts for use in an explosive atmosphere. Motor shall be explosion proof type if located in air stream.

#### **2.6 CENTRIFUGAL CEILING FANS (SMALL CABINET FAN)**

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Steel housing, baked enamel finish, direct connected fan assembly, attached grille. Provide gravity back draft assembly, aluminum wall cap and bird or insect screen. Provide electric motor operated damper where indicated.
- C. Acoustical Lining: 12.5 mm (1/2 inch) thick mineral fiber, dark finish. Comply with UL 181 for erosion.
- D. Motor: Shaded pole or permanent split capacitor, sleeve bearings, supported by steel brackets in combination with rubber isolators.
- E. Ceiling Grille, (Where indicated): White plastic egg crate design, 80 percent free area.
- F. Control: Provide solid state speed control (located at unit) for final air balancing.

#### **2.7 PROPELLER FANS**

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE.
- B. Belt-driven or direct-driven fans as indicated on drawings.

- C. Square steel panel, deep drawn venturi, arc welded to support arms and fan/motor support brackets, baked enamel finish. Provide wall collar for thru-wall installations.
- D. Motor, Motor Base and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Motor shall be totally enclosed type.
- E. Wire Safety Guards: Provide on exposed inlet and outlet.

### **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 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 shall include a heating function as well.
  - 4. Where such equipment is provided in more than one assembly the separated assemblies shall 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 and BOILER PLANT INSULATION: Requirements for piping insulation.
- E. Section 23 23 00, REFRIGERANT PIPING: Requirements for refrigerant pipes and fittings.
- F. Section 23 82 00, CONVECTION HEATING and COOLING UNITS: Requirements for other similar units.

### **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) Self-contained units
      - 2) Split systems
      - 3) Rooftop units
    - b. Window air conditioners
    - c. Through-the-wall packaged terminal air conditioning units
    - d. Gas-Fired Furnaces
  - 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 Contracting Officer's Representative three weeks prior to final inspection.

### **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**

### **2.3 SPLIT-SYSTEM AIR CONDITIONERS**

- A. Description: Factory assembled and tested, wall-mounted an aircooled remote condensing unit, and field-installed refrigeration pipingB.  
Concealed Evaporator Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  2. Insulation: Factory-applied duct liner.
  3. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2007.
  4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
  5. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
  6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
  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. Disposable Filters: 25 mm (1 inch) thick, in fiberboard frames
  9. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- B. Floor-Mounting, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
  2. Discharge Grille: Steel with surface-mounted frame.
  3. Insulation: Factory-installed duct liner.
  4. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1-2007.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

6. Coils:

a. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.

7. Fan: Direct drive, centrifugal.

8. Filters: Disposable, with MERV rating of 7 or higher according to ASHRAE 52.2.

C. 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. Electric-Resistance Heating Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

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.

D. 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 reciprocating or 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."

E. Water-Cooled, Compressor-Condenser Components:

1. Casing: Steel, with baked-enamel finish in color selected by Architect, removable panels for access to controls, and mounting holes in base. Service valves, fittings, and gage ports shall be brass and located on outside of casing.
2. Compressor: Hermetically sealed reciprocating or 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. Heat Exchanger: Copper tubes in copper tube or in steel shell, with water-temperature-actuated, water-regulating valve.
6. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install wind restraints according to manufacturer's written instructions. restrained vibration isolation roof-curb rails are specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- B. Install units level and plumb maintaining manufacturer's recommended clearances and tolerances.
- C. Install water-cooled units with thermometer and pressure gage at the water supply and return connection.
- D. 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
- E. Install ground-mounting, compressor-condenser components on 100 mm (4-inch) thick, reinforced concrete base; 100 mm (4 inches) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Section 03 30 00, CAST-IN-PLACE CONCRETE. Coordinate anchor installation with concrete base.
- F. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
- G. 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.
- H. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- I. 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. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- C. Install piping adjacent to units to allow service and maintenance.
- D. Gas Piping: Comply with applicable requirements in Section 23 11 23, FACILITY NATURAL-GAS PIPING. Connect gas piping to burner, full size of

gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

- E. Install ducts to termination at top of roof curb. Cut roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
- F. Connect supply ducts to units with flexible duct connectors specified in Section 23 31 00, HVAC DUCTS and CASINGS.
- G. Install return-air duct continuously through roof structure.
- 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 self contained and 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. Install ducts to the units with flexible duct connections.
- L. Connect piping with shutoff duty valves on the supply and return side of the coil and unions at all connections and with a throttling valve on the return piping near the coil.
- M. Connect piping with shutoff duty valves on the supply and return side of the water cooled condenser and unions at all connections and with a throttling valve on the return piping near the condenser
- N. Connect piping with shutoff duty valves and unions on the steam supply and condensate side of the steam coil. On the condensate line near the coil provide a strainer, trap and shutoff valve.

### **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**

- A. 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**

- A. The Contracting Officer's Representative shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative. Provide a minimum of 7 days prior notice.

**3.6 DEMONSTRATION AND TRAINING**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.

---END---

**SECTION 23 82 00**  
**CONVECTION HEATING AND COOLING UNITS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies convectors.

**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.

**1.3 QUALITY ASSURANCE**

- A. 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. Convectors.
- C. Certificates:
1. Compliance with paragraph, QUALITY ASSURANCE.
2. Compliance with specified standards.
- D. 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. American National Standards Institute / Air Conditioning, Heating and Refrigeration Institute (ANSI/AHRI):
- 440-08.....Performance Rating of Room Fan Coils
- National Fire Protection Association (NFPA):
- 90A-09.....Standard for the Installation of Air
- Conditioning and Ventilating Systems
- 70-11.....National Electrical Code
- C. Underwriters Laboratories, Inc. (UL):
- 181-08.....Standard for Factory-Made Air Ducts and Air
- Connectors

1995-05.....Heating and Cooling Equipment

#### **1.6 GUARANTY**

- A. In accordance with FAR clause 52.246-21

### **PART 2 - PRODUCTS**

#### **2.1 CONVECTORS**

- A. Ratings: In accordance with AHRI 445.
- B. Enclosure: Steel panels, minimum 1.3 mm (18 gage) front and 1.0 mm (20 gage) back and sides. Provide baked enamel finish in standard manufacturer's colors as selected by the Architect. Provide easy access to heating elements, valves and controls.
  - 1. Fully recessed units: Flanged enclosure with 13 mm (1/2-inch) thick fiber-glass insulation on the back. Provide one-piece front panel with integral inlet and outlet grilles.
  - 2. Wall hung and freestanding units:
- C. Electric Heating Elements (Wall Hung and Freestanding Units):
  - 1. Cal-rod electric resistance type inside aluminum tubes, mechanically expanded into fins and suspended between junction boxes. Provide capillary type automatic reset thermal cutout for immediate overheat protection. Front panel temperature shall not exceed 54 degrees C (130 degrees F). Units shall be UL approved.
  - 2. Unit mounted temperature control: Two stage (low/high/off) line or low voltage thermostat with control relays.

### **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. Install fiberglass blanket insulation with a minimum R value of 8 above hydronic radiant panels.

#### **3.2 OPERATIONAL TEST**

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

**3.3 STARTUP AND TESTING**

- A. The COR shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR. Provide a minimum of 7 days prior notice.

**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.

- - - 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, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
- C. 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.
- 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 shall 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 shall be safe, shall 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 shall 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 shall 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.
- 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.
- E. When Factory Testing Is Specified:

1. The Government shall have the option of witnessing factory tests.  
The Contractor shall notify the Government through the COR a minimum of 15 working days prior to the manufacturer's performing the factory tests.
2. Four copies of certified test reports shall be furnished to the COR two weeks prior to final inspection and not more than 90 days after completion of the tests.
3. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the Government to witness re-testing.

#### **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 COR.
  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 shall use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools) while working on energized systems in accordance with NFPA 70E.
  - 2. Before initiating any work, a job specific work plan shall be developed by the Contractor with a peer review conducted and documented by the COR and Medical Center staff. The work plan shall include procedures shall be used on and near the live electrical equipment, barriers shall be installed, safety equipment shall be used, and exit pathways.
  - 3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the COR.
- 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 indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm<sup>2</sup>), required PPE category and description

including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

#### **1.12 SUBMITTALS**

- A. Submit to the COR 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 shall 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 shall 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. 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.
  3. 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 shall 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 COR 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.

#### **1.14 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.

#### **1.15 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.

#### **1.16 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 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 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 COR 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.
- E. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Installation of conductors and cables in manholes and ducts.

**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.
- D. 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.
  3. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
  4. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Yellow
Blue	C	Orange
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

5. 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 COR.

6. 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 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.

## **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, manholes, 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 shall 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**

- A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

### **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 and each underground manhole and handhole, 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 manhole and handhole, install embossed brass tags to identify the system served and function.

### **3.9 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 shall 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.
- D. H. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.
- E. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage switchgear.
- F. J. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.
- G. K. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.
- H. M. Section 26 32 13, ENGINE GENERATORS: Engine generators.
- I. N. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Automatic transfer switches.
- J. 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 COR.
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**

- A. Steel or copper clad steel 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

### **2.3 CONCRETE ENCASED ELECTRODE**

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

### **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:
  1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
  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.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

### **3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS**

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
  - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
  - 2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.
- C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, 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:
  - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
  - 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 a 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.
- H. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.

### **3.6 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.

### **3.7 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.
- B. In operating rooms and at intensive care and coronary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

### **3.8 LIGHTNING PROTECTION SYSTEM**

- A. Bond the lightning protection system to the electrical grounding electrode system.

### **3.9 MAIN ELECTRICAL ROOM GROUNDING**

- A. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.

### **3.10 EXTERIOR LIGHT POLES**

- A. Provide 6.1 M (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

### **3.11 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

### **3.12 GROUND ROD INSTALLATION**

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

### **3.13 ACCEPTANCE CHECKS AND TESTS**

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems shall be used to meet the required resistance, but the specified number of electrodes shall still be provided.
- C. Below-grade connections shall be visually inspected by the COR prior to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

---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**

- A. Section 06 10 00, ROUGH CARPENTRY: Mounting board for telephone closets.
- B. Section 07 60 00, FLASHING AND SHEET METAL: Fabrications for the deflection of water away from the building envelope at penetrations.
- 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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- G. 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.
- H. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground conduits.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:

- A. Manufacturer's Literature and Data: Showing each cable type and rating. The specific item proposed and its area of application shall be identified on the catalog cuts.
- 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.

C. Certifications:

1. Two weeks prior to the final inspection, submit four copies of the following certifications to the COR:
  - a. Certification by the manufacturer that the material conforms to the requirements of the drawings and specifications.
  - b. Certification by the contractor that the material has 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):
- 70-08.....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):
- 1-05.....Flexible Metal Conduit
  - 5-04.....Surface Metal Raceway and Fittings
  - 6-07.....Electrical Rigid Metal Conduit - Steel
  - 50-95.....Enclosures for Electrical Equipment
  - 360-093.....Liquid-Tight Flexible Steel Conduit
  - 467-07.....Grounding and Bonding Equipment
  - 514A-04.....Metallic Outlet Boxes
  - 514B-04.....Conduit, Tubing, and Cable Fittings
  - 514C-96.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
  - 651-05.....Schedule 40 and 80 Rigid PVC Conduit and Fittings
  - 651A-00.....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-2-03.....Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIAL**

- A. Conduit Size: In accordance with the NEC, but not less than 0.75 in [19 mm] unless otherwise shown. Where permitted by the NEC, 0.5 in [13 mm] flexible conduit shall be used for tap connections to recessed lighting fixtures.
- B. Conduit:
1. Rigid steel: Shall conform to UL 6 and ANSI C80.1.
  2. Rigid intermediate steel conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
  3. Electrical metallic tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 4 in [105 mm] and shall be permitted only with cable rated 600 V or less.
  4. Flexible galvanized steel conduit: Shall conform to UL 1.
  5. Liquid-tight flexible metal conduit: Shall conform to UL 360.
  6. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
  7. Surface metal raceway: Shall conform to UL 5.
- C. Conduit Fittings:
1. Rigid steel and IMC 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.
- 2. 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.
    - a. Compression couplings and connectors: Concrete-tight and rain-tight, with connectors having insulated throats.
  - c) Indent-type connectors or couplings are prohibited.
  - d) Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
- 3. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp-type, with insulated throat.
- 4. 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 shall 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 0.75 in [19 mm] 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 1.5 x 1.5 in [38 mm x 38 mm], 12-gauge steel, cold-formed, lipped channels; with not less than 0.375 in [9 mm] 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. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
4. 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.

- F. Wireways: Equip with hinged covers, except where removable covers are shown. 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 shall be placed in the structural elements, such as ribs or beams. Obtain the approval of the COR 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 where permitted by the COR as required by limited working space.

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 clearances around the conduit and make watertight, as specified in Section 07 92 00, JOINT SEALANTS.

### **3.2 INSTALLATION, GENERAL**

A. In accordance with UL, NEC, as shown, and as specified herein.

B. Essential (Emergency) raceway systems shall be entirely independent of other raceway systems, except where shown on drawings.

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 undamaged material.
4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square, ream, remove burrs, and draw up tight.
6. Independently support conduit at 8 ft [2.4 M] on centers. Do not use other supports, i.e., suspended ceilings, suspended ceiling supporting members, lighting fixtures, conduits, mechanical piping, or mechanical ducts.
7. Support within 12 in [300 mm] of changes of direction, and within 12 in [300 mm] of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
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. 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 shall 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 approved by the COR.

**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 COR 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 3 in [75 mm] 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 shall be a minimum of 0.75 in [19 mm] 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:

1. Conduit for conductors 600 V and below: Rigid steel, IMC, or EMT. Mixing different types of conduits indiscriminately in the same system is prohibited.

2. Align and run conduit parallel or perpendicular to the building lines.
3. Connect recessed lighting fixtures to conduit runs with maximum 6 ft [1.8 M] of flexible metal conduit extending from a junction box to the fixture.
4. Tightening setscrews 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 above 600 V: Rigid steel. Mixing different types of conduits indiscriminately in the system is prohibited.
- C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits indiscriminately 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 8 ft [2.4 M] intervals.
- G. Surface metal raceways: Use only where shown.
- 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 2 in [50 mm] high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 20 ft [6 M] intervals in between.

#### **3.5 DIRECT BURIAL INSTALLATION**

- A. Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

#### **3.6 HAZARDOUS LOCATIONS**

- A. Use rigid steel conduit only, notwithstanding requirements otherwise specified in this or other sections of these specifications.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

#### **3.7 WET OR DAMP LOCATIONS**

- A. Unless otherwise shown, use conduits of rigid steel or IMC.
- 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. Unless otherwise shown, use rigid steel or IMC conduit within 5 ft [1.5 M] of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

### **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. Provide a green equipment grounding conductor with flexible metal conduit.

### **3.9 EXPANSION JOINTS**

- A. Conduits 3 in [75 mm] 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 3 in [75 mm] with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 5 in [125 mm] vertical drop midway between the ends. Flexible conduit shall have a bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for conduits 15 in [375 mm] and larger are acceptable.
- C. Install expansion and deflection couplings where shown.

### **3.10 CONDUIT SUPPORTS, INSTALLATION**

- 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 200 lbs [90 kg]. 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 0.25 in [6 mm] bolt size and not less than 1.125 in [28 mm] embedment.
    - b. Power set fasteners not less than 0.25 in [6 mm] diameter with depth of penetration not less than 3 in [75 mm].
    - 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.
- 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 mounted back-to-back in the same wall are prohibited. A minimum 24 in [600 mm] center-to-center lateral spacing shall be maintained between boxes.

- E. Minimum size of outlet boxes for ground fault interrupter (GFI)  
receptacles is 4 in [100 mm] square x 2.125 in [55 mm] 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.

- - - E N D - - -



**SECTION 26 05 41**  
**UNDERGROUND ELECTRICAL CONSTRUCTION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of underground ducts and raceways, and precast manholes and pullboxes to form a complete underground electrical raceway system.
- B. The terms "duct" and "conduit" are used interchangeably in this section.

**1.2 RELATED WORK**

- A. Section 07 92 00, JOINT SEALANTS: Sealing of conduit penetrations.
- 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 31 20 11, EARTH MOVING (SHORT FORM): Trenching, backfill, and compaction.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Coordinate layout and installation of ducts, manholes, and pullboxes with final arrangement of other utilities, site grading, and surface features.

**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 information on manholes, pullboxes, ducts, and hardware.  
Submit manhole plan and elevation drawings, showing openings, pulling irons, cable supports, cover, ladder, sump, and other accessories.
    - c. Proposed deviations from the drawings shall be clearly marked on the submittals. If it is necessary to locate manholes, pullboxes, or duct banks at locations other than shown on the drawings, show

the proposed locations accurately on scaled site drawings, and submit to the COR for approval prior to construction.

2. Certifications: Two weeks prior to the final inspection, submit the following.

- a. Certification by the manufacturer that the materials conform to the requirements of the drawings and specifications.
- b. Certification by the Contractor that the materials have been properly installed, connected, 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 Concrete Institute (ACI):

Building Code Requirements for Structural Concrete  
318-11/318M-11.....Building Code Requirements for Structural  
Concrete & Commentary  
SP-66-04.....ACI Detailing Manual

C. American National Standards Institute (ANSI):

77-10.....Underground Enclosure Integrity

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

C478-12.....Standard Specification for Precast Reinforced  
Concrete Manhole Sections  
C858-10e1.....Underground Precast Concrete Utility Structures  
C990-09.....Joints for Concrete Pipe, Manholes and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants.

E. National Electrical Manufacturers Association (NEMA):

TC 2-03.....Electrical Polyvinyl Chloride (PVC) Conduit  
TC 3-04.....Polyvinyl Chloride (PVC) Fittings for Use With  
Rigid PVC Conduit And Tubing  
TC 6 & 8-03.....Polyvinyl Chloride (PVC) Plastic Utilities Duct  
For Underground Installations  
TC 9-04.....Fittings For Polyvinyl Chloride (PVC) Plastic  
Utilities Duct For Underground Installation

F. National Fire Protection Association (NFPA):

70-11.....National Electrical Code (NEC)

70E-12.....National Electrical Safety Code

G. Underwriters Laboratories, Inc. (UL):

6-07.....Electrical Rigid Metal Conduit-Steel

467-07.....Grounding and Bonding Equipment

651-11.....Schedule 40, 80, Type EB and A Rigid PVC

Conduit and Fittings

651A-11.....Schedule 40 and 80 High Density Polyethylene

(HDPE) Conduit

651B-07.....Continuous Length HDPE Conduit

**PART 2 - PRODUCTS**

**2.1 PULLBOXES**

- A. General: Size as indicated on the drawings. Provide pullboxes with weatherproof, non-skid covers with recessed hook eyes, secured with corrosion- and tamper-resistant hardware. Cover material shall be identical to pullbox material. Covers shall have molded lettering, ELECTRIC or SIGNAL as applicable. Pullboxes shall comply with the requirements of ANSI 77 loading. Provide pulling irons, 22 mm (0.875 inch) diameter galvanized steel bar with exposed triangular-shaped opening.

**2.2 DUCTS**

- A. Number and sizes shall be as shown on the drawings.

B. Ducts (concrete-encased):

1. Plastic Duct:

- a. UL 651 and 651A Schedule 40 PVC conduit.
- b. Duct shall be suitable for use with 90° C (194° F) rated conductors.

2. Conduit Spacers: Prefabricated plastic.

C. Ducts (direct-burial):

1. Plastic duct:

- a. Schedule 40 PVC or Schedule 80 PVC .
- b. Duct shall be suitable for use with 75° C (167° F) rated conductors.

2. Rigid metal conduit: UL6 and NEMA RN1 galvanized rigid metal, half-lap wrapped with 10 mil PVC tape.

**2.3 GROUNDING**

- A. Ground Rods and Ground Wire: Per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

#### **2.4 WARNING TAPE**

- A. 4-mil polyethylene 75 mm (3 inches) wide detectable tape, red with black letters, imprinted with "CAUTION - BURIED ELECTRIC CABLE BELOW" or similar.

#### **2.5 PULL ROPE FOR SPARE DUCTS**

- A. Plastic with 890 N (200 lb) minimum tensile strength.

### **PART 3 - EXECUTION**

#### **3.1 TRENCHING**

- A. Refer to Section 31 20 11 EARTH MOVING (SHORT FORM) for trenching, backfilling, and compaction.
- B. Before performing trenching work at existing facilities, a Ground Penetrating Radar Survey shall be carefully performed by a certified technician to reveal all existing underground ducts, conduits, cables, and other utility systems.
- C. Work with extreme care near existing ducts, conduits, and other utilities to avoid damaging them.
- D. Cut the trenches neatly and uniformly.
- E. For Concrete-Encased Ducts:
  - 1. After excavation of the trench, stakes shall be driven in the bottom of the trench at 1.2 M (4 foot) intervals to establish the grade and route of the duct bank.
  - 2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts toward buildings wherever possible.
  - 3. The walls of the trench shall be used to form the side walls of the duct bank, provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.
  - 4. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth, and appropriate warning tape installed.
- F. Individual conduits shall be installed under existing paved areas and roads that cannot be disturbed shall be jacked into place using rigid metal conduit, or bored using plastic utilities duct or PVC conduit, as approved by the COR.

### 3.2 DUCT INSTALLATION

#### A. General Requirements:

1. Ducts shall be in accordance with the NEC, as shown on the drawings, and as specified.
2. Join and terminate ducts with fittings recommended by the manufacturer.
3. Slope ducts to drain towards manholes and pullboxes, and away from building and equipment entrances. Pitch not less than 100 mm (4 inch) in 30 M (100 feet).
4. Underground conduit stub-ups and sweeps to equipment inside of buildings shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) outside the building foundation. Tops of conduits below building slab shall be minimum 610 mm (24 inches) below bottom of slab.
5. Stub-ups and sweeps to equipment mounted on outdoor concrete slabs shall be galvanized rigid metal conduit half-lap wrapped with PVC tape, and shall extend a minimum of 1.5 M (5 feet) away from the edge of slab.
6. Install insulated grounding bushings on the conduit terminations.
7. Radius for sweeps shall be sufficient to accomplish pulls without damage. Minimum radius shall be six times conduit diameter.
8. All multiple conduit runs shall have conduit spacers. Spacers shall securely support and maintain uniform spacing of the duct assembly a minimum of 75 mm (3 inches) above the bottom of the trench during the concrete pour. Spacer spacing shall not exceed 1.5 M (5 feet). Secure spacers to ducts and earth to prevent floating during concrete pour. Provide nonferrous tie wires to prevent displacement of the ducts during concrete pour. Tie wires shall not act as substitute for spacers.
9. Duct lines shall be installed no less than 300 mm (12 inches) from other utility systems, such as water, sewer, chilled water.
10. Clearances between individual ducts:
  - a. For similar services, not less than 75 mm (3 inches).
  - b. For power and signal services, not less than 150 mm (6 inches).
11. Duct lines shall terminate at window openings in manhole walls as shown on the drawings. All ducts shall be fitted with end bells.

12. Couple the ducts with proper couplings. Stagger couplings in rows and layers to ensure maximum strength and rigidity of the duct bank.
13. Keep ducts clean of earth, sand, or gravel, and seal with tapered plugs upon completion of each portion of the work.
14. Spare Ducts: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.
15. Duct Identification: Place continuous strip of warning tape approximately 300 mm (12 inches) above ducts before backfilling trenches. Warning tape shall be preprinted with proper identification.
16. Duct Sealing: Seal ducts, including spare ducts, at building entrances and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of foreign objects and material, moisture, and gases.
17. Use plastic ties to secure cables to insulators on cable arms. Use minimum two ties per cable per insulator.

B. Concrete-Encased Ducts:

1. Install concrete-encased ducts for medium-voltage systems, low-voltage systems, and signal systems, unless otherwise shown on the drawings.
2. Duct banks shall be single or multiple duct assemblies encased in concrete. Ducts shall be uniform in size and material throughout the installation.
3. Tops of concrete-encased ducts shall be:
  - a. Not less than 600 mm (24 inches) and not less than shown on the drawings, below finished grade.
  - b. Not less than 750 mm (30 inches) and not less than shown on the drawings, below roads and other paved surfaces.
  - c. Additional burial depth shall be required in order to accomplish NEC-required minimum bend radius of ducts.
  - d. Conduits crossing under grade slab construction joints shall be installed a minimum of 1.2 M (4 feet) below slab.
4. Extend the concrete envelope encasing the ducts not less than 75 mm (3 inches) beyond the outside walls of the outer ducts.

5. Within 3 M (10 feet) of building and manhole wall penetrations, install reinforcing steel bars at the top and bottom of each concrete envelope to provide protection against vertical shearing.
6. Install reinforcing steel bars at the top and bottom of each concrete envelope of all ducts underneath roadways and parking areas.
7. Where new ducts and concrete envelopes shall be joined to existing manholes, pullboxes, ducts, and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.
8. Duct joints in concrete shall be placed side by side horizontally, but shall be staggered at least 150 mm (6 inches) vertically.
9. Pour each run of concrete envelope between manholes or other terminations in one continuous pour. If more than one pour is necessary, terminate each pour in a vertical plane and install 19 mm (0.75 inch) reinforcing rod dowels extending 450 mm (18 inches) into concrete on both sides of joint near corners of envelope.
10. Pour concrete so that open spaces are uniformly filled. Do not agitate with power equipment unless approved by COR.

### **3.3 ACCEPTANCE CHECKS AND TESTS**

#### **A. Duct Testing and Cleaning:**

1. Upon completion of the duct installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the duct, and to test for out-of-round conditions.
2. The mandrel shall be not less than 300 mm (12 inches) long, and shall have a diameter not less than 13 mm (0.5 inch) less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.
3. If testing reveals obstructions or out-of-round conditions, the Contractor shall replace affected section(s) of duct and retest to the satisfaction of the COR at no cost to the Government.
4. Mandrel pulls shall be witnessed by the COR.

---END---

**SECTION 26 09 23  
LIGHTING CONTROLS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation and connection of the lighting controls.

**1.2 RELATED WORK**

- A. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Interface of lighting controls with HVAC control systems.
- 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 21, 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 24 26 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.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Product Data: For each type of lighting control, submit the following information.
  - 1. Manufacturer's catalog data.
  - 2. Wiring schematic and connection diagram.
  - 3. Installation details.
- C. Manuals:
  - 1. Submit, simultaneously with the shop drawings companion copies of complete maintenance and operating manuals including technical data sheets, and information for ordering replacement parts.



2. Two weeks prior to the final inspection, submit four copies of the final updated maintenance and operating manuals, including any changes, to the Contracting Officer's Representative (COR).

D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the COR:
  - a. Certification by the Contractor that the equipment has 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. Green Seal (GS):  
GC-12.....Occupancy Sensors
- C. Illuminating Engineering Society of North America (IESNA):  
IESNA LM-48.....Guide for Calibration of Photoelectric Control Devices
- D. National Electrical Manufacturer's Association (NEMA)  
C136.10.....American National Standard for Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing  
ICS-1.....Standard for Industrial Control and Systems General Requirements  
ICS-2.....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.....Standard for Industrial Controls and Systems Enclosures
- E. Underwriters Laboratories, Inc. (UL):  
20.....Standard for General-Use Snap Switches  
773.....Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

773A .....Nonindustrial Photoelectric Switches for  
Lighting Control  
98.....Enclosed and Dead-Front Switches  
917.....Clock Operated Switches

## **PART 2 - PRODUCTS**

### **2.1 ELECTRONIC TIME SWITCHES**

- A. Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: DPDT.
  2. Contact Rating: 30-A inductive or resistive, ballast load, 120/240-V ac.
  3. Astronomical Clock: Capable of switching a load on at sunset and off at sunrise, and automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Additionally, it shall be programmable to a fixed on/off weekly schedule.
  4. Battery Backup: For schedules and time clock.

### **2.2 ELECTROMECHANICAL-DIAL TIME SWITCHES**

- A. Electromechanical-dial time switches; complying with UL 917.
1. Contact Configuration: DPDT.
  2. Contact Rating: 30-A inductive or resistive,
  3. Wound-spring reserve carryover mechanism to keep time during power failures.

### **2.3 OUTDOOR PHOTOELECTRIC SWITCHES**

- A. Solid state, with DPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc [16.14 to 108 lx], with adjustable turn-on and turn-off levels.
  2. Time Delay: 15-second minimum.
  3. Surge Protection: Metal-oxide varistor.
  4. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

### **2.4 TIMER SWITCHES**

- A. Digital switches with backlit LCD display, 120/277 volt rated, fitting as a replacement for standard wall switches.
1. Compatibility: Compatible with all ballasts.

2. Warning: Audible warning to sound during the last minute of "on" operation.
3. Time-out: Adjustable from 5 minutes to 12 hours.
4. Faceplate: Refer to wall plate material and color requirements for toggle switches, as specified in Section 26 27 26, WIRING DEVICES.

## **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 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  3. Monitoring Range: 10 to 200 fc [108 to 2152 lx], 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**

- A. Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight; with separate relay unit.
  1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  2. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  3. Monitoring Range: 1000 to 10,000 fc [10,800 to 108,000 lx], 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.

## **2.7 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 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  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 2 to 200 fc [21.5 to 2152 lx]; 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 ultrasonic detection methods, field-selectable.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm], and detect a person of average size and weight moving not less than 12 inches [305 mm] in either a horizontal or a vertical manner at an approximate speed of 12 inches/s [305 mm/s].
  3. Detection Coverage: as scheduled on drawings.

## **2.8 OUTDOOR MOTION SENSOR (PIR)**

- A. Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C).
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a 1 to 15 minute adjustable time delay for turning lights off.
  2. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.

- b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
- 3. Bypass Switch: Override the on function in case of sensor failure.
- 4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc [11 to 215 lx]; keep lighting off during daylight hours.
- B. Detector Sensitivity: Detect occurrences of 6-inch [150mm] minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. [232 sq. cm].
- C. Detection Coverage: as scheduled on drawings.
- D. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  - 1. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  - 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

## **2.9 LIGHTING CONTROL PANEL - RELAY TYPE**

- A. 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 sensors and other sources, and capable of timed overrides and/or blink-warning on a per-circuit basis. Controller communication protocol shall be compatible with the building automation system specified in SECTION 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. 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.
- B. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.
- C. Directory: Identifies each relay as to load controlled.
- D. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
- E. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20 A, 125-V ac for tungsten

filaments and 20 A, 277-V ac for ballasts, 50,000 cycles at rated capacity.

**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 photocell switch according to manufacturer's recommendations. Set adjustable window slide for 1 footcandle photocell 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 15 minutes.
- E. Locate light level sensors as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for the scheduled light level at the typical work plane for that area.
- F. Label time switches and contactors with a unique designation.

**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. Program lighting control panels per schedule on drawings.

**3.3 FOLLOW-UP VERIFICATION**

- A. 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.

- - - 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.  
C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- 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: Conduit.

**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, 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 shall 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. Exterior Location: Mount transformers on concrete slab. Unless otherwise indicated, the slab shall be at least 200 mm (8 inches) thick, reinforced with a 150 by 150 mm (6 by 6 inches) No. 6 mesh placed uniformly 100 mm (4 inches) from the top of the slab. Slab shall be placed on a 150 mm (6 inches) thick, well-compacted gravel base. The top of the concrete slab shall be approximately 100 mm (4 inches) above the finished grade. Edges above grade shall have 15 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment shall be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE
- D. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation. Minimum clearance shall be 150 mm (6 inches).
- E. 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**

- A. Section 09 91 00, PAINTING: Painting of panelboards.
- 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 fault currents.
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- F. Section 26 09 23, LIGHTING CONTROLS: Lighting controls integral to panelboards.

**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 shall 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 and 120/240 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 shall 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. Breaker magnetic trip setting shall be set to maximum, unless otherwise noted.
- 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.

### **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. Install a printed schedule of circuits in each panelboard after approval by the COR. 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
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.

#### **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 21, 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 brown 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 brown 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 brownnylon.

- 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, in use 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.
- E. Surge Protective (TVSS) Receptacles shall have integral surge suppression in line to ground, line to neutral, and neutral to ground modes.
  - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 Volts and minimum single transient pulse energy dissipation of 210 Joules.
  - 2. Active TVSS Indication: LED, visible in face of device to indicate device is active or no longer in service.

## **2.2 TOGGLE SWITCHES**

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be brown 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 302 stainless steel in color unless otherwise specified.

## **2.4 WALL PLATES**

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- B. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- C. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- D. Duplex Receptacles on Emergency Circuit: Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters.

## **2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES**

- A. Shall have the following features:
1. Enclosures:
    - a. Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1-1/2 inches by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3-1/2 square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
  2. Receptacles shall be duplex, hospital grade. See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
  3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.
  4. Conductors shall be as specified in Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.
  5. Installation fittings shall be the manufacturer's standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
  6. Bond the assemblies to the branch circuit conduit system.

### **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 shall 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 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 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 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:  
Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- E. 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.
  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**

- A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

### **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**

- A. Shall be in accordance with NEMA FU 1.
- B. Service Entrance: Class RK1, time delay.
- C. Feeders: Class RK1, time delay .
- D. Motor Branch Circuits: Class RK5, time delay.
- E. Other Branch Circuits: Class RK1, time delay Class J, time delay.
- F. Control Circuits: Class CC, fast acting.

## **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. 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 COR.

---END---

**SECTION 26 32 13**  
**ENGINE GENERATORS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the low-voltage engine generators.

**1.2 RELATED WORK**

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- 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 fault currents.
- E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Requirements for pipe and equipment support and noise control.
- F. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Requirements for hot piping and equipment insulation.
- G. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Requirements for secondary distribution switchgear.
- H. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Requirements for secondary distribution switchboards.
- I. Section 26 36 23, AUTOMATIC TRANSFER SWITCHES: Requirements for automatic transfer switches for use with engine generators.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 8 hours maximum of notification.

#### 1.4 FACTORY TESTS

- A. Load Test: Shall include two hours while the engine generator is delivering 100% of the specified kW, and four hours while the engine generator is delivering 80% of the specified kW. During this test, record the following data at 20-minute intervals:

Time	Engine RPM	Oil Temperature Out
kW	Water Temperature In	Fuel Pressure
Voltage	Water Temperature Out	Oil Pressure
Amperes	Oil Temperature In	Ambient Temperature

- B. Cold Start Test: Record time required for the engine generator to develop specified voltage, frequency, and kW load from a standstill condition with engine at ambient temperature.
- C. Furnish four (4) copies of certified manufacturer's factory test reports to the COR prior to shipment of the engine generators to ensure that the engine generator has been successfully tested as specified.
- D. The manufacturer shall furnish fuel, load banks, testing instruments, and all other equipment necessary to perform these tests.
- E. The Government shall have an option to witness the factory tests. All expenses of the Government Representative's trips to witness the testing shall be paid by the Government. Notify the COR not less than 30 days prior to making tests at the factory.

#### 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. Scaled drawings, showing plan views, side views, elevations, and cross-sections.

2. Diagrams:

- a. Control system diagrams, control sequence diagrams or tables, wiring diagrams, interconnections diagrams (between engine generators, automatic transfer switches, paralleling switchgear, local control cubicles, remote annunciator panels, and fuel storage tanks, as applicable), and other like items.

3. Technical Data:

- a. Published ratings, catalog cuts, pictures, and manufacturer's specifications for engine generator, governor, voltage regulator, radiator, muffler, dampers, day tank, pumps, fuel tank, batteries and charger, jacket heaters, torsional vibration, and control and supervisory equipment.
  - b. Description of operation.
  - c. Short-circuit current capacity and subtransient reactance.
  - d. Sound power level data.
4. Calculations:
  - a. Calculated performance derations appropriate to installed environment.
5. Manuals:
  - a. When submitting the shop drawings, submit complete maintenance and operating manuals, to include the following:
    - 1) Technical data sheets.
    - 2) Wiring diagrams.
    - 3) Include information for testing, repair, troubleshooting, and factory recommended periodic maintenance procedures and frequency.
    - 4) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
  - 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.
6. Test Reports:
  - a. Submit certified factory test reports for approval.
  - b. Submit field test reports two weeks prior to the final inspection.
7. Certifications:
  - a. Prior to fabrication of the engine generator, submit the following for approval:
    - 1) A certification in writing that an engine generator of the same model and configuration, with the same bore, stroke, number of cylinders, and equal or higher kW/kVA ratings as the proposed engine generator, has been operating satisfactorily with connected loads of not less than 75% of the specified



kW/kVA rating, for not fewer than 2,000 hours without any failure of a crankshaft, camshaft, piston, valve, injector, or governor system.

- 2) A certification in writing that devices and circuits shall be incorporated to protect the voltage regulator and other components of the engine generator during operation at speeds other than the rated RPM while performing maintenance. Submit thorough descriptions of any precautions necessary to protect the voltage regulator and other components of the system during operation of the engine generator at speeds other than the rated RPM.
- 3) A certification from the engine manufacturer stating that the engine exhaust emissions meet the applicable federal, state, and local regulations and restrictions. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and hazardous air pollutants (HPAs).
- b. Prior to installation of the engine generator at the job site, submit certified factory test data.
- c. Two weeks prior to the final inspection, submit the following.
  - 1) Certification by the manufacturer that the engine generators conform to the requirements of the drawings and specifications.
  - 2) Certification by the Contractor that the engine generators have been properly installed, adjusted, and tested.

#### **1.6 STORAGE AND HANDLING**

- A. Engine generators shall withstand shipping and handling stresses in addition to the electrical and mechanical stresses which occur during operation of the system. Protect radiator core with wood sheet.
- B. Store the engine generators in a location approved by the COR.

#### **1.7 JOB CONDITIONS**

- A. Job conditions shall conform to the arrangements and details shown on the drawings. The dimensions, enclosures, and arrangements of the engine generator system shall permit the operating personnel to safely and conveniently operate and maintain the system in the space designated for installation.

## 1.8 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):
- C37.50-07.....Low-Voltage AC Power Circuit Breakers Used In Enclosures-Test Procedures
  - C39.1-81 (R1992) .....Requirements for Electrical Analog Indicating Instruments
- C. American Society of Testing Materials (ASTM):
- A53/A53M-10.....Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc Coated Welded and Seamless
  - B88-09.....Specification for Seamless Copper Water Tube
  - B88M-11.....Specification for Seamless Copper water Tube (Metric)
  - D975-11b.....Diesel Fuel Oils
- D. Institute of Electrical and Electronic Engineers (IEEE):
- C37.13-08.....Low Voltage AC Power Circuit Breakers Used In Enclosures
  - C37.90.1-02.....Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- E. International Code Council (ICC):
- IBC-12.....International Building Code
- F. National Electrical Manufacturers Association (NEMA):
- ICS 6-06.....Enclosures
  - ICS 4-10.....Application Guideline for Terminal Blocks
  - MG 1-11.....Motor and Generators
  - MG 2-07.....Safety Standard and Guide for Selection, Installation and Use of Electric Motors and Generators
  - PB 2-11.....Dead-Front Distribution Switchboards
  - 250-08.....Enclosures for Electrical Equipment (1000 Volts Maximum)
- G. National Fire Protection Association (NFPA):
- 30-12.....Flammable and Combustible Liquids Code

37-10.....Installations and Use of Stationary Combustion  
Engine and Gas Turbines  
70-11.....National Electrical Code (NEC)  
99-12.....Health Care Facilities  
110-10.....Standard for Emergency and Standby Power  
Systems

H. Underwriters Laboratories, Inc. (UL):

50-07.....Enclosures for Electrical Equipment  
142-06.....Steel Aboveground Tanks for Flammable and  
Combustible Liquids  
467-07.....Grounding and Bonding Equipment  
489-09.....Molded-Case Circuit Breakers, Molded-Case  
Switches and Circuit-Breaker Enclosures  
508-99.....Industrial Control Equipment  
891-05.....Switchboards  
1236-06.....Battery Chargers for Charging Engine-Starter  
Batteries  
2085-97.....Insulated Aboveground Tanks for Flammable and  
Combustible Liquids  
2200-98.....Stationary Engine Generator Assemblies

**PART 2 - PRODUCTS**

**2.1 GENERAL REQUIREMENTS**

- A. The engine generator system shall be in accordance with NFPA, UL, NEMA and ANSI, and as specified herein.
- B. Provide a factory-assembled, wired (except for field connections), complete, fully automatic engine generator system.
- C. Engine Generator Parameter Schedule:
1. Power Rating: Emergency Standby
  2. Voltage: 277/480V
  3. Rated Power: \_\_ 175\_\_ kW // \_\_ 218.75\_\_// kVA continuous)
  4. Power Factor: 0.8 lagging
  5. Engine Generator Application: parallel with utility source
  6. Fuel: diesel
  7. Voltage Regulation: + 2% (maximum) (No Load to Full Load)  
(standalone applications)

8. Phases: 3 Phase, Wye9. Each component of the engine generator system shall be capable of operating at (\_500\_\_\_ feet) above sea level which shall have average ambient air temperature ranging from a minimum of 27.6 °F) in winter to maximum of //90 °F) in summer.
- D. Assemble, connect, and wire the engine generator at the factory so that only the external connections need shall be made at the construction site.
- E. Engine Generator Unit shall be factory-painted with manufacturer's primer and standard finishes.
- F. Connections between components of the system shall conform to the recommendations of the manufacturer.
- G. Couplings, shafts, and other moving parts shall be enclosed and guarded. Guards shall be metal, ruggedly constructed, rigidly fastened, and readily removable for convenient servicing of the equipment without disassembling any pipes and fittings.
- H. Engine generator shall have the following features:
1. Factory-mounted on a common, rigid, welded, structural steel base.
  2. Engine generator shall be statically and dynamically balanced so that the maximum vibration in the horizontal, vertical, and axial directions shall be limited to 0.15 mm (0.0059 inch), with an overall velocity limit of 24 mm/sec (0.866 inch per second) RMS, for all speeds.
  3. The isolators shall be constrained with restraints capable of withstanding static forces in any direction equal to twice the weight of the supported equipment.
  4. Shall be capable of operating satisfactorily as specified for not fewer than 10,000 hours between major overhauls.

## **2.2 ENGINE**

- A. The engine shall be coupled directly to a generator.
- B. Minimum four cylinders.
- C. The engine shall be able to start in a 4.5 °C (40 °F) ambient temperature while using No. 2 diesel fuel oil without the use of starting aids such as glow plugs and ether injections.
- D. The engine shall be equipped with electric heater for maintaining the coolant temperature between 32-38 °C (90-100 °F), or as recommended by the manufacturer.

1. Install thermostatic controls, contactors, and circuit breaker-protected circuits for the heaters.
2. The heaters shall operate continuously except while the engine is operating or the water temperature is at the predetermined level.

### **2.3 GOVERNOR**

- A. Isochronous, electronic type.
- B. Steady-state speed band at 60 Hz shall not exceed plus or minus 0.33%.

### **2.4 LUBRICATION OIL SYSTEM**

- A. Pressurized type.
- B. Positive-displacement pump driven by engine crankshaft.
- C. Full-flow strainer and full-flow or by-pass filters.
- D. Filters shall be cleanable or replaceable type and shall remove particles as small as 3 microns without removing the additives in the oil. For by-pass filters, flow shall be diverted without flow interruption.
- E. Extend lube oil sump drain line out through the skid base and terminate it with a drain valve and plug.
- F. Provide a 120-volt oil heater for exterior engine generator.

### **2.5 FUEL SYSTEM**

- A. Main fuel storage tank(s) shall comply with the requirements of Section 23 10 00, FACILITY FUEL SYSTEMS.
- B. Shall comply with NFPA 37 and NFPA 30, and have the following features:
  1. Injection pump(s) and nozzles.
  2. Plungers shall be carefully lapped for precision fit and shall not require any packing.
  3. Filters or screens that require periodic cleaning or replacement shall not be permitted in the injection system assemblies.
  4. Return surplus oil from the injectors to the main storage tank by gravity or a pump.
  5. Filter System:
    - a. Dual primary filters shall be located between the main fuel oil storage and day tank.
    - b. Secondary filters (engine-mounted) shall be located such that the oil shall be thoroughly filtered before it reaches the injection system assemblies.

- c. Filters shall be cleanable or replaceable type and shall entrap and remove water from oil as recommended by the engine manufacturer.

C. Day Tank:

1. Each engine generator shall be provided with a welded steel integral day tank with double-wall fuel containment.
2. The fuel tank shall have capacity to supply fuel to the engine for a 96-hour period at 100% rated load without being refilled, including fuel that is returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90% of the ultimate volume of the tank.
3. Secure, pipe, and connect the tank adequately for maximum protection from fire hazards, including oil leaks.
4. Incorporate a vent, drain cock, shutoff cocks, and gauge glass. Terminate the vent piping outdoors with mushroom vent cap.
5. Incorporate a float switch on the day tank to control the fuel oil transfer pump and to actuate an alarm in the engine generator control cubicle when the oil level in the tank drops below the level at which the transfer pump shall start to refill the tank.
  - a. The float switch contacts controlling the fuel oil transfer pump shall be set to energize the pump when the liquid level in the tank reaches one-third of the total volume of the tank.
  - b. The float switch contacts that actuate the low fuel oil day tank alarm device shall be set to alarm and energize the second fuel transfer pump when the liquid level in the tank reaches one-quarter of the total volume of the tank.
6. Day tank and engine supply line elevations shall be below the elevation of the injector return outlet on the engine.

D. Fuel Transfer Pump - Main Storage Tank to Day Tank(s):

1. Electric motor-driven, duplex arrangement, close-coupled, single-stage, positive-displacement type with built-in pressure relief valves. When the fuel is used for cooling components of the fuel injection system, the engine's fuel return line shall be returned to the main storage tank, rather than the day tank.
2. Include a heavy-duty automatic alternator and H-O-A switch to alternate sequence of pumps. Pumps shall be controlled with the

float switch on the day tank and H-O-A selector switch such that the day tank shall be refilled automatically when the oil level lowers to the low limit for the float switch. The H-O-A selector switches shall enable the pumps shall be operated manually at any time.

3. For all engines, the related transfer pump and its electrical and plumbing connections shall be sized to provide a flow rate of at least four times the engine's fuel pumping rate.
4. Provide a manually-operated, rotary-type transfer pump connected in parallel with the electric motor-driven transfer pumps so that oil can be pumped to the day tank while the electric motor-driven pumps are inoperative.

E. Piping System: Black steel standard weight ASTM A-53 pipe and necessary valves and pressure gauges between:

1. The engine and the day tank as shown on the drawings.
2. The day tank and the supply and return connections at the underground storage tank as shown on the drawings. Connections at the engine shall be made with flexible piping suitable for the fuel furnished.

## **2.6 COOLING SYSTEM**

- A. Liquid-cooled, closed loop, with fin-tube radiator mounted on the engine generator, and integral engine driven circulating pump, as shown on the drawings.
- B. Cooling capacity shall not be less than the cooling requirements of the engine generator and its lubricating oil while operating continuously at 100% of its specified rating.
- C. Water circulating pumps shall be the centrifugal type driven by engine. Incorporate pressure relief devices where required to prevent excessive pressure increase after the engine stops.
- D. Coolant shall be extended-life antifreeze solution, 50% ethylene glycol and 50% soft water, with corrosion inhibitor additive as recommended by the manufacturer.
- E. Fan shall be driven by multiple belts from engine shaft .
- F. Coolant hoses shall be flexible, per manufacturer's recommendation.
- G. Self-contained thermostatic-control valve shall modulate coolant flow to maintain optimum constant coolant temperature, as recommended by the engine manufacturer.

## 2.7 AIR INTAKE AND EXHAUST SYSTEMS

### A. Air Intake:

1. Provide an engine-mounted air cleaner with replaceable dry filter and dirty filter indicator.

### B. Exhaust System:

#### 1. Exhaust Muffler:

Shall be critical grade type and capable of the following noise attenuation:

Octave Band Hertz (Mid Frequency)	Minimum db Attenuation (.0002 Microbar Reference)
31	5
63	10
125	27
500	37
1000	31
2000	26
4000	25
8000	26

3. Pressure drop in the complete exhaust system shall be small enough for satisfactory operation of the engine generator while it is delivering 100% of its specified rating.
4. Exhaust pipe size from the engine to the muffler shall be as recommended by the engine manufacturer. Pipe size from muffler to air discharge shall be two pipe sizes larger than engine exhaust pipe.
5. Connections at the engine exhaust outlet shall be made with a flexible exhaust pipe. Provide bolted type pipe flanges welded to each end of the flexible section.

### C. Condensate drain at muffler shall be made with schedule 40 black steel pipe through a petcock.

### D. Exhaust Piping and Supports: Black steel pipe, ASTM A-53 standard weight with welded fittings. Spring type hangers, as specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, shall support the pipe.



E. Insulation for Exhaust Pipe and Muffler:

1. Calcium silicate minimum 75 mm (3 inches) thick.
2. Insulation shall be as specified in Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
3. The installed insulation shall be covered with aluminum jacket 0.4 mm (0.016 inch) thick. The jacket shall be held in place by bands of 0.38 mm (0.015 inch) thick by 15 mm (0.5 inch) wide aluminum.
4. Insulation and jacket are not required on flexible exhaust sections.

F. Sleeves: Pipe sleeves (thimble) shall be Schedule 40 standard weight steel pipe. Flash exhaust pipe thimble through roof with 16 oz soft sheet copper, flanged, and made watertight under built-up roofing and extended up around pipe thimble. The exhaust pipe shall be positioned within the thimble by four 150 mm (6 inches) wide spiders welded to the exhaust pipe.

G. Vertical exhaust piping shall be provided with a hinged, gravity-operated, self-closing rain cover.

**2.8 ENGINE STARTING SYSTEM**

A. The engine starting system shall start the engine at any position of the flywheel.

B. Electric cranking motor:

1. Shall be engine-mounted.
2. Shall crank the engine via a gear drive.
3. Rating shall be adequate for cranking the cold engine at the voltage provided by the battery system, and at the required RPM during five consecutive starting attempts of 10 seconds cranking each at 10-second intervals, for a total of 50 seconds of actual cranking without damage (the fifth starting attempt shall be manually initiated upon failure of a complete engine cranking cycle).

C. Batteries shall be lead-acid high discharge rate type.

1. Each battery cell shall have minimum and maximum electrolyte level indicators and a flip-top flame arrestor vent cap.
2. Batteries shall have connector covers for protection against external short circuits.
3. With the charger disconnected, the batteries shall have sufficient capacity so that the total system voltage does not fall below 85% of the nominal system voltage with the following demands:

Five consecutive starting attempts of 10 seconds cranking at 10 second intervals for a total of 50 seconds of actual cranking (the fifth starting attempt shall be manually initiated upon failure of a complete engine cranking cycle).

4. Battery racks shall be metal with an alkali-resistant finish and thermal insulation, and secured to the floor.

D. Battery Charger:

1. A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize-charging rate for recharging fully depleted batteries within 24 hours and a floating charge rate for maintaining the batteries at fully charged condition.
2. An ammeter shall be provided to indicate charging rate. A voltmeter shall be provided to indicate charging voltage.

**2.9 LUBRICATING OIL HEATER**

- A. Provide a thermostatically-controlled electric heater to automatically maintain the oil temperature within plus or minus 1.7 °C (3 °F) of the control temperature.

**2.10 JACKET COOLANT HEATER**

- A. Provide a thermostatically-controlled electric heater mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 1.7 °C (3 °F) of the temperature recommended by the engine manufacturer to meet the starting time specified at the minimum winter outdoor temperature.

**2.11 GENERATOR**

- A. Synchronous, amortisseur windings, bracket-bearing, self-venting, rotating-field type connected directly to the engine.
- B. Lifting lugs designed for convenient connection to and removal from the engine.
- C. Integral poles and spider, or individual poles dove-tailed to the spider.
- D. Designed for sustained short-circuit currents in conformance with NEMA Standards.
- E. Designed for sustained operation at 100% of the RPM specified for the engine generator without damage.
- F. Telephone influence factor shall conform to NEMA MG 1.

- G. Furnished with brushless excitation system or static-exciter-regulator assembly.
- H. Nameplates attached to the generator shall show the manufacturer's name, equipment identification, serial number, voltage ratings, field current ratings, kW/kVA output ratings, power factor rating, time rating, temperature rise ratings, RPM ratings, full load current rating, number of phases and frequency, and date of manufacture.
- I. The grounded (neutral) conductor shall be electrically isolated from equipment ground and terminated in the same junction box as the phase conductors.

#### **2.12 GENERATOR OVERCURRENT AND FAULT PROTECTION**

- A. Generator circuit breaker shall be molded-case, electronic-trip type, and 100% rated, complying with UL 489. Tripping characteristics shall be adjustable long-time and short-time delay and instantaneous. Provide shunt trip to trip breaker when engine generator is shut down by other protective devices.
- B. Generator circuit breaker shall be insulated-case, electronic-trip type; 100 percent rated; complying with UL 489. Tripping characteristics shall be adjustable long-time and short-time delay and instantaneous. Provide shunt trip to trip breaker when engine generator is shut down by other protective devices.
- C. Integrate ground-fault indication with other engine generator alarm indications.
- D. Overcurrent protective device cubicle shall contain terminations for neutral and equipment grounding conductors as necessary.

#### **2.13 CONTROLS**

- A. Shall include Engine Generator Control Cubicle(s) and Remote Annunciator Panel.
- B. General:
  - 1. Control equipment shall be in accordance with UL 508, NEMA ICS-4, ICS-6, and ANSI C37.90.1.
  - 2. Panels shall be in accordance with UL 50.
  - 3. Cubicles shall be in accordance with UL 891.
  - 4. Coordinate controls with the automatic transfer switches shown on the drawings so that the systems shall operate as specified.
  - 5. Cubicles:

- a. Code gauge steel: manufacturer's recommended heavy gauge steel with factory primer and light gray finish.
  - b. Doors shall be gasketed, attached with concealed or semi-concealed hinges, and shall have a permanent means of latching in closed position.
  - c. Panels shall be wall-mounted or incorporated in other equipment as indicated on the drawings or as specified.
  - d. Door locks for panels and cubicles shall be keyed identically to operate from a single key.
6. Wiring: Insulated, rated at 600 V.
- a. Install the wiring in vertical and horizontal runs, neatly harnessed.
  - b. Terminate all external wiring at heavy duty, pressure-type, terminal blocks.
7. The equipment, wiring terminals, and wires shall be clearly and permanently labeled.
8. The appropriate wiring diagrams shall be laminated or mounted under plexiglass within the frame on the inside of the cubicles and panels.
9. All indicating lamps and switches shall be accessible and mounted on the cubicle doors.
10. The manufacturer shall coordinate the interconnection and programming of the generator controls with all related equipment, including automatic transfer switches and generator paralleling controls as applicable, specified in other sections.
- C. Engine generator Control Cubicle:
1. Starting and Stopping Controls:
- a. A three-position, maintained-contact type selector switch with positions marked "AUTOMATIC," "OFF," and "MANUAL." Provide flashing amber light for OFF and MANUAL positions.
  - b. A momentary contact push-button switch with positions marked "MANUAL START" and "MANUAL STOP."
  - c. Selector switch in AUTOMATIC position shall cause the engine to start automatically when a single pole contact in a remote device closes. When the generator's output voltage increases to not less than 90% of its rated voltage, and its frequency increases to not less than 58 Hz, the remote devices shall transfer the load to

the generator. An adjustable time delay relay, in the 0 to 15 minute range, shall cause the engine generator to continue operating without any load after completion of the period of operation with load. Upon completion of the additional 0 to 15 minute (adjustable) period, the engine generator shall stop.

- d. Selector switch in OFF position shall prevent the engine from starting either automatically or manually. Selector switch in MANUAL position shall also cause the engine to start when the manual start push-button is depressed momentarily.
  - e. With selector switch is in MANUAL position, depressing the MANUAL STOP push-button momentarily shall stop the engine after a cool-down period.
  - f. A maintained-contact, red mushroom-head push-button switch marked "EMERGENCY STOP" shall cause the engine to stop without a cool-down period, independent of the position of the selector switch.
2. Engine Cranking Controls:
- a. The cranking cycles shall be controlled by a timer that shall be independent of the battery voltage fluctuations.
  - b. The controls shall crank the engine through one complete cranking cycle, consisting of four starting attempts of 10 seconds each with 10 seconds between each attempt.
  - c. Total actual cranking time for the complete cranking cycle shall be 40 seconds during a 70-second interval.
  - d. Cranking shall terminate when the engine starts so that the starting system shall not be damaged. Termination of the cranking shall be controlled by self-contained, speed-sensitive switch. The switch shall prevent re-cranking of the engine until after the engine stops.
  - e. After the engine has stopped, the cranking control shall reset.
3. Supervisory Controls:
- a. Overcrank:
    - 1) When the cranking control system completes one cranking cycle (four starting attempts), without starting the engine, the OVERCRANK signal light and the audible alarm shall be energized.
    - 2) The cranking control system shall lock-out, and shall require a manual reset.

b. Coolant Temperature:

- 1) When the temperature rises to the predetermined first stage level, the HIGH COOLANT TEMPERATURE - FIRST STAGE signal light and the audible alarm shall be energized.
- 2) When the temperature rises to the predetermined second stage level, which shall be low enough to prevent any damage to the engine and high enough to avoid unnecessary engine shutdowns, the HIGH COOLANT TEMPERATURE - SECOND STAGE signal light and the audible alarm shall be energized and the engine shall stop.
- 3) The difference between the first and second stage temperature settings shall be approximately  $-12^{\circ}\text{C}$  ( $10^{\circ}\text{F}$ ).
- 4) Permanently indicate the temperature settings near the associated signal light.
- 5) When the coolant temperature drops to below  $21^{\circ}\text{C}$  ( $70^{\circ}\text{F}$ ), the "LOW COOLANT TEMPERATURE" signal light and the audible alarm shall be energized.

c. Low Coolant Level: When the coolant level falls below the minimum level recommended by the manufacturer, the LOW COOLANT LEVEL signal light and audible alarm shall be energized.

d. Lubricating Oil Pressure:

- 1) When the pressure falls to the predetermined first stage level, the OIL PRESSURE - FIRST STAGE signal light and the audible alarm shall be energized.
- 2) When the pressure falls to the predetermined second stage level, which shall be high enough to prevent damage to the engine and low enough to avoid unnecessary engine shutdowns, the OIL PRESSURE - SECOND STAGE signal light and the audible alarm shall be energized and the engine shall stop.
- 3) The difference between the first and second stage pressure settings shall be approximately 15% of the oil pressure.
- 4) The pressure settings near the associated signal light shall be permanently displayed so that the running oil pressure can be compared to the target (setpoint) value.

e. Overspeed:

- 1) When the engine RPM exceeds the maximum RPM recommended by the manufacturer of the engine, the engine shall stop.

2) Simultaneously, the OVERSPEED signal light and the audible alarm shall be energized.

f. Low Fuel - Day Tank:

When the fuel oil level in the day tank decreases to less than the level at which the fuel oil transfer pump shall start to refill the tank, the LOW FUEL DAY TANK light and the audible alarm shall be energized.

g. Low Fuel - Main Storage Tank:

When the fuel oil level in the storage tank decreases to less than one-third of total tank capacity, the LOW FUEL-MAIN STORAGE TANK signal light and audible alarm shall be energized.

h. Reset Alarms and Signals:

Overcrank, Coolant Temperature, Coolant Level, Oil Pressure, Overspeed, and Low Fuel signal lights and the associated audible alarms shall require manual reset. A momentary-contact silencing switch and push-button shall silence the audible alarm by using relays or solid state devices to seal in the audible alarm in the de-energized condition. Elimination of the alarm condition shall automatically release the sealed-in circuit for the audible alarm so that it shall be automatically energized again when the next alarm condition occurs. The signal lights shall require manual reset after elimination of the condition which caused them shall be energized. Install the audible alarm just outside the engine generator room in a location as directed by the COR. The audible alarm shall be rated for 85 dB at 3 M (10 feet).

i. Generator Breaker Signal Light:

- 1) A flashing green light shall be energized when the engine generator circuit breaker is in the OPEN or TRIPPED position.
- 2) Simultaneously, the audible alarm shall be energized.

4. Monitoring Devices:

- a. Electric type gauges for the cooling water temperatures and lubricating oil pressures. These gauges shall be engine mounted with proper vibration isolation.
- b. A running time indicator, totalizing not fewer than 9,999 hours, and an electric type tachometer.
- c. A voltmeter, ammeter, frequency meter, kilowatt meter, manual adjusting knob for the output voltage, and the other items shown

on the drawings shall be mounted on the front of the generator control panels.

- d. Install potential and current transformers as required.
  - e. Visual Indications:
    - 1) OVERCRANK
    - 2) HIGH COOLANT TEMPERATURE - FIRST STAGE
    - 3) HIGH COOLANT TEMPERATURE - SECOND STAGE
    - 4) LOW COOLANT TEMPERATURE
    - 5) OIL PRESSURE - FIRST STAGE
    - 6) OIL PRESSURE - SECOND STAGE
    - 7) LOW COOLANT LEVEL
    - 8) GENERATOR BREAKER
    - 9) OVERSPEED
    - 10) LOW FUEL - DAY TANK
    - 11) LOW FUEL - MAIN STORAGE TANK
  - f. Lamp Test: The LAMP TEST momentary contact switch shall momentarily actuate the alarm buzzer and all the indicating lamps.
5. Automatic Voltage Regulator:
- a. Shall correct voltage fluctuations rapidly and restore the output voltage to the predetermined level with a minimum amount of hunting.
  - b. Shall include voltage level rheostat located inside the control cubicle.
  - c. Provide a 3-phase automatic voltage regulator immune to waveform distortion.

#### **2.14 REMOTE ANNUNCIATOR PANEL**

- A. A remote annunciator panel shall be installed at location as shown on the drawings.
- B. The annunciator shall indicate alarm conditions as required by NFPA 99 and 110.
- C. Include control wiring between the remote annunciator panel and the engine generator. Wiring shall be as required by the manufacturer.

#### **2.15 SOUND-ATTENUATED ENCLOSURE**

- A. The engine generator and related equipment shall be housed in an outdoor weatherproof enclosure.



- B. The enclosure shall be provided with a factory-installed and factory-wired panelboard, 20A 120V receptacles, and compact fluorescent light fixtures with guards and switches.
- C. Enclosure shall be walk-in type and sound-attenuated (maximum 85 dBA at 1525 mm (5 feet) from any side, top and bottom to no more than 75 dBA when measured at 15 M (50 feet) horizontally from any part of the enclosure or appendage on the enclosure. Sound ratings shall be based on full-load condition of engine generator in a single unit operation condition.
- D. Airflow configuration shall be intake through rear of unit, and discharge air vertically up. Enclosure shall be suitable for winds up to 193 kmh (120 miles per hour) roof load shall be equal to or greater than 200 kg/sq m (40 pounds per square foot) Non-distributed loading as required.
- E. The enclosure shall meet the following requirements:
  - 1. Radiator exhaust outlet shall be ducted through the end of the enclosure.
  - 2. All exterior surfaces shall be factory-painted with industrial enamel.
  - 3. Unit shall have sufficient guards to prevent entrance by small animals.
  - 4. Batteries shall fit inside enclosure and alongside the engine generator. Batteries under the generator are not acceptable.
  - 5. The muffler shall be mounted and thermally-insulated inside the enclosure.

#### **2.16 SPARE PARTS**

- A. For each engine generator:
  - 1. Six lubricating oil filters.
  - 2. Six primary fuel oil filters.
  - 3. Six secondary fuel oil filters.
  - 4. Six intake air filters.
- B. For each battery charger:
  - 1. Three complete sets of fuses.
- C. For each control panel:
  - 1. Three complete sets of fuses, if applicable.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install concrete bases of dimensions shown on the drawings.
- B. Installation of the engine generator shall comply with manufacturer's written instructions and with NFPA 110.
- C. Mounting:
  - 1. Support the base of engine generator on vibration isolators, each isolator bolted to the floor (pad), and the generator base bolted to isolator.
  - 2. Install sufficient isolators so that the floor (pad) bearing pressure under each isolator is within the floor (pad) loading specification.
  - 3. Install equal number of isolators on each side of the engine generator's base.
  - 4. Locate isolators for approximately equal load distribution and deflection per isolator. The base of the engine generator shall be drilled at the factory for the isolator bolts.
  - 5. Isolators shall be shipped loose with the engine generator.
  - 6. All connections between the engine generator and exterior systems, such as fuel lines, electrical connections, and engine exhaust system and air exhaust shroud, shall be flexible.
- D. alance:
  - 1. The vibration velocity in the horizontal, vertical, and axial directions shall not exceed 16.25 mm (0.65 inch) per second peak at any specific frequency. These limits apply to main structural components such as the engine block and the generator frame at the bearings.
- E. Connect all components of the generator system so that they shall continue shall be energized during failure of the normal electrical power supply system.
- F. Install piping between engine generator and remote components of cooling, fuel, and exhaust systems.
- G. Flexible connection between radiator and exhaust shroud at the wall damper:
  - 1. Install noncombustible flexible connections made of 20-oz neoprene-coated fiberglass fabric approximately 150 mm (6 inches) wide.

2. Crimp and fasten the fabric to the sheet metal with screws 50 mm (2 inches) on center. The fabric shall not be stressed, except by the air pressure.

H. Exhaust System Insulation:

1. Adhesive and insulation materials shall be applied on clean, dry surfaces from which loose scale and construction debris has been removed by wire brushing.
2. Fill all cracks, voids, and joints of applied insulation material with high temperature 1093 °C (2000 °F) insulating cement before applying the outer covering.
3. The installation shall be clean and free of debris, thermally and structurally tight without sag, neatly finished at all hangers or other penetrations, and shall provide a smooth finished surface.
4. Insulation and jacket shall terminate hard and tight at all anchor points.
5. Insulate completely from engine exhaust flexible connection through roof or wall construction, including muffler.

**3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Provide the services of a factory-authorized, factory-trained representative of the engine generator manufacturer to inspect field-assembled components and equipment installation, and to supervise the field tests.
- B. When the complete engine generator system has been installed and prior to the final inspection, test all components of the system in the presence of the COR for proper operation of the individual components and the complete system and to eliminate electrical and mechanical defects.
- C. Furnish fuel oil, lubricating oil, anti-freeze liquid, water treatment, rust-inhibitor, and load bank for testing of the engine generator.
- D. Visual Inspection: Visually verify proper installation of engine generator and all components per manufacturer's pre-functional installation checklist.
- E. Field Tests:
  1. Perform manufacturer's after-starting checks and inspections.
  2. Test the engine generator for six hours of continuous operation as follows:
    - a. Two hours while delivering 100% of the specified kW.

- b. Four hours while the engine generator is delivering 80% of its specified kW rating.
    - c. If during the 6-hour continuous test, an engine generator failure occurs or the engine generator cannot maintain specified power output, the test(s) are null and void. After repair and/or adjustments, the test(s) shall be repeated at no additional cost to the Government until satisfactory results are attained.
  - 3. Record the following test data at 30-minute intervals:
    - a. Time of day, as well as reading of running time indicator.
    - b. kW.
    - c. Voltage on each phase.
    - d. Amperes on each phase.
    - e. Engine RPM.
    - f. Frequency.
    - g. Coolant water temperature.
    - h. Fuel pressure.
    - i. Oil pressure.
    - j. Outdoor temperature.
    - k. Average ambient temperature in the vicinity of the engine generator.
  - 4. Demonstrate that the engine generator shall attain proper voltage and frequency within the specified time limit from a cold start after the closing of a single contact.
  - 5. Furnish a resistance-type load for the testing of the engine generator. Test loads shall always include adequate resistance to assure stability of the loads and equipment during all of the testing operations. The test load kW rating shall not be less than 100% of the specified kW rating of the engine generator.
- F. Starting System Test:
- 1. Demonstrate that the batteries and cranking motor are capable of five starting attempts of 10 seconds cranking each at 10-second intervals with the battery charger turned off.
- G. Remote Annunciator Panel Tests:
- Simulate conditions to verify proper operation of each visual or audible indication, interconnecting hardware and software, and reset button.

H. Fuel systems shall be flushed and tested per Section 23 10 00, FACILITY FUEL SYSTEMS: Fuel supply and storage requirements.

I. Automatic Operation Tests:

Test the engine generator and associated automatic transfer switches to demonstrate automatic starting, loading and unloading. The load for this test shall be the actual connected loads. Initiate loss of normal source and verify the specified sequence of operation. Restore the normal power source and verify the specified sequence of operation. Verify resetting of controls to normal.

J. At the completion of the field tests, fill the main storage tank and day tank with fuel of grade and quality as recommended by the manufacturer of the engine. Fill all engine fluids to levels as recommended by manufacturer.

K. When any defects are detected during the tests, correct all the deficiencies and repeat all or part of the 6-hour continuous test as requested by the COR, at no additional cost to the Government.

L. Provide test and inspection results in writing to the COR.

**3.3 FOLLOW-UP VERIFICATION**

A. After completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the engine generator(s) and control and annunciation components are in good operating condition and properly performing the intended function.

**3.4 INSTRUCTIONS AND FINAL INSPECTIONS**

A. Laminate or mount under acrylic resin a set of operating instructions for the system and install instructions within a frame mounted on the wall near the engine generator at a location per the COR.

B. Furnish the services of a competent, factory-trained technician for one 4-hour period for instructions to VA personnel in operation and maintenance of the equipment, on the date requested by the COR.

---END---

**SECTION 26 36 23**  
**AUTOMATIC TRANSFER SWITCHES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of open-transition automatic transfer switches with bypass isolation, indicated as automatic transfer switches or ATS in this section.

**1.2 RELATED WORK**

- A. Section 03 30 00, CAST-IN-PLACE CONCRETE: Requirements for concrete equipment pads.
- B. Section 14 21 00, ELECTRIC TRACTION ELEVATORS: Requirements for elevator operation.
- 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 personal safety and to provide a low impedance path for possible ground fault currents.
- F. Section 26 05 33, RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
- G. Section 26 32 13, ENGINE-GENERATORS: Requirements for normal and emergency power generation.
- H. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General communications requirements that are common to more than one section in Division 27.
- I. Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATION SYSTEMS: Raceways for communications cabling.
- J. SECTION 27 15 00, COMMUNICATIONS HORIZONTAL CABLING: Communications media for interconnecting automatic transfer switches and remote control and annunciation components.

**1.3 QUALITY ASSURANCE**

- A. QUALITY ASSURANCE
- Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

- B. A factory-authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 8 hours maximum of notification.
- C. Automatic transfer switch, bypass/isolation switch, and annunciation control panels shall be products of the same manufacturer.

#### **1.4 FACTORY TESTS**

- A. Automatic transfer switches shall be thoroughly tested at the factory to ensure that there are no electrical or mechanical defects. Tests shall be conducted per UL standards. Factory tests shall be certified, and shall include the following tests:
  - 1. Visual inspection to verify that each ATS is as specified.
  - 2. Mechanical test to verify that ATS sections are free of mechanical hindrances.
  - 3. Insulation resistance test to ensure electrical integrity and continuity of entire system.
  - 4. Main switch contact resistance test.
  - 5. Electrical tests to verify complete system electrical operation.
- B. Furnish four (4) copies of certified manufacturer's factory test reports to the COR prior to shipment of the ATS to ensure that the ATS has been successfully tested as specified.

#### **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. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.
    - c. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting

communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.

- d. Complete nameplate data, including manufacturer's name and catalog number.
- e. A copy of the markings that are to appear on the automatic transfer switches when installed.

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) Schematic signal and control diagrams, with all terminals identified, matching terminal identification in the automatic transfer switches.
  - 2) Include information for testing, repair, troubleshooting, assembly, disassembly, and factory recommended/required periodic maintenance procedures and frequency.
  - 3) Provide a replacement and spare parts list. Include a list of tools and instruments for testing and maintenance purposes.
- 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.
  - 1) Include complete "As Installed" diagrams that indicate all pieces of equipment and their interconnecting wiring.
  - 2) Include complete diagrams of the internal wiring for each piece of equipment, including "As Installed" revisions of the diagrams.
  - 3) The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation, and testing.

3. Certifications:

- a. When submitting the shop drawings, submit a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 prototype testing.
- b. Two weeks prior to final inspection, submit the following.



- 1) Certification by the manufacturer that the ATS conform to the requirements of the drawings and specifications.
- 2) Certification by the Contractor that transfer switches 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 referenced in the text by designation only.
- B. Institute of Electrical and Electronic Engineers (IEEE):
- 446-95.....Emergency and Standby Power Systems for  
Industrial and Commercial ApplicationsC37.90.1-  
02 Surge Withstand Capability (SWC) Tests  
for Relays and Relay Systems Associated with  
Electric Power Apparatus
  - C62.41.1-02.....Guide on the Surges Environment in Low-Voltage  
(1000 V and Less) AC Power Circuits
  - C62.41.2-02.....Recommended Practice on Characterization of  
Surges in Low-Voltage (1000 V and Less) AC  
Power Circuits
- C. International Code Council (ICC):
- IBC-12.....International Building Code
- D. National Electrical Manufacturers Association (NEMA):
- 250-08.....Enclosures for Electrical Equipment (1000 Volts  
Maximum)
  - ICS 6-06.....Enclosures
  - ICS 4-10.....Application Guideline for Terminal Blocks
  - MG 1-11.....Motors and Generators
- E. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
  - 99-12.....Health Care Facilities
  - 110-10.....Emergency and Standby Power Systems
- F. Underwriters Laboratories, Inc. (UL):
- 50-95.....Enclosures for Electrical Equipment
  - 508-99.....Industrial Control Equipment
  - 891-07.....Switchboards
  - 1008-07.....Transfer Switch Equipment

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Automatic transfer switches shall comply with UL, NEMA, NEC, ANSI, IEEE, and NFPA, and have the following features:
1. Automatic transfer switches shall be open transition switches, 4-pole, draw-out construction, electrically operated, mechanically held open contact type, without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.
  2. Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.
  3. Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.
  4. Ratings:
    - a. Phases, voltage, continuous current, poles, and withstand and closing ratings shall be as shown on the drawings.
    - b. Transfer switches shall be rated for continuous duty at specified continuous current rating on 60Hz systems.
    - c. Maximum automatic transfer switch rating: 800 A.
  5. Markings:
    - a. Markings shall be in accordance with UL 1008.
  6. Tests:
    - a. Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device and available fault current specified.
  7. Surge Withstand Test:
    - a. Automatic transfer switches utilizing solid-state devices in sensing, relaying, operating, or communication equipment or circuits shall comply with IEEE C37.90.1.
  8. Housing:

- a. Enclose automatic transfer switches in wall- or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings.
  - b. Enclosure shall be constructed so that personnel are protected from energized bypass-isolation components during automatic transfer switch maintenance.
  - c. Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.
  - d. Finish: Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.
  - e. Viewing Ports: Provide viewing ports so that contacts shall be inspected without disassembly.
9. Operating Mechanism:
- a. Actuated by an electrical operator.
  - b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal and emergency position.
  - c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
  - d. Contact transfer time shall not exceed six cycles.
  - e. Operating mechanism components and mechanical interlocks shall be insulated or grounded.
10. Contacts:
- a. Main contacts: Silver alloy.
  - b. Neutral contacts: Silver alloy, with same current rating as phase contacts .
  - c. Current carrying capacity of arcing contacts shall not be used in the determination of the automatic transfer switch rating, and shall be separate from the main contacts.
  - d. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.
11. Manual Operator:

- a. Capable of operation by one person in either direction under no load.
12. Replaceable Parts:
- a. Include the main and arcing contacts individually or as units, as well as relays, and control devices.
  - b. Automatic transfer switch contacts and accessories shall be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
13. Sensing Features:
- a. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100% of nominal, and dropout voltage is adjustable from 75 to 98% of pickup value. Factory set for pickup at 90% and dropout at 85%.
  - b. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
  - c. Voltage/Frequency Lockout Relay: Prevent premature transfer to the engine-generator. Pickup voltage shall be adjustable from 85 to 100% of nominal. Factory set for pickup at 90%. Pickup frequency shall be adjustable from 90 to 100% of nominal. Factory set for pickup at 95%.
  - d. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  - e. Test Switch: Simulate normal-source failure.
  - f. Switch-Position Indication: Indicate source to which load is connected.
  - g. Source-Available Indication: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
  - h. Normal Power Indication: Indicate "Normal Source Available."
  - i. Emergency Power Indication: Indicate "Emergency Source Available."
  - j. Transfer Override Control: Overrides automatic retransfer control so that automatic transfer switch shall remain connected

- to emergency power source regardless of condition of normal source. Control panel shall indicate override status.
- k. Engine Starting Contacts: One isolated and normally closed and one isolated and normally open; rated 5 A at 30 V DC minimum.
  - l. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
  - m. Engine-Generator Exerciser: Programmable exerciser starts engine-generator(s) and transfers load to them from normal source for a preset time, then retransfers and shuts down engine-generator(s) after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period.
14. Controls:
- a. Controls shall provide indication of switch status and be equipped with alarm diagnostics.
  - b. Controls shall control operation of the automatic transfer switches.
15. Factory Wiring: Train and bundle factory wiring and label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.
16. Annunciation, Control, and Programming Interface Components: Devices for communicating with remote programming devices, annunciators, or control panel shall have open-protocol communication capability matched with remote device.
17. Provide contacts for connection to elevator controllers, one closed when automatic transfer switch is connected to the normal source, and one closed when automatic transfer switch is connected to the emergency source.
18. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control

connection to motor starters is through wiring external to the automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit in-rush and seal currents are rated for actual currents shall be encountered.

## **2.2 SEQUENCE OF OPERATION**

- A. The specified voltage decrease in one or more phases of the normal power source shall initiate the transfer sequence. The automatic transfer switch shall start the engine-generator(s) after a specified time delay to permit override of momentary dips in the normal power source.
- B. The automatic transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine-generator(s) have attained the specified percent of rated value.
- C. Engine Start: A voltage decrease, at any automatic transfer switch, in one or more phases of the normal power source to less than the specified value of normal shall start the engine-generator(s) after a specified time delay.
- D. Transfer to Emergency System Loads: Automatic transfer switches for Emergency System loads shall transfer their loads from normal to emergency source when frequency and voltage of the engine-generator(s) have attained the specified percent of rated value. Only those switches with deficient normal source voltage shall transfer.
- E. Transfer to Equipment Branch Loads: Automatic transfer switches for Equipment Branch loads shall transfer their loads to the engine-generator on a time-delayed, staggered basis, after the Emergency System switches have transferred. Only those switches with deficient normal source voltage shall transfer.
- F. Retransfer to Normal (All Loads): Automatic transfer switches shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to the specified percent or more of normal voltage, and after a specified time delay. Shall the emergency source fail during this time, the automatic transfer switches shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the engine-generator(s)

shall continue to run unloaded for a specified interval before shut-down.

### **2.3 BYPASS-ISOLATION SWITCH**

- A. Provide each automatic transfer switch with two-way bypass-isolation manual type switch. The bypass-isolation switch shall permit load bypass to either normal or emergency power source and complete isolation of the automatic transfer switch, independent of transfer switch position. Bypass and isolation shall be possible under all conditions including when the automatic transfer switch is removed from service.
- B. Operation: The bypass-isolation switch shall have provisions for operation by one person through the movement of a maximum of two handles at a common dead front panel in no more than 15 seconds. Provide a lock, which shall energize to unlock the bypass switch, to prevent bypassing to a dead source. Provide means to prevent simultaneous connection between normal and emergency sources.
  - 1. Bypass to normal (or emergency): Operation of bypass handle shall allow direct connection of the load to the normal (or emergency) source, without load interruption or by using a break-before-make design, or provide separate load interrupter contacts to momentarily interrupt the load.
    - a. Ensure continuity of auxiliary circuits necessary for proper operation of the system.
    - b. A red indicating lamp shall light when the automatic transfer switch is bypassed.
    - c. Bypassing source to source: If the power source is lost while in the bypass position, bypass to the alternate source shall be achievable without re-energization of the automatic transfer switch service and load connections.
  - 2. Isolation: Operation of the isolating handle shall isolate all live power conductors to the automatic transfer switch without interruption of the load.
    - a. Interlocking: Provide interlocking as part of the bypass-isolation switch to eliminate personnel-controlled sequence of operation, and to prevent operation to the isolation position until the bypass function has been completed.
    - b. Padlocking: Include provisions to padlock the isolating handle in the isolated position.

- c. Visual verification: The isolation blades shall be visible in the isolated position.
- 3. Testing: It shall be possible to test (normal electrical operation) the automatic transfer switch and engine-generator(s) with the isolation contacts closed and the load bypassed without interruption of power to the load.
- C. Ratings: The electrical capabilities and ratings of the bypass-isolation switch shall be compatible with those of the associated automatic transfer switch, including any required additional withstand tests.

#### **2.4 REMOTE ANNUNCIATOR SYSTEM**

- A. Remote annunciator panel shall annunciate conditions for indicated automatic transfer switches. Annunciation shall include the following:
  - 1. Sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
  - 2. Switch position.
  - 3. Switch in test mode.
  - 4. Failure of communication link.
- B. Remote annunciator panel shall be visual and audible type with LED display panel, audible signal, and silencing switch.
  - 1. Panel shall indicate each automatic transfer switch monitored, the location of automatic transfer switch, and the identity of load it serves.
  - 2. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

#### **2.5 REMOTE ANNUNCIATOR AND CONTROL SYSTEM**

- A. Include the following functions for indicated automatic transfer switches:
  - 1. Indication of sources available, as defined by actual pickup and dropout settings of automatic transfer switch controls.
  - 2. Indication of automatic transfer switch position.
  - 3. Indication of automatic transfer switch in test mode.
  - 4. Indication of failure of communication link.
  - 5. Key-switch or user-code access to control functions of panel.
  - 6. Control of automatic transfer switch test initiation.
  - 7. Control of automatic transfer switch operation in either direction.
  - 8. Control of time-delay bypass for transfer to normal source.



- B. Malfunction of remote annunciator and control system or communication link shall not affect functions of automatic transfer switches. Automatic transfer switch sensing, controlling, or operating functions shall not depend on remote annunciator and control system for proper operation.
- C. Remote annunciation and control system shall include the following features:
1. Touchscreen type operator interface.
  2. Control and indication means grouped together for each automatic transfer switch.
  3. Label each indication and control group. Indicate the automatic transfer switch it controls, the location of the automatic transfer switch, and the identity of the load that it serves.
  4. Digital Communication Capability: Matched to that of automatic transfer switches supervised.
  5. Mounting: Steel cabinet, flush or surface mounted, as shown on the drawings.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install automatic transfer switches in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor automatic transfer switches with rustproof bolts, nuts, and washers not less than 12 mm (1/2 inch) diameter, in accordance with manufacturer's instructions, and as shown on drawings.
- C. Mount automatic transfer switches on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 12.5 mm (1/2 inch) chamfer. The slab shall be of adequate size to project at least 100 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment shall be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface. Concrete work shall be as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

D. Anchor remote control and/or annunciator panel to wall.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. An authorized representative of the automatic transfer switch manufacturer shall technically supervise and participate during all of the field adjustments and tests. Major adjustments and field tests shall be witnessed by the COR. The manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. 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. Confirm correct application of manufacturer's recommended lubricants.
    - d. Verify appropriate anchorage, required area clearances, and correct alignment.
    - e. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
    - f. Verify grounding connections.
    - g. Verify ratings of sensors.
    - h. Vacuum-clean enclosure interior. Clean enclosure exterior.
    - i. Exercise all active components.
    - j. Verify that manual transfer warning signs are properly placed.
    - k. Verify the correct operation of all sensing devices, alarms, and indicating devices.
  - 2. Electrical tests:
    - a. Perform insulation-resistance tests.
    - b. After energizing circuits, demonstrate the interlocking sequence and operational function for each automatic transfer switch at least three times.
      - 1) Test bypass-isolation unit functional modes and related automatic transfer switch operations.

- 2) Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
  - 3) Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
  - 4) Low phase-to-ground voltage shall be simulated for each phase of normal source.
  - 5) Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
  - 6) Verify pickup and dropout voltages by data readout or inspection of control settings.
  - 7) Verify that bypass and isolation functions perform correctly, including the physical removal of the automatic transfer switch while in bypass mode.
- C. Ground-fault tests: Verify that operation of automatic transfer switches shall not cause nuisance tripping or alarms of ground fault protection on either source.
- D. When any defects are detected, correct the defects and repeat the tests as requested by the COR at no additional cost to the Government.

### **3.3 FIELD SETTINGS VERIFICATION**

- A. The automatic transfer switch settings shall be verified in the field by an authorized representative of the manufacturer.

### **3.4 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition and properly performing the intended function.

### **3.5 INSTRUCTION**

- A. Furnish the services of a factory-trained technician for one 4-hour training period for instructing personnel in the maintenance and

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October 24, 2014  
BID Documents  
Project No. 246-13-C-0127

operation of the automatic transfer switches, on the dates requested by  
the COR.

---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.

**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 bare copper points.
  3. Ground rods: Copper-clad steel 0.75 in (19 mm) diameter by 3 m (10 feet) long.
  4. Ground plates: Solid copper, not less than 20 gauge.
  5. Bonding plates: Bronze, 50 square cm (8 square inches).
  6. Through roof connectors: Solid copper riser bar, length and type as required to accommodate roof structure and flashing requirements.
  7. Down conductor guards: Stiff copper or brass.
  8. 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.

9. 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.
10. 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 COR.
- 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 insure 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 shall 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.

### **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 COR.

---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 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:  
Requirements that apply to all sections of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:  
Low-voltage conductors.
- 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 fault currents.
- D. 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 LIGHTING FIXTURE 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.
- D. Lamp Sockets:
  - 1. Fluorescent: Single slot entry type, requiring a one-quarter turn of the lamp after insertion. Lampholder contacts shall be the biting edge type.
  - 2. Compact Fluorescent: 4-pin.
  - 3. High Intensity Discharge (HID): Porcelain.
- 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 and hinged housings) 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 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.
- 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.
- 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).

### **2.3 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: ≥ 0.95.
    - f. Total Harmonic Distortion: ≤ 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 LIGHTING FIXTURE SCHEDULE.
    - c. Minimum Rated Life: 50,000 hours per IES L70.

d. Light output lumens as indicated in the LIGHTING FIXTURE

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 shall 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.
4. 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 shall 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 shall have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
5. 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 shall 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 shall 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 shall, 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.
6. 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.
7. 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 and flanges) , 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.

### **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 COR. 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 26 56 00**  
**EXTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of exterior luminaires, poles, and supports.

**1.2 RELATED WORK**

- A. Section 09 06 00, SCHEDULE FOR FINISHES: Finishes for exterior light poles and luminaires.
- B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- C. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage power and lighting wiring.
- D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path
- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits, fittings, and boxes for raceway systems.
- F. Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION: Underground handholes and conduits.
- G. Section 26 09 23, LIGHTING CONTROLS: Controls for exterior lighting.

**1.3 QUALITY ASSURANCE**

- A. Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 SUBMITTALS**

- A. Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. Shop Drawings:
  - 1. Clearly present sufficient information to determine compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting, details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaires, lamps, and accessories. Include electronic photometric files in IES format, for each specific fixture used, excluding wallpack fixtures.

- C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the COR. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement lamps, ballasts, and parts.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the COR:
  - 1. Certification by the manufacturer that the materials are in accordance with the drawings and specifications.
  - 2. Certification by the contractor that the complete installation 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. Aluminum Association Inc. (AA):  
AAH35.1-06.....Alloy and Temper Designation Systems for  
Aluminum
- C. American Association of State Highway and Transportation Officials  
(AASHTO):  
LTS-5-09 .....Structural Supports for Highway Signs,  
Luminaires and Traffic Signals
- D. American Concrete Institute (ACI):  
318-05 .....Building Code Requirements for Structural  
Concrete
- E. American National Standards Institute (ANSI):  
C81.61-09 .....Electrical Lamp Bases - Specifications for  
Bases (Caps) for Electric Lamps
- F. American Society for Testing and Materials (ASTM):  
A123/A123M-09 .....Zinc (Hot-Dip Galvanized) Coatings on Iron and  
Steel Products  
A153/A153M-09.....Zinc Coating (Hot-Dip) on Iron and Steel  
Hardware  
B108-03a-08 .....Aluminum-Alloy Permanent Mold Castings  
C1089-06 .....Spun Cast Prestressed Concrete Poles
- G. Federal Aviation Administration (FAA):  
AC 70/7460-IK-07.....Obstruction Lighting and Marking

- AC 150/5345-43F-06.....Obstruction Lighting Equipment
- H. Illuminating Engineering Society of North America (IESNA)
- HB-9-00.....Lighting Handbook
- RP-8-05.....Roadway Lighting
- RP-20-98.....Lighting for Parking Facilities
- RP-33-99.....Lighting for Exterior Environments
- LM-5-96.....Photometric Measurements of Area and Sports  
Lighting Installations
- LM-50-99.....Photometric Measurements of Roadway Lighting  
Installations
- LM-52-99.....Photometric Measurements of Roadway Sign  
Installations
- LM-64-01.....Photometric Measurements of Parking Areas
- LM-72-97.....Directional Positioning of Photometric Data
- LM-79-08.....Approved Method for the Electrical and  
Photometric Measurements of Solid-State Lighting  
Products
- LM-80-08.....Approved Method for Measuring Lumen Maintenance  
of LED Light Sources
- I. National Electrical Manufacturers Association (NEMA):
- C78.41-06.....Electric Lamps - Guidelines for Low-Pressure  
Sodium Lamps
- C78.42-07 .....Electric Lamps - Guidelines for High-Pressure  
Sodium Lamps
- C78.43-07 .....Electric Lamps - Single-Ended Metal-Halide  
Lamps
- C78.1381-98.....Electric Lamps - 70-Watt M85 Double-Ended  
Metal-Halide Lamps
- C82.4-02 .....Ballasts for High-Intensity-Discharge and Low-  
Pressure Sodium Lamps (Multiple-Supply Type)
- C136.3-05 .....For Roadway and Area Lighting Equipment -  
Luminaire Attachments
- C136.17-05 .....Roadway and Area Lighting Equipment - Enclosed  
Side-Mounted Luminaires for Horizontal-Burning  
High-Intensity-Discharge Lamps - Mechanical  
Interchangeability of Refractors

ICS 2-00 (R2005) .....Controllers, Contactors and Overload Relays  
Rated 600 Volts

ICS 6-93 (R2006) .....Enclosures

J. National Fire Protection Association (NFPA):

70-08 .....National Electrical Code (NEC)

K. Underwriters Laboratories, Inc. (UL):

496-08 .....Lampholders

773-95.....Plug-In, Locking Type Photocontrols for Use  
with Area Lighting

773A-06 .....Nonindustrial Photoelectric Switches for  
Lighting Control

1029-94.....High-Intensity-Discharge Lamp Ballasts

1598-08 .....Luminaires

8750-08.....Light Emitting Diode (LED) Light Sources for  
Use in Lighting Products

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

- A. Provide manufacturer's standard provisions for protecting pole finishes during transport, storage, and installation. Do not store poles on ground. Store poles so they are at least 12 in [305 mm] above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

#### **2.2 POLES**

A. General:

1. Poles shall be as shown on the drawings, and as specified. Finish shall be as specified on the drawings.
2. The pole and arm assembly shall be designed for wind loading of 100 mph [161 km/hr], with an additional 30% gust factor, supporting luminaire(s) and accessories such as shields, banner arms, and banners that have the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base, as shown on the drawings.
3. Poles shall be anchor-bolt type designed for use with underground supply conductors. Poles shall have handhole having a minimum clear

opening of 2.5 x 5 in [65 x 125 mm]. Handhole covers shall be secured by stainless steel captive screws.

4. Provide a steel-grounding stud opposite handhole openings, designed to prevent electrolysis when used with copper wire.
5. Provide a base cover that matches the pole in material and color to conceal the mounting hardware pole-base welds and anchor bolts.
6. Hardware and Accessories: All necessary hardware and specified accessories shall be the product of the pole manufacturer.
7. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.

**B. Types:**

2. Steel: Provide square steel poles having minimum 11-gauge steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized factory finish. Galvanized steel poles shall comply with ASTM A123 and A153.

**2.3 FOUNDATIONS FOR POLES**

- A. Foundations shall be cast-in-place concrete, having 3000 psi minimum 28-day compressive strength.
- B. Foundations shall support the effective projected area of the specified pole, arm(s), luminaire(s), and accessories, such as shields, banner arms, and banners, under wind conditions previously specified in this section.
- C. Place concrete in spirally-wrapped treated paper forms for round foundations, and construct forms for square foundations.
- D. Rub-finish and round all above-grade concrete edges to approximately 0.25 in [6 mm] radius.
- E. Anchor bolt assemblies and reinforcing of concrete foundations shall be as shown on the drawings. Anchor bolts shall be in a welded cage or properly positioned by the tie wire to stirrups.
- F. Prior to concrete pour, install electrode per Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

**2.4 LUMINAIRES**

- A. Per UL 1598 and NEMA C136.17. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and relamping.



- B. Light distribution pattern types shall be as shown on the drawings.
- C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.
- D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.
- F. Pre-wire internal components to terminal strips at the factory.
- G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.
- H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.
- I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials. Where indicated on drawings, provide finishes as indicated in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

## **2.5 LAMPS**

- A. Install the proper lamps in every luminaire installed and every existing luminaire relocated or reinstalled.
- B. Lamps shall be general-service, outdoor lighting types.
- C. High-Pressure Sodium (HPS) Lamps: NEMA C78.42, CRI 21 (minimum), wattage as indicated. Lamps shall have minimum average rated life of 24,000 hours.
- D. Low-Pressure Sodium (LPS) Lamps: NEMA C78.43.
- E. Metal-Halide Lamps: NEMA C78.43 or NEMA C78.1381.
- F. LED sources shall meet the following requirements:
  - 1. Operating temperature rating shall be between -40° F [-40° C] and 120° F [50° C].
  - 2. Correlated Color Temperature (CCT): 4000K
  - 3. Color Rendering Index (CRI): <sup>3</sup> 65.

4. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

G. Mercury vapor lamps shall not be used.

## **2.6 LED DRIVERS**

- A. LED drivers shall meet the following requirements:
  1. Drivers shall have a minimum efficiency of 85%.
  2. Starting Temperature: -40° F [-40° C].
  3. Input Voltage: 120 to 480 (±10%) V.
  4. Power Supplies: Class I or II output.
  5. Surge Protection: The system shall survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 µs, 10kA/8 x 20 µs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
  6. Power Factor (PF): ≥ 0.90.
  7. Total Harmonic Distortion (THD): ≤ 20%.
  8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
  9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

## **2.7 EXISTING LIGHTING SYSTEMS**

- A. For modifications or additions to existing lighting systems, the new components shall be compatible with the existing systems.
- B. New poles and luminaires shall have approximately the same configurations and dimensions as the existing poles and luminaires, except where otherwise shown on the drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.
- B. Pole Foundations:
  1. Excavate only as necessary to provide sufficient working clearance for installation of forms and proper use of tamper to the full depth of the excavation. Prevent surface water from flowing into the

excavation. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath, and the end of conduit.

2. Set anchor bolts according to anchor-bolt templates furnished by the pole manufacturer.
3. Install poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.
4. After the poles have been installed, shimmed, and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a plastic or copper tube, of not less than 0.375 in [9 mm] inside diameter through the grout, tight to the top of the concrete base to prevent moisture weeping from the interior of the pole.

C. Install lamps in each luminaire.

D. Adjust luminaires that require field adjustment or aiming.

### **3.2 GROUNDING**

- A. Ground noncurrent-carrying parts of equipment, including metal poles, luminaires, mounting arms, brackets, and metallic enclosures, as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Where copper grounding conductor is connected to a metal other than copper, provide specially-treated or lined connectors suitable and listed for this purpose.

### **3.3 ACCEPTANCE CHECKS AND TESTS**

- A. Verify operation after installing luminaires and energizing circuits.

- - - E N D - - -

**SECTION 27 05 11  
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section, Requirements for Communications Installations, applies to all sections of Division 27.
- B. Furnish and install communications cabling, systems, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable, and other items and arrangements for the specified items are shown on drawings.

**1.2 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.

**1.3 QUALIFICATIONS (PRODUCTS AND SERVICES)**

- 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. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which shall render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

**1.4 MANUFACTURED PRODUCTS**

- 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 Contracting Officer's Representative (COR) 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 COR 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.

#### **1.5 EQUIPMENT REQUIREMENTS**

- 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.

#### **1.6 EQUIPMENT PROTECTION**

- 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 COR, 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 kraft 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.

#### **1.7 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.

#### **1.8 EQUIPMENT INSTALLATION AND REQUIREMENTS**

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. 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.

#### **1.9 EQUIPMENT IDENTIFICATION**

- A. Install an identification sign which clearly indicates information required for use and maintenance of equipment.
- B. 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 manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions.

#### **1.10 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 shall not be permitted at the job site.
- C. 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.
- 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 shall 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, pictures, nameplate data and test reports as required.
  - 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

F. Manuals: 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. 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 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. Approvals shall be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the COR 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. Raceway and pathway hangers, clamps and supports.
  - 4. Duct sealing compound.

**1.11 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.

**1.12 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 Contracting Officer Representative (COR) at least 30 days prior to the planned training.

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**SECTION 27 05 26**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, telecommunications system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning.

**1.2 RELATED WORK**

- A. Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 27.
- B. Section 27 10 00, STRUCTURED CABLING: Low Voltage power and lighting wiring.
- C. Section 26 41 00, FACILITY LIGHTNING PROTECTION: Requirements for a lightning protection system.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- B. Shop Drawings:
  - 1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officer Representative (COR):
  - 1. Certification that the materials and installation is in accordance with the drawings and specifications.
  - 2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

#### 1.4 APPLICABLE PUBLICATIONS

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.

- A. 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
- B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
- C. National Fire Protection Association (NFPA):
  - 70-2005.....National Electrical Code (NEC)
- D. Telecommunications Industry Association, (TIA)
  - J-STO-607-A-2002.....Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- E. Underwriters Laboratories, Inc. (UL):
  - 44-2005 .....Thermoset-Insulated Wires and Cables
  - 83-2003 .....Thermoplastic-Insulated Wires and Cables
  - 467-2004 .....Grounding and Bonding Equipment
  - 486A-486B-2003 .....Wire Connectors

#### PART 2 - PRODUCTS

##### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted shall be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.
- C. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.

- D. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm<sup>2</sup> (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

## **2.2 GROUND RODS**

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

## **2.3 SPLICES AND TERMINATION COMPONENTS**

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

## **2.4 TELECOMMUNICATION SYSTEM GROUND BUSBARS**

- A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as follows:
1. Telecom Room Signal Grounding: 300 mm x 100 mm (12 inches x 4 inch).
  2. Main Master Signal Ground: 600 mm x 100 mm (24 inches x 4 inch).

## **2.5 GROUND CONNECTIONS**

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
  2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
  3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.
- C. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.

## **2.6 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 with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x 3/4 inch).

## **2.7 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 screw lug-type terminal blocks.

## **2.8 SPLICE CASE GROUND ACCESSORIES**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
  - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
  - 3. Isolation transformers and isolated power systems shall not be system grounded.
- C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

### **3.3 SECONDARY EQUIPMENT AND CIRCUITS**

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
  - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.

2. Provide a supplemental ground electrode and bond to the grounding electrode system.

C. Conduit Systems:

1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

D. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

E. 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.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

F. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

### **3.4 CORROSION INHIBITORS**

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.5 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

### **3.6 TELECOMMUNICATIONS SYSTEM**

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.
- B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
- D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milli ohms or less.
- E. Below-Grade Grounding 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 the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the COR prior to backfilling any ground connections.
- F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- G. Bonding Jumpers:
  - 1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire.
  - 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
  - 3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- H. Bonding Jumper Fasteners:
  - 1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type

conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

### **3.7 COMMUNICATION ROOM GROUNDING**

#### **A. Telecommunications Ground Busbars:**

1. Provide communications room telecommunications ground busbar hardware at 950 mm (18 inches) at locations indicated on the Drawings.
2. Connect the telecommunications room ground busbars to other room grounding busbars as indicated on the Grounding Riser diagram.

#### **B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:**

1. Install a 16 mm<sup>2</sup> (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.

#### **C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:**

1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
2. Bond together nonadjacent 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.



3. Provide a 16 mm<sup>2</sup> (6 AWG) bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.
- D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 mm<sup>2</sup> (16 AWG) bonding jumper.
- E. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.

### **3.8 COMMUNICATIONS CABLE GROUNDING**

- A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.
  1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
  2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

### **3.9 COMMUNICATIONS RACEWAY GROUNDING**

- A. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

- C. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 16 meters (50 feet).

### **3.10 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Government. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems shall be used to meet the required resistance, but the specified number of electrodes shall still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COR to backfilling. The Contractor shall notify the COR 24 hours before the connections are ready for inspection.

### **3.11 GROUND ROD INSTALLATION**

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

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**SECTION 27 05 33  
RACEWAYS AND BOXES FOR COMMUNICATIONS 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, raceway systems. Raceways are required for all communications 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. Bedding of conduits: Section 31 20 00, EARTH MOVING.
- B. Mounting board for communication closets: Section 06 10 00, ROUGH CARPENTRY.
- C. Sealing around penetrations to maintain the integrity of fire rated construction: Section 07 84 00, FIRESTOPPING.
- D. Fabrications for the deflection of water away from the building envelope at penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- E. Sealing around conduit penetrations through the building envelope to prevent moisture migration into the building: Section 07 92 00, JOINT SEALANTS.
- F. Identification and painting of conduit and other devices: Section 09 91 00, PAINTING.
- G. General electrical requirements and items that is common to more than one section of 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.

**1.3 SUBMITTALS**

In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

- A. Shop Drawings:
  - 1. Size and location of panels and pull boxes
  - 2. Layout of required conduit penetrations through structural elements.
  - 3. The specific item proposed and its area of application shall be identified on the catalog cuts.

#### 1.4 APPLICABLE PUBLICATIONS

B. National Fire Protection Association (NFPA):

C. Underwriters Laboratories, Inc. (UL):

1242-00.....Intermediate Metal Conduit

FB1-03.....Fittings, Cast Metal Boxes and Conduit Bodies  
for Conduit, Electrical Metallic Tubing and  
Cable

## 2.1 MATERIAL

27 05 33 - 2

B. Conduit:

1. Electrical metallic tubing (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.
2. Flexible galvanized steel conduit: Shall Conform to UL 1.
3. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
4. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
5. Surface metal raceway: Shall Conform to UL 5.

C. Conduit Fittings:

1. Electrical metallic tubing fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. 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.
  - 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.
2. Flexible steel conduit fittings:
  - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
  - b. Clamp type, with insulated throat.
3. Liquid-tight flexible metal conduit fittings:
  - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Fittings shall incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
4. Direct burial plastic conduit fittings:
  - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.

- b. As recommended by the conduit manufacturer.
- 5. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 6. Expansion and deflection couplings:
  - a. Conform to UL 467 and UL 514B.
  - b. Accommodate, 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 fault currents in accordance with UL 467, and the NEC code tables for ground 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 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.
  - 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. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
  - 3. Sheet metal boxes: Galvanized steel, except where otherwise shown.
  - 4. 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.
- F. Wireways: Equip with hinged covers, except where removable covers are shown.

- G. Warning Tape: Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters, and imprinted with "CAUTION BURIED COMMUNICATIONS CABLE BELOW".

### **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 COR 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 COR as required by limited working space.

- B. 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 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 8'0" 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 (1 foot) of changes of direction, and within 300 mm (1 foot) 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. Do not use aluminum conduits in wet locations.
  12. 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 shall 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:
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the COR.

### **3.3 CONCEALED WORK INSTALLATION**

- A. In Concrete:
1. Conduit: PVC. 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 COR 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  $1/3$  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 shall 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 600 volts and below:
    - a. EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
  2. Align and run conduit parallel or perpendicular to the building lines.
  3. 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. 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.

### **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. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1".

### **3.8 COMMUNICATION SYSTEM CONDUIT**

- A. Install the communication 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 communication 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 Section 0610 00, ROUGH CARPENTRY 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).

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**SECTION 27 10 00  
STRUCTURED CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of the structured cabling system to provide a comprehensive telecommunications infrastructure.

**1.2 RELATED WORK**

- A. Excavation and backfill for cables that are installed in conduit: Section 31 20 00, EARTH MOVING.
- B. Sealing around penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- C. General electrical requirements that are common to more than one section in Division 27: Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- D. Conduits for cables and wiring: Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- E. 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 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 Contracting Officer Representative (COR) four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

**1.4 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-59544-00.....Cable and Wire, Electrical (Power, Fixed  
Installation)
- D. National Fire Protection Association (NFPA):  
70-05.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):  
44-02.....Thermoset-Insulated Wires and Cables  
83-03.....Thermoplastic-Insulated Wires and Cables  
467-01.....Electrical Grounding and Bonding Equipment  
486A-01.....Wire Connectors and Soldering Lugs for Use with  
Copper Conductors  
486C-02.....Splicing Wire Connectors  
486D-02.....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  
493-01.....Thermoplastic-Insulated Underground Feeder and  
Branch Circuit Cable  
514B-02.....Fittings for Cable and Conduit  
1479-03.....Fire Tests of Through-Penetration Fire Stops

## **PART 2 - PRODUCTS**

### **2.1 CONTROL WIRING**

- A. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring, except the minimum size shall be not less than No. 14 AWG.
- B. Control wiring shall be large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

### **2.2 COMMUNICATION AND SIGNAL WIRING**

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as required for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

### **2.3 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.

### **2.4 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, GENERAL**

- A. Install all wiring in raceway systems.
- B. 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.
- C. Wire Pulling:
  - 1. Provide installation equipment that shall prevent the cutting or abrasion of insulation during pulling of cables.
  - 2. Use ropes made of nonmetallic material for pulling feeders.
  - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the COR.
  - 4. Pull in multiple cables together in a single conduit.

### **3.2 CONTROL, COMMUNICATION AND SIGNAL WIRING INSTALLATION**

- A. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
- B. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system shall not affect other systems.

- C. Where separate power supply circuits are not shown, connect the systems to the nearest panelboards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
- D. 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.
- E. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.

### **3.3 CONTROL, COMMUNICATION AND SIGNAL SYSTEM 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 manhole and handhole, install embossed brass tags to identify the system served and function.

### **3.4 EXISTING WIRING**

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation.

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**SECTION 27 11 00**  
**COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware shall be installed in the VA Garage here-in-after referred to as "*the Facility*". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic, and analog radio frequency (RF) systems coaxial distribution cables, connectors, "patch" cables, and/or "break out" devices.
- B. 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.
- C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Voice and Digital Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, Government, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission(JC), Manual for Health Care

Facilities, all necessary Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The 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.

- E. The VA Contracting Officer's Representative (COR) is the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the COR before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:
  - a. Provide the following interchange (or interface) capabilities:
    - 1) Basic Rate (BRI).
    - 2) Primary Rate (PRI).
  - b. ISDN
    - 1) Narrow Band BRI:
      - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
      - b) D Channel: 16 kBps, minimum.
      - c) H Channel: 384 kBps, minimum.
    - 2) Narrow Band PRI:
      - a) B Channel: 64 kBps, minimum.
      - b) D Channel: 64 kBps, minimum.
      - c) H Channel: 1,920 kBps, minimum.
    - 3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
  - c. ATM operation and interface: ATM 155.
  - e. Integrated Data Communications Utility (IDCU) operation and interface.
  - f. Government Open Systems Interconnection Profile (GOSSIP) compliant.
  - g. Fiber optic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed.

- h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.
- 2. At a minimum the System shall support the following operating parameters:
  - a. EPBX connection:
    - 1) System speed: 1.0 gBps per second, minimum.
    - 2) Impedance: 600 Ohms.
    - 3) Cross Modulation: -60 deci-Bel (dB).
    - 4) Hum Modulation: -55 dB.
    - 5) System data error: 10 to the -10 Bps, minimum.
    - 6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
      - a) Trunk to station: 1.5 dB, maximum.
      - b) Station to station: 3.0 dB, maximum.
      - c) Internal switch crosstalk: -60 dB when a signal of  $\pm 10$  deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
      - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
    - e) Traffic Grade of Service for Voice and Data:
      - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits shall not interfere with, or degrade, the voice service.
      - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.
  - b. Telecommunications Outlet (TCO):
    - 1) Voice:
      - a) Isolation (outlet-outlet): 24 dB.
      - b) Impedance: 600 Ohms, balanced (BAL).
      - c) Signal Level: 0 deciBel per mili-Volt (dBmV)  $\pm 0.1$  dBmV.
      - d) System speed: 100 mBps, minimum.
      - e) System data error: 10 to the -6 Bps, minimum.

2) Data:

- a) Isolation (outlet-outlet): 24 dB.
- b) Impedance: 600 Ohms, BAL.
- c) Signal Level: 0 dBmV  $\pm$  0.1 dBmV.
- d) System speed: 120 mBps, minimum.
- e) System data error: 10 to the -8 Bps, minimum.

5) Closed Circuit Analog Video Service: Analog video service is considered shall be at baseband (below 100 mHz in frequency bandwidth). An analog video circuit requires a separate analog video from the audio connector. The following minimum operating parameters shall be capable over each installed analog video circuit:

Impedance	75 Ohm, unbalanced
Output Level	1.0 V peak to peak (P-P), for 87.5% depth of Modulation (Mod)
Diff Gain	$\pm 1$ dB at 87.5% Mod
Diff Phase	$\pm 1.5$ at 87.5% Mod
Signal to Noise (S/N) ratio	44 dB, minimum
Hum Modulation	-55 dB
Return Loss	-14 dB (or 1.5 Voltage Standing Wave Ratio [VSWR]), maximum
Isolation (outlet-outlet)	24 DB, MINIMUM
Bandwidth	6.0 mHz per channel, fully loaded, minimum

**1.2 RELATED WORK**

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 10 00, STRUCTURED CABLING.
- E. Specification Section 26 27 26, WIRING DEVICES.
- F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.

**1.3 APPLICABLE PUBLICATIONS**

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568B	Commercial Building Telecommunications Wiring Standard
569B	Commercial Building Standard for Telecommunications Pathways and Spaces
606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS
607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
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- E. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".
- F. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).
- G. Federal Information Processing Standards (FIPS) Publications.
- H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.
- I. United States Air Force: Technical Order 33K-1-100 Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.
- J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.
- K. National and/or Government Life Safety Code(s): The more stringent of each listed code.

#### **1.4 QUALITY ASSURANCE**

- A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.
- C. The System 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 System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System 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 certification shall be provided in writing as part of the Contractor's Technical Submittal.

- D. All 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.
- E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, 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 COR before being allowed to commence work on the System.

#### **1.5 SUBMITTALS**

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The COR shall retain one copy for review and approval.
  - 1. If the submittal is approved the COR shall retain one copy for Official Records and return three (3) copies to the Contractor.
  - 2. If the submittal is disapproved, three (3) copies shall be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The COR shall retain one copy for Official Records.
- B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the 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: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
  - 5. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
  - 6. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
  - 7. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.

8. Conduit size requirement (between main TC, computer, and console rooms).
  9. Main trunk line and riser pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
    - a. VA Medical Center.
    - b. Contractor's name, address, and telephone (including FAX) numbers.
    - c. Date of Submittal.
    - d. VA Project No.
  2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
    - a. Installation Location and Name.
    - b. Owner's or User's name, address, and telephone (including FAX) numbers.
    - c. Date of Project Start and Date of Final Acceptance by Owner.
    - d. System Project Number.
    - e. Brief (three paragraphs minimum) description of each system's function, operation, and installation.
  3. Narrative Description of the system.
  4. A List of the equipment shall be furnished. The quantity, make, and model number of each item is required. Select the required equipment items quantities that shall satisfy the needs of the system. The following is the minimum equipment required by the system:

QUANTITY	UNIT
As required	Cabinet Assembly(s)
As required	Equipment Rack
As required	Cross Connection (CCS) Systems
As required	Wire Management System/Equipment
As required	Telecommunications Outlets (TCO)
As Required	Distribution Cables
As required	TCO Connection Cables
As required	System Connectors



As required	Terminators
As required	Distribution Frames
As required	Telecommunications Closets (TC)
As required	Environmental Requirements
1 ea.	Installation Kit
As-required	Separate List Containing Each Equipment Spare(s)

6. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected shall be installed and configured.
  7. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment shall be furnished.
  8. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiberoptic, and coaxial cable jack.
  9. List of test equipment as per paragraph 1.5.D. below.
  10. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
  11. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.
- D. Test Equipment List:
1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters shall be tested.
  2. The test equipment 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:
    - a. Spectrum Analyzer.
    - b. Signal Level Meter.

- c. Volt-Ohm Meter.
  - d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
  - e. Bit Error Test Set (BERT).
  - f. Camera with a minimum of 60 pictures to that shall develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
- E. Certifications:
- 1. Submit written certification from the OEM indicating that 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.
  - 2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA shall not approve any submittal without this certification.
  - 3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.
- F. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the COR. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.
- G. Record Wiring Diagrams:
- 1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the COR. 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.
  - 2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current

operating version of Computer Aided Drafting (AutoCAD) system. The COR shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

3. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. A specific cable count shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:
- a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling shall be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.) cabling and TCOs shall be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required shall be provided on each floor designated OR the number of cable pair (VA Owned) shall be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

- b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title,

	or location, and main signal closet or intermediate signal closet cabling is provided from
TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

c. Analog RF Cabling Requirements/Column Explanation:

Column	Explanation
FLOOR	Identifies the floor by number (i.e. 1st, 2nd, etc.)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
TO FLOOR TC	Identifies building, by number or location, to which cabling is installed
NUMBER OF STRANDS	Identifies the number of strands in each run of RF cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

4. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT AND MATERIALS**

A. System Requirements:

1. The System shall provide the following minimum services that are designed in accordance with and supported by an Original Equipment Manufacturer (OEM), and as specified herein. The System shall provide continuous inter and/or intra-Facility voice and data, and analog RF service. The System shall be capacity sized so that loss of connectivity to external telephone systems shall not affect the Facilities operation in specific designated locations. The System shall:
  - a. Be capable of inter-connecting and functioning fully with the existing Local Telephone Exchange (LEC) Network(s), Federal Telephone System (FTS) Inter-city Network(s), Inter-exchange Carriers, Integrated Services Digital Network (ISDN), Electronic Private Branch Exchange (EPBX) switches, asynchronous/synchronous data terminals and circuits including Automatic Transfer Mode (ATM), Frame Relay, and local area networks (LAN), at a minimum.
  - b. Be a voice and data cable distribution system that is based on a physical "Star" Topology.
  - c. Be compatible with and able to provide direct digital connection to trunk level equipment including, but, not limited to: directly accessing trunk level equipment including the telephone system, audio paging, Industry Standard "T" and/or "DS" carrier services and external protocol converters.
  - d. Where the System connects to an existing or future telephone system.
2. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital and analog RF telecommunications cabling system: "Main" (MTC), "intermediate" (IMTC), and "riser" (RTC) TC's; "vertical" (or "riser") trunk cabling system; vertical cross-connection (VCC) cabling systems, and TCO's with a minimum of three (3) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.
  - a. Telecommunication Closet (TC):
    - 1) There shall be a minimum of one TC for each building .  
However, in large building(s), where the horizontal distance to the farthest voice and digital work area shall exceed 90

Meters (M) (or 295 feet [ft]), additional TC's shall be provided as described herein. The maximum DC resistance per cable pair shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.

2) Additionally, the TC's shall house fire alarm, and video. Regardless of the method of installation, mounting, termination, or cross-connecting used, all vertical copper and fiber optic and analog RF coaxial cables shall be terminated on appropriate cross-connection systems (CCS) containing patch panel(s), punch blocks, and/or breakout devices provided in enclosures and tested as described herein. A cable and/or wire management system shall be a part of each CCS.

a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M<sup>2</sup> (or 8,000 ft<sup>2</sup>) of useable floor space. Additional outlets shall be equally spaced along the wall.

B. System Performance:

1. At a minimum, the System shall be able to support the following voice and data and analog RF operations for Category 6 Certified Telecommunication Service:

a. Provide the following interchange (or interface) capabilities:

- 1) Basic Rate (BRI).
- 2) Primary Rate (PRI).

b. ISDN:

- 1) Narrow Band BRI.

- a) B Channel: 64 kilo-Bits per second (kBps), minimum.
    - b) D Channel: 16 kBps, minimum.
    - c) H Channel: 384 kBps, minimum.
  - 2) Narrow Band PRI:
    - a) B Channel: 64 kBps, minimum.
    - b) D Channel: 64 kBps, minimum.
    - c) H Channel: 1,920 kBps, minimum.
  - 3) Wide (or Broad) Band:
    - a) All channels: 140 mega (m)-Bps, minimum, capable to 565 mBps at "T" reference.
  - c. ATM operation and interface: ATM 155 mBps
  - d. Frame Relay: All stated compliance's.
  - e. Integrated Data Communications Utility (IDCU) operation and interface
  - f. Government Open Systems Interconnection Profile (GOSSIP) compliant.
  - g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed.
  - h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data and analog RF locations.
2. At a minimum the System shall support the following operating parameters:
- a. EPBX connection:
    - 1) System speed: 1.0 gBps per second, minimum.
    - 2) Impedance: 600 Ohms.
    - 3) Cross Modulation: -60 deci-Bel (dB).
    - 4) Hum Modulation: -55 Db.
    - 5) System data error: 10 to the -10 Bps, minimum loss measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
      - a) Trunk to station: 1.5 dB, maximum.
      - b) Station to station: 3.0 dB, maximum.
      - c) Internal switch crosstalk: -60 dB when a signal of  $\pm 10$  deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.

- d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
- e) Traffic Grade of Service for Voice and Data:
  - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits shall not interfere with, or degrade, the voice service.
  - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

1) Voice:

- a) Isolation (outlet-outlet): 24 dB.
- b) Impedance: 600 Ohms, balanced (BAL).
- c) Signal Level: 0 deciBel per mili-Volt (dBmV)  $\pm$  0.1 dBmV.
- d) System speed: 100 mBps, minimum.
- e) System data error: 10 to the -6 Bps, minimum.

2) Data:

- a) Isolation (outlet-outlet): 24 dB.
- b) Impedance: 600 Ohms, BAL.
- c) Signal Level: 0 dBmV  $\pm$  0.1 dBmV.
- d) System speed: 120 mBps, minimum.
- e) System data error: 10 to the -8 Bps, minimum.

C. General:

- 1. All equipment shall be supplied under this specification shall be new and the current model of a standard product of an OEM or 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:
  - a. Maintains a stock of replacement parts for the item submitted.
  - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.
  - c. 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.



2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, in writing to the COR 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 shall be by another subcontractor.
4. All interconnecting twisted pair, fiber-optic 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, fiber-optic, or coaxial cable unterminated, unconnected, loose or unsecured.
5. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever 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. Reference Specification Section 27 10 00, STRUCTURED CABLING.
6. 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 COR regarding a suitable circuit location prior to bidding.
7. 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 shall not be approved.
8. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cyclac plastic for the areas where provided.
  9. 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.
  10. Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

D. Equipment Functional Characteristics:

FUNCTIONS	CHARACTERISTICS
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ $\pm$ 2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support 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. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such

standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.

3. The provided active and passive equipment required by the System design and approved technical submittal shall conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the COR approved system equipment necessary shall be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment shall be used in completion of this contract, the equipment shall bear the approved UL seal.
4. Each item of electronic equipment shall be provided under this contract shall 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.

## **2.2 EQUIPMENT ITEMS**

### **A. Cabinet with Internal Equipment Mounting Rack:**

1. The provided equipment cabinet shall be lockable, fabricated of heavy 16 gauge (ga) steel, and have fully adjustable internal equipment mounting racks or rails that allows front panel equipment mounting and access. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color shall be selected by the using Facility Service Chief. It shall be floor or wall mounted with knock-out holes for cable entrance and conduit connection, contain ventilation ports and a quiet fan with non disposable air filter for equipment cooling. Two keys shall be provided to the COR for each lock when the VA accepts the System.
2. A minimum of one cabinet shall be provided with blank rack space, for additional equipment. Blank panels shall be installed to cover any open or unused rack space. In addition, provide two 120 VAC power strips connected to surge protectors, a ventilation fan with non-disposable air filter, and a conduit or cable duct interfaced to adjacent cabinet(s), as part of this cabinet.
3. Blank panels shall be color matched to the cabinet, 3.175 mm (1/8in.) aluminum with vertical dimensions in increments of one rack unit 45 mm (or 1.75in.) with mounting holes spaced to correspond to EIA 480 mm (or 19in.) rack dimensions. Single standard size blank

panels shall be used to fill unused panel or rack spaces in lieu of numerous 45 mm (1.75in.) types. One blank 45 mm (1.75in.) high blank panel shall be installed between each item of equipment.

4. Technical Characteristics:

Overall Height	2180 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

5. Internal Cabinet Components (minimum required):

a. AC power outlet strip(s):

- 1) Power outlet strip(s) shall be provided as directed by the COR or the IRM. The additional equipment cabinet with no installed items in the cabinet, shall contain strip(s) with a minimum of 12 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 shall 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 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

strips) shall 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, shall be self contain
Noise filtering	Greater than -45 dB
AC outlets	Four duplex grounded types, minimum
Response time	5.0 ns
Surge suppression	10,000 AMPS
Noise suppression	
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 shall not short circuit the AC power line at any time.
  - (1) The primary surge protection components shall be silicon semiconductors. Secondary stages, if used, shall 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. Distribution or System Interface Cabinet:

1. The cabinet shall be constructed of heavy 16 gauge cold rolled steel, have top and side panels and hinged front and rear (front door only if wall mounted) doors. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color shall be selected by the using Facility Service Chief or the COR, contain integral and adjustable predrilled rack mounting rails or frame that allows front panel equipment mounting and access. When all equipment, doors and panels are installed, snap-in-place chrome trim strip covers are required shall be installed that shall cover all front panel screw fasteners. It shall be equipped the same as the equipment cabinet.

2. Technical Characteristics:

Overall height	2180 mm (85 7/8in.), maximum
Overall depth	650 mm (25 1/2in.), maximum
Overall width	535 mm (21 1/16in.), maximum
Equipment vertical mounting space	1960 mm (77 1/8in.), maximum
Front panel horizontal	484 mm (19 1/16in.), maximum width

D. Stand Alone Equipment (or sometimes called Radio Relay) Rack:

1. The rack shall be constructed of heavy 16 gauge cold rolled steel and have fully adjustable equipment front mounting rails that allows front panel equipment mounting and access. It shall have baked-on iron phosphate primer and baked enamel paint finish in a color shall be selected by the using Facility Service Chief or the COR. It shall

be floor or wall mounted or mounted on casters as directed by the COR.

2. Technical Characteristics:

Overall Height	2180 mm (85 7/8in.), maximum
Overall Depth	650 mm (25 1/2in.), maximum
Overall Width	535 mm (21 1/16in.), maximum
Front Panel Opening	480 mm (19in.), EIA horizontal width
Hole Spacing	per EIA and Industry Standards

E. Cross-Connection System (CCS) Equipment Breakout, Termination Connector (or Bulkhead), and Patch Panels:

1. 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 shall be connected through the panel. Each panel shall be color matched to the cabinet installed.

a. Voice (or Telephone):

- 1) The CSS for voice or telephone service shall be Industry Standard type 110 (minimum) punch blocks for voice or telephone, and control wiring in lieu of patch panels, each being certified for category six service. IDC punch blocks (with internal RJ45 jacks) are acceptable for use in all CCS and shall be specifically designed for category six telecommunications service and the size and type of UTP cable used as described herein. As a minimum, punch block strips shall be secured to an OEM designed physical anchoring unit on a wall location in the TC. However, console, cabinet, rail, panel, etc. mounting is allowed at the OEM recommendation and as approved by the COR. Punch blocks shall not be used for Class II or 120 VAC power wiring.

2) Technical Characteristics:

Number of horizontal rows	100, MINIMUM
Number of terminals per row	4, minimum
Terminal protector	required for each used or unused terminal
Insulation splicing	required between each row of

	terminals
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b. Digital or High Speed Data:

- 1) The CSS for digital or high-speed data service shall be a patch panel with modular female RJ45 jacks installed in rows. Patch panels and RJ45 jacks shall be specifically designed for category six telecommunications service and the size and type of UTP or STP cable used. Each panel shall be 480 mm (19in.) horizontal EIA rack mountable dimensions with EIA standard spaced vertical mounting holes.
- 2) Technical Characteristics:

Number of horizontal rows	2, minimum
Number of jacks per row	24, MINIMUM
Type of jacks	RJ45
Terminal protector	required for each used or unused jack
Insulation	required between each row of jacks

c. Fiber optic :

- 1) 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. This panel shall be used for fiber optic, audio, control cable, and Class II Low Voltage Wiring installations when provided with the proper connectors. This panel is not allowed shall be used for 120 VAC power connections.
- 2) 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 COR 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 COR 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

d. Mounting Strips and Blocks:

- 1) 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.

2) 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

2. 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.

3. Punch Blocks: As a minimum, Industry Standard 110 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.
4. 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.

F. Wire Management System and Equipment:

1. Wire Management System: The system(s) shall be provided as the management center of the respective cables system, CCS, and TC it is incorporated. It shall perform as a platform to house peripheral equipment in a standard relay rack or equipment cabinet. It shall be arranged in a manner as to provide convenient access to all installed management and other equipment. All cables and connections shall be at the rear of each system interface to IDC and/or patch panels, punch blocks, wire wrap strips, and/or barrier strip.
2. 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, interconnection 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. It shall be fully compatible and interface to each cable tray, duct, wireway, or conduit used in the system. All interconnection or distribution wires and cables shall enter the system at the top (or from a wireway in the floor) via a overhead 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. Each system shall be custom configured to meet the System design and user needs.

### 2.3 INSTALLATION KIT

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 COR 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:

A. System Grounding:

1. 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.
2. This includes, but is not limited to:
  - a. Control Cable Shields.
  - b. Data Cable Shields.
  - c. Equipment Racks.
  - d. Equipment Cabinets.
  - e. Conduits.
  - f. Connector Panels.
  - g. Grounding Blocks.

B. 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.

C. Conduit : 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.

D. 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.

- E. 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.
- F. 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.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. 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 and equipment catalog numbers, model and serial identification numbers. The COR shall inventory the cable, patch panels, and related equipment.
  - 2. Storage and Handling: Store and protect equipment in a manner, which shall preclude damage as directed by the COR.
- B. 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 COR 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 install suitable filters, traps, directional couplers, splitters, TC's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass telephone and data 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 of Paragraph 2.1.C and the System performance standards.

4. 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.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All vertical copper and fiber optic cables shall be terminated so any future changes only requires modifications of the EPBX or signal closet equipment only.
8. 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 cables carrying telephone and data signals in telephone and data systems.
9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. 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, weatherheads, 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 19 mm (3/4 in.).
- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow

telephone cables shall be installed in partitioned cable tray with data cables shall be granted in writing by the COR 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 shall 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 shall 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 signal conduit.
  - f. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized shall 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. 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. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. 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, wirewrap, etc.

E. AC Power: AC power wiring shall be run separately from signal cable.

F. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, crosstalk, etc. The total ground resistance shall be 0.1 Ohm or less.
  - a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
  - b. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
  - c. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and shall not be permitted. These items shall be used only for the dissipation of internally generated static charges (not shall be confused with externally generated lightning) that shall applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
3. Equipment: Equipment shall be bonded to the 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 alternates.

4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

G. Equipment Assembly:

1. Cabinets:

- a. Each 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).
- b. Rack (including freestanding radio relay) mounted equipment shall be installed in the enclosure's equipment adjustable mounting racks with equipment normally requiring adjustment or observation mounted so operational adjustment(s) can be conveniently made. 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. Equipment shall be provided with sufficient cable slack to permit servicing by removal of the installed equipment from the front of the enclosure. 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. The enclosure shall be designed for efficient equipment cooling and air ventilation. Each console or cabinet shall be equipped with a quiet fan and nondisposable air filter.
- c. 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.



- d. 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 shall 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 shall be called "outputs".
  - 1) 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.
  - 2) 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.
  - 3) 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.
- H. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers. Handwritten labels are not acceptable.
  - 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.
  - 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 workstation outlets and patch panel connections using color coded labels with

identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams".

### **3.2 TESTS**

#### **A. Pretesting:**

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. 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 telephone and data channel, at each of the following points in the system:
    - 1) Local Telephone Company Interfaces or Inputs.
    - 2) EPBX interfaces or inputs and outputs.
    - 3) MDF interfaces or inputs and outputs.
    - 4) EPBX output S/NR for each telephone and data channel.
    - 5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
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 COR.

#### **B. Acceptance Test:**

1. After the System has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 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 and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

C. Verification Tests:

1. Test the 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 the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.
2. Multimode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/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 ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-7 using Method A, Optical Power Meter and Light Source. Perform verification acceptance test.

D. Performance Testing:

1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: 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 ANSI/EIA/TIA-568-B.3.

E. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) and the multimode and/or single mode fiber optic cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

**3.3 TRAINING**

A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM

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 shall be accomplished. Training shall be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

### **3.4 WARRANTY**

- A. Comply with FAR clause 52.246-21, except that warranty shall be as follows:

1. The Contractor shall warranty that all installed material and equipment shall be free from defects, workmanship, and shall 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 COR (or Facility Contracting Officer if the Facility has taken possession of the building(s)), 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. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and shall 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 one year warranty period:
  - a. Response Time:
    - 1) The COR (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor's reporting and contact officials for the System trouble calls, during the warranty period.
    - 2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., 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 working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord shall be inoperable.
  - b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point shall be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.
- 4) The Contractor shall respond on-site to a catastrophic trouble call within 4 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 the standard work time limits), the Contractor shall be responsible for providing alternate system CSS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the 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.) shall also be deemed as a catastrophic trouble call if so determined by the COR or Facility Director. The COR or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.
- b. Required on-site visits during the one year warranty period
- 1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the warranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.
    - a) The Contractor shall arrange all Facility visits with the COR or Facility Contracting Officer prior to performing the required maintenance visits.
    - b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive

maintenance during a non-busy time agreed to by the COR or Facility Contracting Officer and the Contractor.

- c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COR.
- 2) The Contractor shall provide the COR 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 COR with sample copies of these reports for review and approval at the beginning of the Total System Acceptance Test. The following reports are the minimum required:
  - a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to COR by the fifth 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) Contractor Log: 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.
- 3) The COR shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
  - a) The COR or Facility Contracting Officer shall ensure copies of these reports are entered into the System's official acquisition documents.
  - b) The Facilities Chief Engineer shall ensure copies of these reports are entered into the System's official technical as-installed documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor,

contractor, owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COR in writing upon the discovery of these incidents. The COR or Facility Contracting Officer shall investigate all reported incidents and render findings concerning any Contractor's responsibility.

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**SECTION 27 15 00**  
**COMMUNICATIONS HORIZONTAL CABLING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This Section specifies the furnishing, installing, certification, testing, and guaranty of a complete and operating Voice and Digital Cable Distribution System (here-in-after referred to as "*the System*"), and associated equipment and hardware shall be installed in the VA Garage here-in-after referred to as "*the Facility*". The System shall include, but not be limited to: equipment cabinets, interface enclosures, and relay racks; necessary combiners, traps, and filters; and necessary passive devices such as: splitters, couplers, cable "patch", "punch down", and cross-connector blocks or devices, voice and data distribution sub-systems, and associated hardware. The System shall additionally include, but not be limited to: telecommunication closets (TC); telecommunications outlets (TCO); copper and fiber optic distribution cables, connectors, "patch" cables, and/or "break out" devices.
- B. 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.
- C. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- D. The Voice and Digital and Analog Telecommunication Distribution Cable Equipment and System provides the media which voice and data information travels over and connects to the Telephone System which is defined as an Emergency Critical Care Communication System by the National Fire Protection Association (NFPA). Therefore, since the System connects to or extends the telephone system, the System's installation and operation shall adhere to all appropriate National, Government, and/or Local Life Safety and/or Support Codes, which ever are the more stringent for this Facility. At a minimum , the System shall be installed according to NFPA, Section 70, National Electrical Code (NEC), Article 517 and Chapter 7; NFPA, Section 99, Health Care Facilities, Chapter 3-4; NFPA, Section 101, Life Safety Code, Chapters 7, 12, and/or 13; Joint Commission on Accreditation of Health Care



Organization (JCAHCO), Manual for Health Care Facilities, all necessary Life Safety and/or Support guidelines; this specification; and the original equipment manufacturer's (OEM) suggested installation design, recommendations, and instructions. The 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.

- E. The Contracting Officer Representative (COR) are the approving authorities for all contractual and mechanical changes to the System. The Contractor is cautioned to obtain in writing, all approvals for system changes relating to the published contract specifications and drawings, from the PM and/or the COR before proceeding with the change.

F. System Performance:

1. At a minimum, the System shall be able to support the following voice and data operations for Category 6 Certified Telecommunication Service:
  - a. Provide the following interchange (or interface) capabilities:
    - 1) Basic Rate (BRI).
    - 2) Primary Rate (PRI).
  - b. ISDN:
    - 1) Narrow Band BRI:
      - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
      - b) D Channel: 16 kBps, minimum.
      - c) H Channel: 384 kBps, minimum.
    - 2) Narrow Band PRI:
      - a) B Channel: 64 kBps, minimum.
      - b) D Channel: 64 kBps, minimum.
      - c) H Channel: 1,920 kBps, minimum.
    - 3) Wide (or Broad) Band: All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
  - c. ATM operation and interface: ATM 155 mBps.
  - d. Frame Relay: All stated compliance's.
  - e. Integrated Data Communications Utility (IDCU) operation and interface.
  - f. Government Open Systems Interconnection Profile (GOSSIP) compliant.

- g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data locations.
- 2. At a minimum the System shall support the following operating parameters:
  - a. EPBX connection:
    - 1) System speed: 1.0 gBps per second, minimum.
    - 2) Impedance: 600 Ohms.
    - 3) Cross Modulation: -60 deci-Bel (dB).
    - 4) Hum Modulation: -55 dB.
    - 5) System data error: 10 to the -10 Bps, minimum.
    - 6) Loss: Measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
      - a) Trunk to station: 1.5 dB, maximum.
      - b) Station to station: 3.0 dB, maximum.
      - c) Internal switch crosstalk: -60 dB when a signal of  $\pm 10$  deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
      - d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
    - e) Traffic Grade of Service for Voice and Data:
      - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits shall not interfere with, or degrade, the voice service.
      - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.
  - b. Telecommunications Outlet (TCO):
    - 1) Voice:
      - a) Isolation (outlet-outlet): 24 dB.
      - b) Impedance: 600 Ohms, balanced (BAL).
      - c) Signal Level: 0 deciBel per mili-Volt (dBmV)  $\pm$  0.1 dBmV.
      - d) System speed: 100 mBps, minimum.

- e) System data error: 10 to the -6 Bps, minimum.
- 2) Data:
  - a) Isolation (outlet-outlet): 24 dB.
  - b) Impedance: 600 Ohms, BAL.
  - c) Signal Level: 0 dBmV  $\pm$  0.1 dBmV.
  - d) System speed: 120 mBps, minimum.
  - e) System data error: 10 to the -8 Bps, minimum.
- 5) Closed Circuit Analog Video Service: Analog video service is considered shall be at baseband (below 100 mHz in frequency bandwidth). An analog video circuit requires a separate analog video from the audio connector. The following minimum operating parameters shall be capable over each installed analog video circuit:

Impedance	75 Ohm, unbalanced
Output Level	1.0 V peak to peak (P-P), for 87.5% depth of Modulation (Mod)
Diff Gain	$\pm 1$ dB at 87.5% Mod
Diff Phase	$\pm 1.5$ at 87.5% Mod
Signal to Noise (S/N) ratio	44 dB, minimum
Hum Modulation	-55 dB
Return Loss	-14 dB (or 1.5 Voltage Standing Wave Ratio [VSWR]), maximum
Isolation (outlet-outlet)	24 DB, MINIMUM
Bandwidth	6.0 mHz per channel, fully loaded, minimum

## 1.2 RELATED WORK

- A. Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Specification Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS.
- C. Specification Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS.
- D. Specification Section 27 10 00, STRUCTURED CABLING.
- E. Specification Section 26 27 26, WIRING DEVICES.

F. Specification Section 27 05 26, GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS.

G. Specification Section 26 41 00, FACILITY LIGHTNING PROTECTION.

### 1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. Except for a specific date given the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date the system's submittal is technically approved by VA, shall be enforced.

B. National Fire Protection Association (NFPA):

70	NATIONAL ELECTRICAL CODE (NEC)
75	Protection of Electronic Computer/Data Processing Equipment
77	Recommended Practice on Static Electricity
	Standard for Health Care Facilities
101	Life Safety Code
1221	Emergency Services Communication Systems

C. Underwriters Laboratories, Inc. (UL):

65	Wired Cabinets
96	Lightning Protection Components
96A	INSTALLATION REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEMS
467	Grounding and Bonding Equipment
497/497A/497B	PROTECTORS FOR PAIRED CONDUCTORS/ COMMUNICATIONS CIRCUITS/DATA COMMUNICATIONS AND FIRE ALARM CIRCUITS
884	Underfloor Raceways and Fittings

D. ANSI/EIA/TIA Publications:

568B	Commercial Building Telecommunications Wiring Standard
569B	Commercial Building Standard for Telecommunications Pathways and Spaces
606A	ADMINISTRATION STANDARD FOR THE TELECOMMUNICATIONS INFRASTRUCTURE OF COMMERCIAL BUILDINGS

607A	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings
758	Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

- E. Lucent Technologies: Document 900-200-318 "Outside Plant Engineering Handbook".
- F. International Telecommunication Union - Telecommunication Standardization Sector (ITU-T).
- G. Federal Information Processing Standards (FIPS) Publications.
- H. Federal Communications Commission (FCC) Publications: Standards for telephone equipment and systems.
- I. United States Air Force: Technical Order 33K-1-100 Test Measurement and Diagnostic Equipment (TMDE) Interval Reference Guide.
- J. Joint Commission on Accreditation of Health Care Organization (JCAHO): Comprehensive Accreditation Manual for Hospitals.
- K. National and/or Government Life Safety Code(s): The more stringent of each listed code.

#### **1.4 QUALITY ASSURANCE**

- A. The authorized representative of the OEM, shall be responsible for the design, satisfactory total operation of the System, and its certification.
- B. The OEM shall meet the minimum requirements identified in Paragraph 2.1.A. Additionally, the Contractor shall have had experience with three or more installations of systems of comparable size and complexity with regards to coordinating, engineering, testing, certifying, supervising, training, and documentation. Identification of these installations shall be provided as a part of the submittal as identified in Paragraph 1.5.
- C. The System 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 System Contractor shall be authorized by the OEM to certify and warranty the installed equipment. In addition, the OEM and System 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 certification shall be provided in writing as part of the Contractor's Technical Submittal.

- D. All 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.
- E. The Contractor's Telecommunications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, 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 COR before being allowed to commence work on the System.

#### **1.5 SUBMITTALS**

- A. Provide submittals in accordance with Specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. The COR shall retain one copy for review and approval.
  - 1. If the submittal is approved the COR shall retain one copy for Official Records and return three (3) copies to the Contractor.
  - 2. If the submittal is disapproved, three (3) copies shall be returned to the Contractor with a written explanation attached that indicates the areas the submittal deviated from the System specifications. The COR shall retain one copy for Official Records.
- B. Environmental Requirements: Technical submittals shall confirm the environmental specifications for physical TC areas occupied by the System. These environmental specifications shall identify the 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: The Contractor shall provide the specific voltage, amperage, phases, and quantities of circuits required.
  - 5. Air conditioning, heating, and humidity requirements. The Contractor shall identify the ambient temperature and relative humidity operating ranges required preventing equipment damage.
  - 6. Air conditioning requirements (expressed in BTU per hour, based on adequate dissipation of generated heat to maintain required room and equipment standards).
  - 7. Proposed floor plan, based on the expanded system configuration of the bidder's proposed EPBX for this FACILITY.

8. Conduit size requirement (between main TC, computer, and console rooms).
  9. Main backbone, trunk line, riser, and horizontal cable pathways, cable duct, and conduit requirements between each MTC, TC, and TCO.
- C. Documents: The submittal shall be separated into sections for each subsystem and shall contain the following:
1. Title page to include:
    - a. VA Medical Center.
    - b. Contractor's name, address, and telephone (including FAX) numbers.
    - c. Date of Submittal.
    - d. VA Project No.
  2. List containing a minimum of three locations of installations of similar size and complexity as identified herein. These locations shall contain the following:
    - a. Installation Location and Name.
    - b. Owner's or User's name, address, and telephone (including FAX) numbers.
    - c. Date of Project Start and Date of Final Acceptance by Owner.
    - d. System Project Number.
    - e. Brief (three paragraphs minimum) description of each system's function, operation, and installation.
  3. Narrative Description of the system.
  4. A List of the equipment shall be furnished. The quantity, make, and model number of each item is required. Select the required equipment items quantities that shall satisfy the needs of the system. The following is the minimum equipment required by the system:

QUANTITY	UNIT
As required	Cabinet Assembly(s)
As required	Equipment Rack
As required	Cross Connection (CCS) Systems
As required	Wire Management System/Equipment
As required	Telecommunications Outlets (TCO)
As Required	Distribution Cables
As required	TCO Connection Cables
As required	System Connectors
As required	Terminators

As required	Distribution Frames
As required	Telecommunications Closets (TC)
As required	Environmental Requirements
1 ea.	Installation Kit
As-required	Separate List Containing Each Equipment Spare(s)

5. Pictorial layouts of each MTC, IMTC, and RTCs; MCCS, IMCCS, VCCS, and HCCS termination cabinet(s), each distribution cabinet layout drawing, and TCO as each is expected shall be installed and configured.
6. Equipment technical literature detailing the electrical and technical characteristics of each item of equipment shall be furnished.
7. Engineering drawings of the System, showing calculated signal levels at the EPBX output, each input and output distribution point, proposed TCO values, and signal level at each TCO multipin, fiber optic jack.
8. List of test equipment as per paragraph 1.5.D. below.
9. Letter certifying that the Contractor understands the requirements of the SAMPLES Paragraph 1.5.E.
10. Letter certifying that the Contractor understands the requirements of Section 3.2 concerning acceptance tests.

D. Test Equipment List:

1. The Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The Contractor shall furnish test equipment of accuracy better than the parameters shall be tested.
2. The test equipment 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:
  - a. Spectrum Analyzer.
  - b. Signal Level Meter.
  - c. Volt-Ohm Meter.



- d. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring).
  - e. Bit Error Test Set (BERT).
  - f. Camera with a minimum of 60 pictures to that shall develop immediately to include appropriate test equipment adapters. A video camera in VHS format is an acceptable alternate.
- E. Certifications:
- 1. Submit written certification from the OEM indicating that 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.
  - 2. Submit written certification from the OEM that the wiring and connection diagrams meet National and/or Government Life Safety Guidelines, NFPA, NEC, UL, this specification, and JCAHCO requirements and instructions, requirements, recommendations, and guidance set forth by the OEM for the proper performance of the System as described herein. The VA shall not approve any submittal without this certification.
  - 3. Preacceptance Certification: This certification shall be made in accordance with the test procedure outlined in paragraph 3.2.B.
- F. Equipment Manuals: Fifteen (15) working days prior to the scheduled acceptance test, the Contractor shall deliver four complete sets of commercial operation and maintenance manuals for each item of equipment furnished as part of the System to the COR. The manuals shall detail the theory of operation and shall include narrative descriptions, pictorial illustrations, block and schematic diagrams, and parts list.
- G. Record Wiring Diagrams:
- 1. Fifteen (15) working days prior to the acceptance test, the Contractor shall deliver four complete sets of the Record Wiring Diagrams of the System to the COR. 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.
  - 2. The Record Wiring Diagrams shall be in hard copy and two compact disk (CD) copies properly formatted to match the Facility's current operating version of Computer Aided Drafting (AutoCAD) system. The

COR shall verify and inform the Contractor of the version of AutoCAD being used by the Facility.

2. Cable Distribution System Design Plan: A design plan for the entire cable distribution systems requirements shall be provided with this document. A specific cable count shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems entire cable requirements and engineer a distribution system requirement plan using the format of the following paragraph(s), at a minimum:

a. UTP (and/or STP) Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from
BUILDING	Identifies the building by number, title, or location cabling shall be provided in
TO BUILDING IMC	Identifies building main terminal signal closet, by room number or location, to which cabling is provided too, in, and from
FLOOR	Identifies the floor by number (i.e. 1st, and 2nd) cabling and TCOs shall be provided
TC ROOM NUMBER	Identifies the floor signal closet room, by room number, which cabling shall be provided
ROOM NUMBER	Identifies the room, by number, from which cabling and TCOs shall be provided
NUMBER OF CABLE PAIR	Identifies the number of cable pair required shall be provided on each floor designated OR the number of cable pair (VA Owned) shall be retained
NUMBER OF STRANDS USED/SPARE	Identifies the number of strands provided in each run

b. Fiber Optic Cabling Requirements/Column Explanation:

Column	Explanation
FROM BUILDING	Identifies the building by number, title, or location, and main signal closet or intermediate signal closet cabling is provided from

TO BUILDING IMC	Identifies building, by number, title, or location, to which cabling is provided
FLOOR	Identifies the floor by number (i.e. 1 <sup>st</sup> and 2nd)
TC ROOM NUMBER	Identifies the room, by number, from which cabling shall be installed
NUMBER OF STRANDS	Identifies the number of strands in each run of fiber optic cable
INSTALLED METHOD	Identifies the method of installation in accordance with as designated herein
NOTES	Identifies a note number for a special feature or equipment
BUILDING MTC	Identifies the building by number or title

3. Telecommunication Outlets: The Contractor shall clearly and fully indicate this category for each outlet location and compare the total count to the locations identified above as a part of the technical submittal. Additionally, the Contractor shall indicate the total number of spares.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS**

#### **A. System Requirements:**

##### **1. Cable Systems - Twisted Pair and Fiber optic:**

###### **a. General:**

- 1) The Contractor shall be responsible for providing a new system conforming to current and accepted telephone and digital industrial/commercial cable distribution standards. The distribution cable installation shall be fully coordinated with the the COR and the Contractor prior to the start of installation.
- 2) The Contractor is responsible for complete knowledge of the space and cable pathways (i.e. equipment rooms, TCs and conduits, wireways) of the Facility. The Contractor shall at a minimum design and install the System using the Pathway Design Handbook H-088C3, TIA/EIA Telecommunications Building Wiring Standards, and Facility Chief of Information Resource Management's (IRM) instructions, as approved in writing by the COR.

- 3) The System cables shall be fully protected by cable duct, trays, wireways, conduit (rigid, thin wall, or flex), and when specifically approved, flexible innerduct. It is the responsibility of the Contractor to confirm all contract drawings and the Facility's physical layout to determine the necessary cable protective devices shall be provided. If flexible innerduct is used, it shall be installed in the same manner as conduit.
- 4) Cable provided in the system (i.e. backbone, outside plant, inside plant, and station cabling) shall conform to accepted industry and OEM standards with regards to size, color code, and insulation. The pair twists of any pair shall not be exactly the same as any other pair within any unit or sub-unit of cables that are bundled in twenty-five (25) pairs or less. The absence of specifications regarding details shall imply that best general industry practices shall prevail and that first quality material and workmanship shall be provided. Certification Standards, (i.e., EIA, CCITT, FIPPS, and NFPA) shall prevail.
- 5) Some areas of this Facility shall be considered "plenum". All wire and cable used in support of the installation in those areas (if any) shall be in compliance with national and local codes pertaining to plenum environments. It is the responsibility of the Contractor to review the VA's cable and wire requirements with the COR and the IRM prior to installation to confirm the type of environment present at each location.
- 6) The Contractor shall provide outside and inside plant cables that furnishes the number of cable pairs required in accordance with the System requirements described herein. The Contractor shall fully coordinate and obtain approval of the design with the OEM, COR and the IRM prior to installation.
- 7) All metallic cable sheaths shall be grounded by the Contractor (i.e.: risers, underground and station wiring) as described herein.
- 8) If temporary cable and wire pairs are used, they shall be installed so as to not present a pedestrian safety hazard and

the Contractor shall be responsible for all work associated with the temporary installation and for their removal when no longer necessary. Temporary cable installations are not required to meet Industry Standards; but, shall be reviewed and approved by the COR and the IRM prior to installation.

- 9) Conductors shall be cabled to provide protection against induction in voice and data circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
- 10) Measures shall be employed by the Contractor to minimize the radiation of RF noise generated by the System equipment so as not to interfere with audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System shall service.
- 11) The System's cables shall be labeled on each end and been fully tested and certified in writing by the Contractor to the RE before proof of performance testing can be conducted. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs. Minimum 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 specified. The tests required for data cable shall be made to guarantee the operation of this cable at not less than 10 mega (m) Hertz (Hz) full bandwidth, fully channel loaded and a Bit Error Rate of a minimum of  $10^{-6}$  at the maximum rate of speed. All cable installation and test records shall be made available at acceptance testing by the COR or Contractor and thereafter maintained in the Facility's Telephone Switch Room. All changes (used pair and failed pair) shall be posted in these records as the change occurs.
- 12) The Contractor shall provide proper test equipment to guarantee that cable pairs meet each OEM's standard transmission requirements, and guarantee the cable shall carry data transmissions at the required speeds, frequencies, and fully loaded bandwidth.

b. Telecommunications Closets (TC): In TC's that are served with both a UTP backbone cable and a fiber optic backbone cable, the UTP cable shall be terminated on separate RJ-45, 8-pin connectors with 110A or equivalent type punch down blocks located on the back or front of a 48-port modular patch panel dedicated to data applications. Only the UTP backbone cable pairs, identified as being connected to the fiber optic backbone, shall be extended to the fiber optic interface device. All connecting cables required to extend these cables (i.e. patch cords and twenty-five pair connectors) to the fiber optic interface device, in the TC's shall also be provided by the Contractor to insure a complete and operational fiber optic distribution system:

- 1) In TC's, which are only served by a UTP backbone cable, the cable shall be terminated on separate modular connecting devices (110A or equivalent) that are dedicated to data applications. In order to provide full service to all data cable pairs as identified in each TC/cabinet including spare capacity noted herein, the size of all vertical (riser) cables and/or outside cables serving these TC's shall be increased as required.

c. Backbone and Trunk Cables:

- 1) The Contractor shall identify, in the technical submittal, the voice and data (analog RF coaxial cable shall not be provided in main trunk or backbone lines) connecting arrangements required by the LEC for interconnection of the System to the commercial telephone and FTS networks. The Contractor shall provide all required voice and data connecting arrangements.
- 2) The Contractor shall be responsible for compatibility of the proposed TCs (shall be compliant with the EPBX and CSU equipment) numbering scheme with the numbering plan for the FTS, DID, local stations, and the North American Numbering Plan. The Contractor shall consult with the VA and the LEC regarding the FTS and North American Numbering plan shall be implemented for the Facility to ensure system compatibility.
- 3) All submitted equipment shall meet or exceed standards, rules, and regulations of the Federal Communications Commission (FCC) and shall be capable of operating without outboard or "extra"

devices. The Contractor shall identify the FCC registration number of the System equipment, EPBX, and proposed CSU (if known) in the technical submittal.

d. Riser Cable:

- 1) All communication riser cables shall be listed as being suitable for the purpose and marked accordingly per Articles 517, 700, and 800 of the NEC.
- 2) All voice and data communication (analog RF coaxial cable shall not be provided in riser systems) riser cables shall be STP or Unshielded Twisted Pair (UTP), minimum 24 American Wire Gauge (AWG) solid, thermoplastic insulated conductors. They shall be enclosed with a thermoplastic outer jacket.
- 3) The Contractor shall provide and install inside riser cables to insure full service to all voice cable pairs identified in each TC terminating enclosure plus not less than 50% additional spare capacity.
- 4) The complete riser cabling system shall be labeled and tested as described herein.

e. Horizontal and Station Cable:

- 1) A Four (4) UTP 24 AWG station wiring cable shall be installed from the top TCO jack to the TC and shall be of a type designed to support Category 6 communications (250 mega-Hertz [mHz] or above). At the jack location, terminate all four pair on the RJ-45/11 jack. At the signal closet, all four pair shall be terminated on the modular punch down blocks dedicated to telephone applications.
- 2) A Four (4) UTP 24 AWG (in thermoplastic jacket unless otherwise specified by COR) station wiring cable shall be installed from each of the two (2) bottom TCO RJ-45 jacks (shall conform to EIA/TIA 568 Standard "T568A" and NFPA) to the TC and shall be of a type designed to support Category 6 communications (250 mHz or above).

- f. Telecommunication Outlets (TCO), Jacks: All TCO's shall have a minimum of three (3) RJ-45 type jacks. The top jack shall be an eight pin RJ-45/11 compatible jack, labeled, and designated for telephone applications only. The bottom two jacks shall be eight

pin RJ-45 type unkeyed (sometimes called center keyed) jacks, labeled, and designated for data.

h. Fiber Optics:

- 1) Provide multi strand , 8.3 mm single mode fiber optic cable shall be provided. Single mode fibers shall be terminated and secured at both ends with "LC or SC" type female stainless steel connectors installed in an appropriate patch or breakout panel. The panel shall be provided with a cable management system. A 610 mm (2 ft.) cable loop (minimum) shall be provided at each end to allow for future movement.
- 2) The Contractor shall test each fiber optic strand. Cable transmission performance specifications shall be in accordance with EIA/TIA standards. Attenuation shall be measured in accordance with EIA fiber optic test procedures EIA/TIA-455-46, -61, or -53 and NFPA. Information transmission capacity shall be measured in accordance with EIA/TIA-455-51 or -30 and NFPA. The written results shall be provided to the COR for review and approval.

3). Provide outdoor rated fiber optic cables for CCTV cameras.

3. Specific Subsystem Requirements: The System shall consist, as a minimum, of the following independent sub-systems to comprise a complete and functional voice and digital telecommunications cabling system: "Main" (MTC), "intermediate" (IMTC), and "riser" (RTC) TC's; "backbone" cabling (BC) system; "vertical" (or "riser") trunk cabling system; "horizontal" (or "lateral") sub-trunk cabling system, vertical and horizontal cross-connection (VCC and HCC respectively) cabling systems, and TCO's with a minimum of three (3) RJ-45 jacks for the appropriate telephone, Data connections, and additional jacks, connectors, drop and patch cords, terminators, and adapters provided.

a. Telecommunication Closet (TC):

- 1) There shall be a minimum of one TC for the MTC, each building IMTC, and each RTC per building floor location. However, in large building(s), where the horizontal distance to the farthest voice and digital work area shall exceed 90 Meters (M) (or 295 feet [ft]), additional TC's shall be provided as described herein. The maximum DC resistance per cable pair



shall be no more than 28.6 Ohms per 305 M (1,000 feet). Each TC shall be centrally located to cover the maximum amount of local floor space. The TC's house in cabinets or enclosures, on relay racks, and/or on backboards, various telecommunication data equipment, controllers, multiplexers, bridges, routers, LAN hub(s), telephone cross-connecting, active and passive equipment.

a) A minimum of three 110-120 VAC active quad outlets shall be provided, each with "U" grounded receptacles at a minimum of one outlet for each front, side and back wall. These outlets shall be separately protected by an AC circuit breaker provided in the designated Government Emergency Critical Care AC power panel, that is connected to the Facilities Emergency AC Power Distribution System. For larger building TC applications, a minimum of one additional quad AC outlet shall be provided for every 800M<sup>2</sup> (or 8,000 ft<sup>2</sup>) of useable floor space. Additional outlets shall be equally spaced along the wall.

b. Cross-connect Systems (CCS):

- 1) The CCS shall be selected based on the following criteria: requires the use of a single tool, has the fewest amount of parts, and requires the least amount of assembly or projected trouble shooting time during the life of the system.
- 2) The CCS system used at the MTC, each IMTC, and each TC 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.
- 3) Copper Cables: The MTC, each IMTC, and TC shall contain a copper CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth. Additionally, each CCS shall provide maximum flexibility, while maintaining performance, in order to meet system-changing requirements that are likely to occur throughout its useful life.

4) Fiber Optic Cables:

- a) The MTC and each TC shall contain a fiber CCS sized to support the System TCO's and connections served by each individual TC and as shown on the drawings. The System layout shall allow for a minimum of 50% anticipated growth.
- b) Each fiber CCS shall provide maximum flexibility and cable management while maintaining performance in order to meet changing requirements that are likely to occur throughout the expected life of the system. All fiber optic cable slack shall be stored in protective enclosures.
- c) If it is determined that a fiber optic distribution system is not necessary for the immediate system needs. Each TC shall be provided with fiber optic cable(s) that contain a minimum of 12 strands "dark" multimode fiber and 12 strands "dark" single mode fiber, each fiber properly terminated on its respective female stainless steel connector mounted in an appropriate fiber termination enclosure provided in each TC.

5) The Contractor shall not "cross-connect" the copper or fiber optic cabling systems and subsystems even though appropriate "patch" cords shall be provided for each "patch", "punch", or "breakout" panel. In addition, the Contractor shall not provide active electronic distribution or interface equipment as a part of the System.

6) Grounding: Proper grounding and bonding shall be provided for each TC and all internal equipment. Reference shall be made to proper codes and standards, such that all grounding systems shall comply with all applicable National, Regional, and Local Building and Electrical codes. The most stringent code of these governing bodies shall apply.

- a) If local grounding codes do not exist for the System location, then at a minimum, a #6 American Wire Gauge (AWG) stranded copper wire, or equivalent copper braid, shall be connected to a separate earth grounding system for each TC (the looping of TC's in a general location is allowed as long as the specifications contained herein are met). Under no circumstance shall the AC neutral be used for this

ground. See PART 3 - EXECUTION for specific grounding instructions.

- b) Each copper UTP cable that enters a TC from the outside of a building (regardless if the cable is installed underground or aerial) shall be provided with a surge protector and grounded an to earth ground at each cable's entry point in and out of the MTC and each IMTC.

c. Voice (or Telephone) Cable Cross-Connection Subsystem:

- 1) Due to the usually high number of copper cable termination's required at the MCCS, Insulation Displacement Connection (IDC) hardware shall be used. Termination options shall include the following for a Category 6 Cabling System: IDC termination of cross-connection wire(s), IDC patch cord connector to IDC patch cord connector, and hybrid modular cord to IDC patch cord connector shall be the minimum provided.
- 2) For ease of maintenance purposes, all terminations shall be accessible without the need for disassembly of the IDC wafer. IDC wafers shall be removable from their mounts to facilitate testing on either side of the connector. Designation strips or labels shall be removable to allow for inspection of the terminations. The maximum number of terminations on a wall or on a rack frame or panel shall comply with the OEM recommendations and guidelines, and as described herein. A cable management system shall be provided as a part of the IDC.
- 3) IDC connectors shall be capable of supporting cable re-terminations without damaging the connector and shall support a minimum of 200 (telephone equipment standard compliant) IDC insertions or withdrawals on either side of the connector panel.
- 4) A non-impact termination method using a full-cycle terminating tool having both a tactile and an audible feedback to indicate proper termination is required. For personnel safety and ease of use in day to day administration, high impact installation tools shall not be used.
- 5) All system "inputs" from the EPBX, FTS, Local Telephone System, or diverse routed voice distribution systems shall

appear on the "left" side of the IDC (110A blocks with RJ45 connections are acceptable alternates to the IDC) of the MCCS.

- 6) All system "outputs" from the MCCS to the voice backbone cable distribution system shall appear on the "right" side of the same IDC (or 110A blocks) of the MCCS.
- 7) The splitting of pairs within cables between different jacks or connections shall not be allowed.
- 8) UTP cross connecting wires shall be provided for each "pair" of connection terminals plus an additional 50% spare.

d. Data Cross-Connection Subsystems:

- 1) The MCCS shall be a Main Distribution Terminating (MDT) data unit and shall be provided in the MTC. The MDT shall consist of a "patch" panel(s) provided with modular RJ45 female connectors for cross-connection of all copper data cable terminations. The panels shall provide for system grounding (where no dielectric cables are used) and be provided with a cable management system.
- 2) Each panel shall conform to EIA dimensions and be suitable for mounting in standard equipment racks, have the RJ45 jacks aligned in two horizontal rows (up to a maximum of 48 jacks per panel), and shall not exceed the OEM's recommendations. Each RJ45 jack shall be of modular design and capable of accepting and functioning with other modular (i.e. RJ11) plugs without damaging the jack. It is not necessary to provide a jack for unused positions that are not part of the 50% expansion requirement.
  - a) All data system inputs from the server(s), data LAN, bridge, or interface distribution systems shall appear on the "top" row of jacks of the appropriate patch panel.
  - b) All System outputs or backbone cable connections shall appear on the "bottom" row of jacks of the same patch panel.
  - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.

- 3) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular RJ45 connectors provided on each end to match the panel's modular RJ45 female jack's being provided.
- f. Fiber optic Cross-Connection Subsystems: The MTC shall be provided with a separate fiber MCCC. Each TC shall be provided with a rack mounted patch or distribution panel that is installed inside a lockable cabinet or "breakout enclosure" that accommodates a minimum of 12 strands multimode fiber and 12 strand single mode fiber (these counts shall not be included the 50% spare requirement). Two of the single mode fibers shall be designated for educational analog video applications. A cable management system shall be provided for each panel.
- 1) The panel(s) shall contain a minimum of 24 female "ST" connectors, be able to accommodate splices and field mountable connectors and have capacity for additional connectors shall be added up to the OEM's maximum standard panel size for this type of use. All patch panel sides, including the front and back, shall be protected by a cabinet or enclosure.
  - 2) The panel(s) shall conform to EIA dimensions and be suitable for installation in standard racks, cabinets, and enclosures. The panels shall provide for system grounding (where no dielectric cables are used).
  - 3) The patch panel with the highest OEM approved density of fiber "LC or SC" termination's (maximum of 72 each), while maintaining a high level of manageability, shall be selected. Patch cables, with proper "LC or SC" connectors installed on each end shall be provided for each pair of fiber optic cable "ST" connectors.
    - a) All System "inputs" from interface equipment or distribution systems shall appear on the "top" row of connectors of the appropriate patch panel.
    - b) All System "outputs" or backbone cable connections shall appear on the "bottom" row of connectors of the same patch panel.
  - 4) In order to achieve a high level of reliability that approximates that of an OEM connector, field installable

connectors shall have an OEM specified physical contact polish. Every fiber cable shall be terminated with the appropriate connector, and tested to ensure compliance to OEM and specifications outlines herein. Where a local fiber optic system connector standard, Industry Standard fiber optic "ST" female connector terminated with a fiber optic cable, shall be used. But, if the fiber optic cable is not used (or "dark"), a "LC or SC" male terminating "cap" shall be provided for each unused "LC or SC" female connector.

- h. Distribution Cable Systems / Backbone Cable System (Common to Inter-buildings): The backbone cable system extends from the MCCA to each IMCCA to establish service between buildings on a campus. The media (copper and fiber optic) used in the BC system shall be designed according to the system requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic backbone system shall be provided as a part of the BC distribution system.
- 1) All outside cable shall be minimum of STP or UTP, 22 AWG solid conductors, solid PVC insulation, and filled core (flexgel - waterproof Rural Electric Association (REA) LISTED PE 39 CODE) between the outer armor or jacket and inner conductors protective lining.
  - 2) The copper cable system shall be configured as a "Star" with separate dedicated cables between the MCCA and each IMCCA.
  - 3) UTP copper cables shall consist of thermoplastic insulated conductors formed into binder groups. The groups shall be identified by distinctly colored binders and assembled to form a single compact core covered by a protective sheath. Each cable shall be rated for Category 6 Telecommunications System Service. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
  - 4) Where the distance limitations of UTP shall be exceeded, multimode (or single mode) fiber optic cable(s) shall be used to augment the voice and/or data backbone cable system(s). The total loss of each fiber shall not exceed 12 decibel (dB) at 850 nano-Meter (nm), 11 dB at 1,300 nm, or 10 dB at 1,500 nm.

- 5) All voice system "inputs" from the MCCA via the BC distribution system shall appear on the "left" side of IDC (minimum 110 blocks) punch terminals of the IMCCA.
  - 6) All voice system "outputs" or trunk line connections shall appear on the "right" side of the same IDC (minimum 110 blocks) of the IMCCA.
  - 7) All data system "inputs" from the MCCA via the BC distribution system shall appear on the "top" row of jacks of the appropriate patch panel of the IMCCA.
  - 8) All data system "outputs" or trunk line connections shall appear on the "bottom" row of jacks in the same patch panel of the IMCCA.
  - 9) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and /or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
  - 10) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
  - 11) The fiber optic BC system shall be configured as a "Buss" Topology with separate dedicated fibers between the MCCA and each IMCCA. The System shall be sized to meet the system requirements plus an expansion capability of 50%. Fiber optic cable(s) having a minimum of 12 strands multimode fiber and 12 strands single mode fiber shall be provided. Two of the single mode fibers shall be designated for analog video service.
  - 12) All BC shall be identified with permanent labels at both ends. Labels shall indicate system, floor, closet, and zone. The label designations shall match those used for cross-connect terminals and patch panels.
- i. Distribution (Common to Intra-Building) Cabling Systems: The intra-building trunk cabling system provides for connection between the IMCCA and each Riser TC's provided vertical cross-connecting system (VCCA) within a building. The media (copper, fiber optic) used in the intra-building backbone cabling system shall be designed according to the system requirements, OEM

standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic trunk system shall be provided as a part of the System.

- 1) Category 6 UTP or STP multi-pair trunk cable(s) shall be used in the voice and data trunk-line-cabling systems. A minimum of eight pairs per circuit, plus an additional 50% spare for growth shall be provided.
- 2) Where the distance limitations of UTP and/or STP shall be exceeded, multimode (or single mode) fiber optic cable shall be used in the voice and/or trunk cabling systems. The total loss of the fiber trunks shall not exceed 12 dB at 850 nM , 11 dB at 1,300 nM, or 10 dB at 1,500 nM.
  - a) All voice system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "right" side of IDC (minimum 110A blocks) punch terminals of the IMCCS.
  - b) All data system "outputs" from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of jacks of the same IDC (minimum 110A blocks) of the IMCCS.
  - c) The splitting of pairs within cables between different jacks shall not be allowed. In the case of ISDN and/or ATM and/or Frame Relay applications, terminating resistors shall be provided externally to the patch panel connector or jack.
  - d) A patch cord shall be provided for each system "pair" of connection jacks. Each patch cord shall have modular connectors provided on each end to match the panel's modular female jack.
- 3) The fiber optic trunk line system shall be configured as a "Buss" Topology with separate dedicated fibers between the IMCCS and each RCS. The System shall be sized to meet the System requirements with a expansion capability of 50% provided. Separate individual fiber optic cable(s) with a minimum of 18 strands multimode fiber and/or 12 strands single mode fiber shall be provided. Two of the single mode fibers shall be designated for analog video service.
- 4) All trunk lines shall be identified with permanent labels at both ends. Labels shall indicate system, floor, closet, and



- zone. The label designations shall match those used for cross-connects and patch panels.
- a) All System outputs from the IMCCS to the trunk-line distribution system shall appear on the "bottom" row of "ST" connectors in the appropriate patch panel.
  - b) A patch cord shall be provided for each system "pair" of connection "ST" connectors. As a minimum, each patch cord shall have "ST" male connectors provided on each end to match the panel's female "ST" connector provided.
- j. VCCS and Horizontal Cross-connecting (HCCS) Systems: Each TC shall be provided with a separate VCCS and HCCS located within the TC. The VCCS and HCCS shall interconnect and interface the riser (vertical) trunk line cables with the horizontal (or station) sub-trunk line cables. The media copper and fiber optic used in the CCS system shall be designed according to the System requirements, OEM standards and guidelines, and as described herein. A multi-pair copper for voice and data, and separate multiple fiber optic CCS system shall be provided as a part of the System.
- 1) The UTP, STP, and fiber optic trunk-line cabling systems are that connected between the trunk-lines and Riser VCCS, shall be terminated:
    - a) On the "left" or "top" IDC (or 110A blocks) for each UTP or STP voice cable.
    - b) On the "top" row of RJ45 jacks on the appropriate patch panel for each UTP or STP data cable.
    - c) On the "top" row of "ST" connectors on the appropriate patch panel for each fiber
  - 2) The UTP, and fiber optic sub-trunk (lateral) floor distribution cabling systems that are connected between each RTC and each TCO or secondary system distribution or connection point, shall terminate on an appropriate HCCS, at the:
    - a) On the "right" IDC (or 110A block) used as the VCCS input for each UTP or STP voice cable.

- b) On the "bottom row of RJ45 jacks on the appropriate patch panel used as the VCCS input for each UTP or STP data cable.
  - c) On the "bottom" row of "ST" connectors on the appropriate patch panel used as the VCCS input for each fiber.
  - d) The technical requirements of the VCCS and HCCS "patch", "terminating", or "breakout" panels and cable management assemblies for voice, data and fiber optic cables shall be as described in the above MCCS, IMCCS, and TC technical paragraphs.
- 3) The Contractor shall not "cross-connect" the VCCS or HCCS cabling systems even though appropriate patch cords are provided for each "patch", "punch", or "breakout" panel. Also, the Contractor shall not provide active interface or distribution electronic equipment as a part of the System.
- k. Horizontal (or Station) Cabling (HC): The HC distribution cabling systems connects the distribution field of the voice and data HCCS, in a "Star" Topology, to each TCO or connector and as shown on the drawings via the sub-trunk system.
- 1) Horizontal cables shall consist of insulated, UTP or STP conductors that are rated for Category 6 telecommunications service for voice and data systems.
  - 2) The number of UTP or STP distribution pairs dedicated to each floor from the HC shall be sufficient to accommodate all the horizontal voice and data circuits served by the distribution cable to each TCO.
    - a) A minimum of four pairs for voice shall be connected to the "right" side of the IDC (or 110A block) that the VCCS "input" connections appear in the RTC.
    - b) A minimum of two separate sets of four pairs each for data shall be connected to the "bottom" row of RJ45 jacks that the VCCS "input" connections appear in the RTC.
  - 3) The horizontal cable length to the farthest system outlet shall be limited to a maximum of 90M (or 295 ft). These maximum lengths shall be derated, adjusted and reduced to include cross-connection and distribution system losses. Additional TC(s) shall be provided on large floor areas of

buildings to limit the horizontal distribution to a maximum of 90M (or 295 ft).

- 4) The splitting of pairs within a cable between different jacks shall not be permitted.
- 5) The installation of the HC shall conform to appropriate OEM recommendations and standards outlined herein. This requirement shall insure adequate protection for Electro-Magnetic Interference (EMI) sources.
- 6) A system design where "looping" the HC distribution cables from room to room shall not be permitted.
- 7) The number of fiber optic cables dedicated from the "bottom" row of "ST" connectors of the appropriate patch panel that the VCCS "input" connections were made, to each floor shall be sufficient to accommodate all the horizontal TCO's served by the distribution cable system in a "home run" configuration minimum of two cables (one multimode and one single mode) per each TCO and as shown on the drawings.
1. System Telecommunication Outlets (TCO): 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 one each fiber optic single mode and multimode cables and shall process and distribute them to the designated TCO's and as shown on the drawings. At a minimum, one TCO shall be provided on each room wall, associated with an active 120 VAC shall be provided and as shown on the drawings. The only exception to the general rule, of one outlet per wall, shall be those "special" locations (e.g., surgical suites, radiology MRI rooms, labs, patient bed rooms, warehouse, loading docks and storage rooms), where there is usually only one TCO provided as designated on the drawings.
  - 1) Each TCO shall consist of three multipin modular RJ45 jacks, one designated for telephone and two for data service, and two fiber optic "ST" connectors, one designated for multimode fiber optic cable and the other for single mode fiber optic cable connection(s). Each TCO with appropriate jacks installed shall be provided by the Contractor in each designated location and as shown on the drawings.

- 2) The Contractor shall connect each telephone multipin modular RJ45 jack to a separate "right side as you look at it" telephone HC distribution system HCCS "punch down" 110A block or approved IDC terminating device in each associated RTC. The modular RJ45 jack shall be able to accept and operate with smaller modular RJ11 plugs while providing proper connection and not damaging the modular jack. The OEM shall warrant all modular RJ45/11 jacks in such a manner shall be usable for modular RJ11 plugs.
- 3) The Contractor shall connect each TCO data multipin modular RJ45 jack to a separate lower row jack on the HCCS "patch panel" in each associated RTC. The Contractor is not to "cross-connect" VCCS and HCCS data distribution cables or provides active electronic data distribution equipment as a part of the System.
- 4) A non-impact termination method, using either a stuffer cap with installation tool or full-cycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact installation tools shall not be used.
- 5) Each terminated conductor end shall be properly trimmed to assure a minimum clearance of 6.35 mm (0.250 in) clearance between the conductors of adjacent modules.
- 6) The multipin RJ45 jack shall be modular in construction that shall accept and operate with a modular UTP and STP RJ45 connector and its pin assignments.
- 7) The Contractor shall connect each fiber optic TCO "ST" connector to a separate fiber optic "bottom" row "ST" connector HCCS "patch panel" or "breakout" terminating device in each associated TC. The Contractor is not to "interconnect" VCCS and HCCS fiber optic distributions cables or provide active fiber optic electronic distribution equipment as a part of the system.

B. System Performance:

1. At a minimum, the System shall be able to support the following voice and data operations for Category 6 Certified Telecommunication Service:

- a. Provide the following interchange (or interface) capabilities:
    - 1) Basic Rate (BRI).
    - 2) Primary Rate (PRI).
  - b. ISDN.:
    - 1) Narrow Band BRI.
      - a) B Channel: 64 kilo-Bits per second (kBps), minimum.
      - b) D Channel: 16 kBps, minimum.
      - c) H Channel: 384 kBps, minimum.
    - 2) Narrow Band PRI:
      - a) B Channel: 64 kBps, minimum.
      - b) D Channel: 64 kBps, minimum.
      - c) H Channel: 1,920 kBps, minimum.
    - 3) Wide (or Broad) Band:
      - a) All channels: 140 mega(m)-Bps, minimum, capable to 565 mBps at "T" reference.
  - c. ATM operation and interface/
  - d. Frame Relay: All stated compliance's
  - e. Integrated Data Communications Utility (IDCU) operation and interface.
  - f. Government Open Systems Interconnection Profile (GOSSIP) compliant.
  - g. Fiberoptic Distributed Data Interface (FDDI): A minimum 100 mBps to a maximum of 1.8 giga(g)-Bps data bit stream speed.
  - h. System Sensitivity: Satisfactory service shall be provided for at least 3,000 feet for all voice and data .
2. At a minimum the System shall support the following operating parameters:
- a. EPBX connection:
    - 1) System speed: 1.0 gBps per second, minimum.
    - 2) Impedance: 600 Ohms.
    - 3) Cross Modulation: -60 deci-Bel (dB).
    - 4) Hum Modulation: -55 Db.
    - 5) System data error: 10 to the -10 Bps, minimum loss measured at the frame output with reference Zero (0) deciBel measured (dBm) at 1,000 Hertz (Hz) applied to the frame input.
      - a) Trunk to station: 1.5 dB, maximum.
      - b) Station to station: 3.0 dB, maximum.

- c) Internal switch crosstalk: -60 dB when a signal of  $\pm 10$  deciBel measured (dBm), 500-2,500 Hz range is applied to the primary path.
- d) Idle channel noise: 25 dBm "C" or 3.0 dBm "O" above reference (terminated) ground noise, whichever is greater.
- e) Traffic Grade of Service for Voice and Data:
  - (1) A minimum grade of service of P-01 with an average traffic load of 7.0 CCS per station per hour and a traffic overload in the data circuits shall not interfere with, or degrade, the voice service.
  - (2) Average CCS per voice station: The average CCS capacity per voice station shall be maintained at 7.0 CCS when the EPBX is expanded up to the projected maximum growth as stated herein.

b. Telecommunications Outlet (TCO):

1) Voice:

- a) Isolation (outlet-outlet): 24 dB.
- b) Impedance: 600 Ohms, balanced (BAL).
- c) Signal Level: 0 deciBel per mili-Volt (dBmV)  $\pm 0.1$  dBmV.
- d) System speed: 100 mBps, minimum.
- e) System data error: 10 to the -6 Bps, minimum.

2) Data:

- a) Isolation (outlet-outlet): 24 dB.
- b) Impedance: 600 Ohms, BAL.
- c) Signal Level: 0 dBmV  $\pm 0.1$  dBmV.
- d) System speed: 120 mBps, minimum.
- e) System data error: 10 to the -8 Bps, minimum.

C. General:

- 1. All equipment shall be supplied under this specification shall be new and the current model of a standard product of an OEM or 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:
  - a. Maintains a stock of replacement parts for the item submitted.
  - b. Maintains engineering drawings, specifications, and operating manuals for the items submitted.

- c. 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.
2. Specifications of equipment as set forth in this document are minimum requirements, unless otherwise stated, and shall not be construed as limiting the overall quality, quantity, or performance characteristics of items furnished in the System. When the Contractor furnishes an item of equipment for which there is a specification contained herein, the item of equipment shall meet or exceed the specification for that item of equipment.
3. The Contractor shall provide written verification, in writing to the COR 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 shall be by another subcontractor.
4. The Telephone Contractor is responsible for providing interfacing cable connections for the telephone systems with the System.
5. The telephone equipment shall be the interface points for connection of the interface cabling from the telephone switch via the system telephone interface unit.
6. 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 equipment, systems, and service.
7. All passive distribution equipment shall meet or exceed -80 dB radiation shielding specifications.
8. All interconnecting twisted pair, fiber-optic 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, fiber-optic cable unterminated, unconnected, loose or unsecured.
9. Color code all distribution wiring to conform to the Telephone Industry standard, EIA/TIA, and this document, which ever 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. Reference Specification Section 27 10 00, STRUCTURED CABLING .
10. 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 COR regarding a suitable circuit location prior to bidding.
  11. All equipment faceplates utilized in the System shall be stainless steel, anodized aluminum, or UL approved cyclac plastic for the areas where provided.
  12. 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.
  13. Underground warning tape shall be standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, red with black letters imprinted with "CAUTION BURIED ELECTRIC LINE BELOW", orange with black letters imprinted with "CAUTION BURIED TELEPHONE LINE BELOW" or orange with black letters imprinted with "CAUTION BURIED FIBER OPTIC LINE BELOW", as applicable.

D. Equipment Functional Characteristics:

<b>FUNCTIONS</b>	<b>CHARACTERISTICS</b>
Input Voltage	105 to 130 VAC
POWER LINE FREQUENCY	60 HZ $\pm$ 2.0 HZ
Operating Temperature	0 to 50 degrees (°) Centigrade (C)
Humidity	80 percent (%) minimum rating

E. Equipment Standards and Testing:

1. The System has been defined herein as connected to systems identified as Critical Care performing Life Support 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. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory where such standards have been established for the supplies, materials or equipment. See paragraph minimum requirements Section 27 05 11, REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS, and the guidelines listed in paragraph 2.J.2.
  3. The provided active and passive equipment required by the System design and approved technical submittal shall conform with each UL standard in effect for the equipment, as of the date of the technical submittal (or the date when the COR approved system equipment necessary shall be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment shall be used in completion of this contract, the equipment shall bear the approved UL seal.
  4. Each item of electronic equipment shall be provided under this contract shall 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.

## **2.2 DISTRIBUTION EQUIPMENT AND SYSTEMS**

### **A. Telecommunication Outlet (TCO):**

1. The TCO shall consist of one telephone multipin jack and two data multipin jacks, and one single mode fiber optic /, and one multimode fiber optic jacks mounted in a steel outlet box. A separate 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled stainless steel faceplate shall be used. A second 100mm (4in.) x 100mm (4in.) x 63mm (2.5in.) steel outlet box with a labeled faceplate shall be provided as required adjacent to the first box to ensure system connections and expandability requirements are met.
2. All telephone multipin connections shall be RJ-45/11 compatible female types. All data multipin connections shall be RJ-45 female types. All fiber optic (single mode and multimode) connections shall be "ST" stainless steel female types.

3. The TCO shall be fed from the appropriate CCS located in the respective RTC in a manner to provide a uniform and balanced distribution system.
  4. Interface of the data multipin jacks to appropriate patch panels (or approved "punch down" blocks) in the associated RTC, is the responsibility of the Contractor. The Contractor shall not extend data cables from the RTCs to data terminal equipment or install data terminal equipment.
  5. The wall outlet shall be provided with a stainless steel or approve alternate cover plate to fit the telephone multipin jack, data multi- pin jacks , fiber optic jacks and the outlet box provided (100mm (4in.) x 100mm (4in.) for single and 100mm (4in.) x 200mm (8in.) for dual outlet box applications). For PBPU installations, the cover plate shall be stainless steel.
- B. Distribution Cables: Each cable shall meet or exceed the following specifications for the specific type of cable. 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 COR or PM. Additionally, the Contractor shall provide a 610 mm (2 ft.) sample of each provided cable, to the COR and receive approval before installation. Cables installed in any outside location (i.e. above ground, under ground in conduit, ducts and pathways) 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.
1. Remote Control:
    - a. The remote control cable shall be multi-conductor with stranded (solid is permissible) conductors. The cable shall be able to handle the power and voltage necessary to control specified system equipment from a remote location. The cable shall be UL listed and pass the FR-1 vertical flame test, at a minimum. Each conductor shall be color-coded. Combined multi-conductor and coaxial cables are acceptable for this installation, as long as all system performance standards are met.
    - b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels
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	minimum
Connectors	As required by system design
Size	18 AWG, minimum, Outside 20 AWG, minimum, Inside
Color coding	Required, EIA industry standard
Bend radius	10X the cable outside diameter
Impedance	As required
Shield coverage	As required by OEM specification
Attenuation	
Frequency in MHz	dB per 305 M (1,000ft.), 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

2. Telephone:

- a. The System cable shall be provided by the Contractor to meet the minimum system requirements of Category Six service. The cable shall interconnect each part of the system. The cable shall be completely survivable in areas where it is installed.
- b. Technical Characteristics:

Length	As required, in 1K (3,000 ft.) reels minimum
Cable	Voice grade category six
Connectors	As required by system design
Size	22 AWG, minimum, Outside 24 AWG, minimum, Inside
Color coding	Required, telephone industry standard
Bend radius	10X the cable outside diameter
Impedance	120 Ohms $\pm$ 15%, BAL
Shield coverage	As required by OEM specification
Attenuation	

Frequency in mHz	dB per 305 M (1,000ft.), 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
62.0	52.0
100.0	68.0

3. Data Multi-Conductor:

- a. 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. It shall meet Category Six service at a minimum.
- b. Technical Characteristics:

Wire size	22 AWG, minimum
Working shield	350 V
Bend radius	10X the cable outside diameter
Impedance	100 Ohms $\pm$ 15%, BAL
Bandwidth	100 mHz, minimum
DC RESISTANCE	10.0 Ohms/100M, maximum
Shield coverage	
Overall Outside (if OEM specified)	100%
Individual Pairs (if OEM specified)	100%
Attenuation	
Frequency in mHz	dB per 305 M (1,000ft.), 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
62.0	52.0
100.0	68.0

4. Fiber Optic:

a. Single mode Fiber:

- 1) The general purpose single mode fiber optic cable shall be a dual window type installed in conduit for all system locations. A load-bearing support braid shall surround the inner tube for strength during cable installation.

2) Technical Characteristics:

Bend radius	100 mm (4 in.) minimum
Outer jacket	PVC
Fiber diameter	8.7 microns
Cladding	125 microns
Attenuation at 850 nM	1.0 dBm per km
Connectors	Stainless Steel

5. AC Power Cable: AC power cable(s) shall be 3-conductor, no. 12 AWG minimum, and rated for 13A-125V and 1,625W. Master AC power, installation specification and requirements, are given in the NEC and herein.

C. Outlet Connection Cables:

1. Telephone:

- a. The Contractor shall provide a connection cable for each TCO telephone jack in the System with 10% spares. The telephone connection cable shall connect the telephone instrument to the TCO telephone jack. The Contractor shall not provide telephone instrument(s) or equipment.

b. Technical Characteristics:

Length	1.8M (6ft.), minimum
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Cable	Voice Grade
Connector	RJ-11/45 compatible male on each end
Size	24 AWG, minimum
Color coding	Required, telephone industry standard

2. Data:

- a. The Contractor shall provide a connection cable for each TCO data jack in the system with 10% spares. The data connection cable shall connect a data instrument to the TCO data jack. The Contractor shall not provide data terminal(s)/equipment.

b. Technical Characteristics:

Length	3M (10 ft.), minimum
Cable	Data grade Category Six
Connector	RJ-45 male on each end
Color coding	Required, data industry standard
Size	24 AWG, minimum

3. Fiber Optic:

- a. The Contractor shall provide a connection cable for each TCO fiber optic connector in the System with 10% spares. The data connection cable shall connect a fiber optic instrument to the TCO fiber optic jack. The Contractor shall not provide fiber optic instrument(s)/equipment.

b. Technical Characteristics:

Length	3 M (10 ft.), minimum
Cable	Flexible single conductor with jacket
Connector	LC or SC male on each end
Size	To fit single mode or multimode cable

D. System Connectors:

1. Solderless (Forked Connector):

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector

shall be designed to fit the wire or cable furnished. The connector barrel shall be insulated and color-coded.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V

2. Multipin:

- a. The connector shall have a crimp-on coupling for quick connect/disconnect of wires or cables. The crimp-on connector shall be designed to fit the wire or cable furnished. The connector housing shall be fully enclosed and shielded. It shall be secured to the cable group by screw type compression sleeves.

b. Technical Characteristics:

Impedance	As required
Working Voltage	500 V
Number of pins	As requires, usually 25 pairs minimum

3. Modular (RJ-45/11 and RJ-45): The connectors shall be commercial types for voice and high speed data transmission applications. he connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the System. The connector shall be compatible with UTP and STP cables.

a. Technical Characteristics:

Type	Number of Pins
RJ-11/45	Compatible with RJ45
RJ-45	Eight
Dielectric	Surge
Voltage	1,000V RMS, 60 Hz @ one minute, minimum
Current	2.2A RMS @ 30 Minutes or 7.0A RMS @ 5.0 seconds
Leakage	100 mA, maximum
Connectability	
Initial contact	20 mili-Ohms, maximum

resistance	
Insulation displacement	10 mili-Ohms, maximum
Interface	Shall interface with modular jacks from a variety of OEMs. RJ-11/45 plugs shall provide connection when used in RJ-45 jacks.
Durability	200 insertions/withdrawals, minimum

4. Fiber Optic: The connectors shall be commercial types for voice and high speed data transmission applications. The connector shall be compatible with telephone instruments, computer terminals, and other type devices requiring linking through the modular telecommunications outlet to the system. The connector shall be compatible with UTP and STP cables.

E. Terminators:

2. Audio:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on audio spade lug, twin plug, XL types that has low VSWR when installed and the proper impedance to terminate the required system unit or coaxial cable.
- b. Technical Characteristics:

Frequency	20-20 kHz, minimum
Power blocking	As required
Return loss	15 dB
Connectors	"Audio spade lug", "1/4", "1/8", "XL" or "RCA"
Impedance	
Bal	100 Ohms, minimum
Unbal	75 Ohm, minimum

3. Fiber Optic:

- a. These units shall be metal-housed precision types in the frequency ranges selected. They shall be the screw-on type that has low VSWR when installed and the proper impedance to terminate the required system unit or fiber optic cable.



b. Technical Characteristics:

Frequency	Lightwave
Power blocking	As required
Return loss	25 dB
Connectors	"ST", minimum
Construction	Stainless steel
Impedance	As required

F. Distribution Frames:

1. A new stand-alone (i.e., self supporting, free standing) MDF shall be provided to interconnect the EPBX and computer room. The MDF shall be modular and equipped with modular terminating mini blocks (i.e. Ericsson and 3M), and patch panels that are as small as possible and provide all the requirements of this specifications as described herein.
2. All cable distribution closets and MDFs shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The MDF/telephone closet riser cable shall be sized to satisfy all voice requirements plus not less than 50% spare (growth) capacity in each telephone closet which includes a fiber optic backbone. The MDF/telephone closet riser cable shall be sized to satisfy all voice and data requirements plus not less than 50% spare (growth) capacity in each telephone closet which does not include a fiber optic backbone.
3. The MDF and all intermediate distribution frames shall be connected to the EPBX system ground.
4. Technical Characteristics:

Telephone	
IDC type unit	As described in Part 2
Contact wires	50 micron of Gold over Nickel
Contact pressure	100 Grams, MIN
110A Punch blocks	Acceptable alternate to IDC
Data	110A blocks as described in Part 2
Fiber optic	Patch panel as described in Part 2

Analog Video	Patch panel as described in Part 2
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### 2.3 TELECOMMUNICATIONS CLOSET REQUIREMENTS

- A. Refer to VA Handbook H-088C3, Telephone System Requirements, for specific TC guidelines for size, power input, security, and backboard mounting requirements. It is the Contractors responsibility to ensure TC compliance with the System Requirements.

### 2.3 INSTALLATION KIT

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, 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 COR 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:

A. System Grounding:

1. 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.
2. This includes, but is not limited to:
  - b. Control Cable Shields.
  - c. Data Cable Shields.
  - d. Equipment Racks.
  - e. Equipment Cabinets.
  - f. Conduits.
  - g. Duct.
  - h. Cable Trays.
  - i. Power Panels.
  - j. Connector Panels.
  - k. Grounding Blocks.

- B. 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, required to accomplish a neat and orderly installation.

- C. 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.
- D. 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.
- E. 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.
- F. 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.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. 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 and equipment catalog numbers, model and serial identification numbers. The COR shall inventory the cable, patch panels, and related equipment.
  - 2. Storage and Handling: Store and protect equipment in a manner, which shall preclude damage as directed by the COR.
- B. 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 COR 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 install suitable filters, traps, directional couplers, splitters, TC's, and pads for minimizing interference and for balancing the System. Items used for balancing and minimizing interference shall be able to pass telephone and data 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 of Paragraph 2.1.C and the System performance standards.
4. 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.
5. Where TCOs are installed adjacent to each other, install one outlet for each instrument.
6. All lines shall be terminated in a suitable manner to facilitate future expansion of the System. There shall be a minimum of one spare 25 pair cable at each distribution point on each floor.
7. All vertical and horizontal copper and fiber optic cables shall be terminated so any future changes only requires modifications of the EPBX or signal closet equipment only.
8. 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 cables carrying telephone and data signals in telephone and data systems.
9. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.
10. Equipment installed indoors shall be installed in metal cabinets with hinged doors and locks with two keys.

C. 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, weatherheads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers shall be sleeved and sealed. The minimum conduit size shall be 19 mm (3/4 in.).
- b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow telephone cables shall be installed in partitioned cable tray with data cables shall be granted in writing by the COR 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 flexible cable protective armor or systems are specifically authorized shall 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 shall 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 signal conduit.
- f. When metal, plastic covered, flexible cable protective armor or systems are specifically authorized shall 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. Distribution System Signal Wires and Cables:

1. Wires and cables shall be provided in the same manner and use like construction practices as Fire Protective and other Emergency Systems that are identified and outlined in NFPA 101, Life Safety Code, Chapters 7, 12, and/or 13, NFPA 70, National Electrical Code, Chapter 7, Special Conditions. The wires and cables shall be able to withstand adverse environmental conditions in their respective location without deterioration. Wires and cables shall enter 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 the cables.
  - a. Each wire and cable shall terminate on an item of equipment by direct connection. Spare or unused wire and cable shall be provided with appropriate connectors (female types) that are installed in appropriate punch blocks, barrier strips, patch, or bulkhead connector panels.
  - b. Fiber optic cables that are spare, unused or dark shall be provided with Industry Standard "LC or SC" type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
  - c. Coaxial cables that are spare, unused or dark shall be provided with the cable OEM specified type female connectors installed in appropriate break out, patch, or bulkhead connector panels provided in enclosure(s) and shall be protected from the environment.
  - 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.
2. Routing and Interconnection:
  - a. Wires or cables between consoles, cabinets, racks and other equipment shall be in an approved conduit, signal duct, cable duct, or cable tray that is secured to building structure.

- b. Wires and cables shall be insulated to prevent contact with signal or current carrying conductors. Wires or cables used in assembling consoles, panels, equipment cabinets and racks shall be formed into harnesses that are bundled and tied. Harnessed wires or cables shall be combed straight, formed and dressed in either a vertical or horizontal relationship to equipment, controls, components or terminations.
- c. Harnesses with intertwined members are not acceptable. Each wire or cable that breaks out from a harness for connection or termination shall have been tied off at that harness or bundle point, and be provided with a neatly formed service loop.
- d. Wires and cables shall be grouped according to service (i.e.: AC, grounds, signal, DC, control). DC, control and signal cables shall be included with any group. Wires and cables shall be neatly formed and shall not change position in the group throughout the conduit run. Wires and cables in approved signal duct, conduit, cable ducts, or cable trays shall be neatly formed, bundled, tied off in 600 mm to 900 mm (24 in. to 36 in.) lengths and shall not change position in the group throughout the run. Concealed splices are not allowed.
- e. Separate, organize, bundle, and route wires or cables to restrict EMI, channel crosstalk, or feedback oscillation inside any enclosure. 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. This installation shall be accomplished with ties and/or fasteners that shall not damage or distort the wires or cables. Limit spacing between tied off points to a maximum of 150 mm (6 inches).
- f. Do not pull wire or cable through any box, fitting or enclosure where change of cable tray or signal or cable duct alignment or direction occurs. Ensure the proper bend radius is maintained for each wire or cable as specified by it's OEM.
- g. Employ temporary guides, sheaves, rollers, and other necessary items to protect the wire or cable from excess tension or damage from bending during installation. Abrasion to wire or cable

jackets is not acceptable and shall not be allowed. Replace all cables whose jacket has been abraded. The discovery of any abraded and/or damaged cables during the proof of performance test shall be grounds for declaring the entire system unacceptable and the termination of the proof of performance test. Completely cover edges of wire or cable passing through holes in chassis, cabinets or racks, enclosures, pull or junction boxes, conduit with plastic or nylon grommeting.

- h. Cable runs shall be splice free between conduit junction and interface boxes and equipment locations.
- i. Cables shall be installed and fastened without causing sharp bends or rubbing of the cables against sharp edges. Cables shall be fastened with hardware that shall not damage or distort them.
- j. Cables shall be labeled with permanent markers at the terminals of the electronic and passive equipment and at each junction point in the System. The lettering on the cables shall correspond with the lettering on the record diagrams.
- k. Completely test all of the cables after installation and replace any defective cables.
- l. 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, shall be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables shall: 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 is not allowed and shall not be approved.
- m. Wires or cables installed outside of conduit, cable trays, wireways and cable duct.
  - 1) Only when specifically authorized as described herein, shall wires or cables be identified and approved shall be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.



- 2) Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
  - 3) Closer wire or cable fastening intervals shall 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.
  - 4) Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets) shall, when specifically authorized by the COR, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
- n. Wires or cables installed in underground conduit and duct.
- 1) Wires or cables installed in underground installations shall be waterproofed by the inclusion of a water protective barrier (i.e. gel and magma) or flooding compound between the outside jacket and first shield. Each underground connection shall be accessible in a manhole, recessed ground level junction box, above ground pedestal and shall be provided with appropriate waterproof connectors to match the cable being installed. Once the System has been tested and found to meet the System performance standards and accepted by VA, the Contractor shall provide waterproof shrink tubing or approved mastic to fully encompass each wire or cable connection and overlay at least 150 mm (6 inches) above each wire or cable jacket trim point.
  - 2) It is not acceptable to connect waterproofed cable directly to an inside CCS punch block or directly to an equipment connection port. When an underground cable enters a building, it shall be routed directly to the closest TC that has been designated as the building's IMTC. The Contractor shall provide a "transition" splice in this TC where the "water proofed" cable enters on one side and "dry" cable exits on the other side. The "transition" splice shall be fully waterproof and be capable of reentry for system servicing. Additionally,

the transition splice shall not allow the waterproofing compound to migrate from the water proof cable to the dry cable.

- 3) Warning tape shall be continuously placed 300 mm (12 inches) above buried conduit and cable.

E. Outlet Boxes, Back Boxes, and Faceplates:

1. Outlet Boxes: Signal, power, interface, connection, distribution, and junction boxes shall be provided as required by the system design, on-site inspection, and review of the contract drawings.
2. Back Boxes: Back boxes shall be provided as directed by the OEM as required by the approved system design, on-site inspection, and review of the contract drawings.
3. Face Plates (or Cover Plates): Faceplates shall be of a standard type, stainless steel, anodized aluminum or UL approved cyclolac plastic construction and provided by the Contractor for each identified system outlet location. Connectors and jacks appearing on the faceplate shall be clearly and permanently marked.

F. 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. AC barrier strips shall be provided with a protective cover to prevent accidental contact with wires carrying live AC current. Punch blocks are approved for signal, not AC wires. 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 and wirewrap.

G. AC Power: AC power wiring shall be run separately from signal cable.

H. Grounding:

1. General: The Contractor shall ground all Contractor Installed Equipment and identified Government Furnished Equipment to eliminate all shock hazards and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup and crosstalk. The total ground resistance shall be 0.1 Ohm or less.
  - a. The Contractor shall install lightning arrestors and grounding in accordance with the NFPA and this specification.
  - b. Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, subcarrier or audio reference ground.
  - c. The use of conduit, signal duct or cable trays as system or electrical ground is not acceptable and shall not be permitted. These items shall be used only for the dissipation of internally generated static charges (not shall be confused with externally generated lightning) that shall applied or generated outside the mechanical and/or physical confines of the System to earth ground. The discovery of improper system grounding shall be grounds to declare the System unacceptable and the termination of all system acceptance testing.
2. Cabinet Buss: A common ground buss of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground. Provide a separate isolated ground connection from each equipment cabinet ground buss to the system ground. Do not tie equipment ground busses together.
3. Equipment: Equipment shall be bonded to the 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 alternates.
4. Cable Shields: Cable shields shall be bonded to the cabinet ground buss with #12 AWG minimum stranded copper wire at only one end of the cable run. Cable shields shall be insulated from each other, faceplates, equipment racks, consoles, enclosures or cabinets; except, at the system common ground point. Coaxial and audio cables, shall have one ground connection at the source; in all cases, cable shield ground connections shall be kept to a minimum.

- I. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for voice and data circuits shall be stenciled using laser printers . Handwritten labels are not acceptable.
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.
  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 workstation outlets and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams".

### **3.2 TESTS**

A. Interim Inspection:

1. This inspection shall verify that the equipment provided adheres to the installation requirements of this document. The interim inspection shall be conducted by a factory-certified representative and witnessed by a Government Representative. Each item of installed equipment shall be checked to insure appropriate UL certification markings. This inspection shall verify cabling terminations in telecommunications rooms and at workstations adhere to color code for T568B pin assignments and cabling connections are in compliance with ANSI/EIA/TIA standards. Visually confirm Category 6 marking of outlets, faceplates, outlet/connectors and patch cords.
2. 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.

B. Pretesting:

1. Upon completing the installation of the System, the Contractor shall align and balance the system. The Contractor shall pretest the entire system.
2. 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 and poling noise. are present. The Contractor shall measure and record the aural carrier levels of each system telephone and data channel, at each of the following points in the system:
    - 1) Local Telephone Company Interfaces or Inputs.
    - 2) EPBX interfaces or inputs and outputs.
    - 3) MDF interfaces or inputs and outputs.
    - 4) EPBX output S/NR for each telephone and data channel.
    - 5) Signal Level at each interface point to the distribution system, the last outlet on each trunk line plus all outlets installed as part of this contract.
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 COR.

C. Acceptance Test: After the System has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 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 and Life Safety compliance. The test shall verify that the total System meets the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

D. Verification Tests:

1. Test the UTP backbone 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 the operation of shorting bars in connection blocks. Test cables after termination and prior to cross-connection.
2. Single mode Fiber Optic Cable: Perform end-to-end attenuation tests in accordance with ANSI/EIA/TIA-568-B.3 and ANSI/EIA/TIA-526-7 using Method A, Optical Power Meter and Light Source. Perform verification acceptance test.

E. Performance Testing:

1. Perform Category 6 tests in accordance with ANSI/EIA/TIA-568-B.1 and ANSI/EIA/TIA-568-B.2. Test shall include the following: 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 ANSI/EIA/TIA-568-B.3.

F. Total System Acceptance Test: The Contractor shall perform verification tests for UTP copper cabling system(s) and the multimode and/or single mode fiber optic cabling system(s) after the complete telecommunication distribution system and workstation outlet are installed.

1. Data Testing: Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network is achieved.

### **3.3 TRAINING**

- A. Furnish the services of a factory-trained engineer or technician for a total of two four hour classes to instruct designated Facility IRM 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 shall be accomplished. Training shall be scheduled at the convenience of the Facilities Contracting Officer and Chief of Engineering Service.

### **3.4 WARRANTY**

- A. Comply with FAR clause 52.246-21, except that warranty shall be as follows:
  - 1. The Contractor shall warranty that all installed material and equipment shall be free from defects, workmanship, and shall 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 COR , 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. The Contractor and OEM shall provide this contact capability at no additional cost to the VA.
  - 3. All Contractor installation, maintenance, and supervisor personnel shall be fully qualified by the OEM and shall 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 one year warranty period:
    - a. Response Time:
      - 1) The COR (or facility Contracting Officer if the facility has taken possession of the building[s]) are the Contractor's reporting and contact officials for the System trouble calls, during the warranty period.
      - 2) A standard workweek is considered 8:00 A.M. to 5:00 P.M., 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 working days of its report. A routine trouble is considered a trouble which causes a system outlet, station, or patch cord shall be inoperable.
  - b) An emergency trouble call within 6 hours of its report. An emergency trouble is considered a trouble which causes a subsystem or distribution point shall be inoperable at anytime. Additionally, the loss of a minimum of 50 station or system lines shall be deemed as this type of a trouble call.
- 4) The Contractor shall respond on-site to a catastrophic trouble call within 4 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 the standard work time limits), the Contractor shall be responsible for providing alternate system CSS or TCO equipment, or cables. The alternate equipment and/or cables shall be operational within four hours after the four hour trouble shooting time.
  - b) Routine or emergency trouble calls in critical emergency health care facilities (i.e., cardiac arrest and intensive care units) shall also be deemed as a catastrophic trouble call if so determined by the COR or Facility Director. The COR or Facility Contracting Officer shall notify the Contractor of this type of trouble call at the direction of the Facilities Director.
- b. Required on-site visits during the one year warranty period
  - 1) The Contractor shall visit, on-site, for a minimum of eight hours, once every 12 weeks, during the warranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this SPEC.
    - a) The Contractor shall arrange all Facility visits with the COR or Facility Contracting Officer prior to performing the required maintenance visits.



- b) The Contractor in accordance with the OEM's recommended practice and service intervals shall perform preventive maintenance during a non-busy time agreed to by the RE or Facility Contracting Officer and the Contractor.
  - c) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COR.
- 2) The Contractor shall provide the COR 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 COR with sample copies of these reports for review and approval at the beginning of the Total System Acceptance Test. The following reports are the minimum required:
- a) Monthly Report: The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to COR by the fifth 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) Contractor Log: 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.
- 3) The COR shall provide the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
- a) The COR shall ensure copies of these reports are entered into the System's official acquisition documents.
  - b) The COR shall ensure copies of these reports are entered into the System's official technical as-installed documents.

B. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use, accidents, other vendor, contractor, owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the COR in writing upon the discovery of these incidents. The COR shall investigate all reported incidents and render findings concerning any Contractor's responsibility.

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**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 19, 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: Apogee Consulting Group-PA

7330 Chapel Hill Road

Suite 200

Raleigh, NC 27607

Tel.919-858-7420

F. Owner: VA Medical Center

G. General Contractor (GC): successful bidder

H. Contractor: Systems Contractor; you; 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 shall 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 Contracting Officer Representative (COR) 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**

- 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.

#### **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 shall 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 shall 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**

- 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 through equipment list of equipment expected shall be installed in the system, with spares, as a part of the submittal. Special Communications (0050P3B - herein after referred to as 0050P3B) shall not review any submittal that does not have this list.
- D. Provide four copies to the PM for technical review. The PM shall 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) shall 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 shall 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 shall prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There shall 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).
- C. The emergency phone system and strobe shall be Call 24 Wireless callbox systems, C24-10A-MU-CS, S series wireless call box station w/LED strobe and LED locator to match existing, Contact person Tom Davenport 1-800-441-9191 EST X 141.

## **2.3 EMERGENCY CALL STATIONS**

- A. The emergency call station shall be a dual button emergency phone. The unit shall be an ADA compliant, multi-function, high strength, vandal resistant security unit. The unit shall include a high quality, vandal resistant, hands free communications device, a powerful (1 million candlepower) strobe light and a vivid blue area light, which serves to identify the unit from great distances. The unit shall include an integrated wall mount enclosure assembly and an emergency phone station.
- B. The unit shall have an integrated blue light and strobe encased in Lexan. The blue light shall be always lit, calling attention to the location of the emergency communication unit. When the emergency phone

is activated, the strobe shall flash at 1 million candlepower and 60 fpm. The strobe shall flash until either actively terminated by the personnel receiving the call or automatically upon termination of the call itself.

- C. The wall mount enclosure shall be made of a vandal resistant, 12-gauge No.4 vertical brushed stainless steel. It shall be designed to withstand prolonged exposure to harsh environments. The unit shall have a blue light/strobe located at the top of the unit, housed in a vandal resistant, blue polycarbonate refractor housing. This blue light and strobe shall be further enclosed in a clear polycarbonate security enclosure. The wall mount emergency telephone box with blue light shall measure 10 inches w x 21 inches h x 6 1/2 inches d and weigh approximately 75 lbs. The ADA-compliant, hands-free emergency phone shall be flush mounted into the wall mount enclosure. Emergency phone station faceplate shall be 12-gauge No.4 brushed stainless steel or as otherwise approved.
- D. The housing for pole mount unit shall be a concentric steel cylinder (bollard) with an 8.75 inch diameter, a .25 inch wall thickness and a height of 84 inches. The unit shall have a blue light and strobe located at the top of the unit. A deep blue polycarbonate prismatic refractor that distributes the light in a horizontal pattern, making the flash bright and visible even at great distances, shall cover the strobe. The ADA-compliant, hands-free emergency phone shall be flush mounted into the pole mount housing. The unit weight approximately 275 lbs.
- E. The blue light and strobe shall be controlled via the emergency phone, and connect to an auxiliary output of the emergency phone. The emergency phone shall connect via its RJ-11 connector to a standard phone line or PBX extension. The emergency phone shall not require connection to any power source other than the telephone line. The blue light, strobe, and faceplate light require 24VAC, 60Hz power.
- F. The unit shall have the following features:
  - 1. Interface with Owner's PBX or regular phone line.
  - 2. Vandal resistant stainless steel faceplate and metal button(s).
  - 3. Phone line powered; no power supply or battery backup required.
  - 4. LED indicator for hearing impaired.
  - 5. Cast metal raised letter and Braille signage for ADA compliance.

6. Auto-answer that allows security to monitor and initiate calls with Owner provided phone.
7. Auxiliary input and outputs programmable to integrate with CCTV and security systems.
- G. Tamper resistant fasteners shall be used. It shall not be possible to enter the unit or remove any component without a special computer designed bit-wrench designed for the purpose. These bit-wrenches are available only from the manufacturer of the unit. All other types of fasteners shall not be acceptable due to the abundance of non-proprietary tools available for their removal.
- H. The entire unit shall be water and insect resistant when fully assembled.
- I. The system shall immediately and automatically dial the security desk when activated. In addition, activation shall simultaneously cause the blue strobe light to flash at no less than 60 times per minute and where indicated activate CCTV camera switching via an interface to the CCTV system and the access control system.
- J. Mounting:
  1. Wall mount security call stations shall be attached to the wall with anchors bolts as recommended by the manufacturer or otherwise indicated herein.
  2. Security call station poles shall be secured as recommended by the manufacturer.
- K. Electrical:
  1. All electrical components shall have quick-disconnect terminals with plug and receptacle attachments for easy service or removal. All wiring shall be concealed within the unit and shall not be visible from the outside.
  2. The unit shall require 24 VAC under normal operation. The entire unit shall be surge protected.
- L. Strobe Lights:
  1. The strobe light shall generate approximately 1,000,000 candlepower, and have a flash rate of no less than 60 flashes per minute. It shall be covered by a deep blue polycarbonate, prismatic refractor that distributes the light in a horizontal pattern, making the flash bright and visible even at great distances. The strobe light shall

be situated within the housing, inaccessible to vandals and weather resistant.

2. The strobe shall be automatically activated when the "Emergency" button is touched, and shall flash until the receiving party of the call deactivates it. The strobe cannot be deactivated at the unit itself.

M. Communications:

1. Each unit shall have a high quality, vandal resistant and ADA compliant communications device.
2. The speakerphone shall have the following standard features:
  - a. Three number dialing capability.
  - b. Programmable from a remote location.
  - c. Two input relays.
  - d. Two output relays.
  - e. Remote speaker volume adjustment.
  - f. Capable of playing up to two digitally stored voice messages.
  - g. Programmable passwords.
  - h. Capable of using interchangeable faceplates.
  - i. Silent dial out.
  - j. Output sound level >80 dB at 1 meter for normal conversation.
  - k. Waterproof speaker.
  - l. Waterproof microphone.
  - m. Auto answer and auto shut-off.
  - n. Operating temperatures of -40°F to +150°F (-40° to +65°C).
  - o. Speakerphone electronics are conformal coated to withstand harsh environments.

N. Graphics:

1. The graphics shall be cut from an engineering grade reflective vinyl for high visibility and legibility, with a seven-year durability.
2. The standard graphics text shall be "Emergency". Standard colors shall be reflective white, reflective blue and reflective black.

O. Finish:

1. For wall mounted unit, the finish shall be stainless steel. The finish shall be uniform and free of visible defects.
2. For pole mounted unit, the unit shall be finished with a coating process known shall be highly graffiti resistant and UV resistant.

P. Security Call Station Power Supply:

1. Security Call Station power supply shall power multiple call stations.
2. Power supply shall include the following:
  - a. Steel, NEMA 1 rated enclosure.
  - b. AC power indicator with power On/Off switch.
  - c. 120 or 230 VAC selectable input.
  - d. 24VAC output or 28VAC output for longer runs.
  - e. Main fused input.
  - f. 10A current capacity.
  - g. 8 fused outputs.
  - h. Input wire size 12-16 gauge.
  - i. Output wire size 12-22 gauge solid or stranded wire.

Q. Security Call Station Cable

1. Call Station communication cable shall meet manufacturers' requirement.
2. Call Station power cable shall be minimum 14 awg wire or as otherwise approved. Power cable for each call station shall be home run from the power supply to the respective call station unit.
3. Cables installed underground or in underground conduits shall be rated for direct burial installation.
4. Cables used inside a building shall be labeled for indoor use as described in NFPA 70, the National Electric Code. Cables shall be plenum rated if used in a plenum space and riser rated in all other areas.

R. The new blue light /telephone shall match the existing units by Call 24.

**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 shall 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 COR.

- C. The Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the COR.
- D. Provide UPS for all active system components:
  - 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 shall 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 shall 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 COR 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 shall 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 and system cables.
  - 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 shall 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 and intercom stations 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 shall be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway shall 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 shall 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 shall be sufficient to allow plates, panels and equipment shall 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 shall 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 shall 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.

E. 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 and receptacle location 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 shall 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 shall not be allowed shall be part of the system. The Contractor shall bear all costs required to provide replacement equipment with approved UL marks.

#### **3.4 SYSTEM PROGRAMMING**

- A. Provide all programming required for a complete and operational system. Coordinate programming parameters with Owner and Engineer.

#### **3.5 PROTECTION OF NETWORK DEVICES**

- A. 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, shall 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 shall 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 shall be conducted by a factory-certified representative and witnessed by a Government Representative. The results of the inspection shall be officially recorded by the Government Representative and maintained on file by the COR until completion of the entire project. The results shall be compared to the Acceptance Test results. An identical inspection shall be conducted between the 65 - 75 percent of the system construction phase, at the direction of the COR.

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 and poling noise 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 COR.

C. Acceptance Test:

1. After the system has been pretested and the Contractor has submitted the pretest results and certification to the COR, then the Contractor shall schedule an acceptance test date and give the COR 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 shall 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 shall 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 shall be utilized to accomplish this requirement.
- b. Individual Item Test: The Government Representative shall 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 COR. Any retesting to comply with these specifications shall be done at the Contractor's expense.
- b. If the system is declared unacceptable without conditions, all rescheduled testing expenses shall 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 shall be free from defects, workmanship and shall 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 COR, 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 shall 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 warranty year guaranty period:
  - a. Response Time During the One Year Warranty Period:
    - 1) The COR (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 warranty period.
    - 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the COR , 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, shall be inoperable at anytime.

b. Required On-Site Visits During the One Year Warranty Guaranty Period

- 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the warranty ~~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 COR 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 COR.
- 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the COR.
- 5) The Contractor shall provide the COR 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 COR 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 COR (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 COR shall convey to the Facility Engineering Officer, two
  - (2) copies of actual reports for evaluation.
  - a) The COR (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 COR in writing upon the discovery of these incidents. The COR shall investigate all reported incidents and render

#### **4.3 TRAINING**

- A. Provide thorough training for the emergency phone system. This training shall be developed and implemented to address two different types of staff. A separate training room shall 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. 8 hours during the opening week for security staff.
  - 2. 4 hours for supervisors and system administrators.

- - - 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 shall 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, 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.
- C. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- E. Section 14 24 00 - HYDROLIC ELEVATORS. Requirements for elevators.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- G. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.

- H. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.  
Requirements for infrastructure.
- I. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.
- J. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- K. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- L. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- M. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.
- N. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- O. 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 shall 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 shall 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 shall 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 COR 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 shall 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 shall render satisfactory service to this installation within eight 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 shall 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 shall 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 shall 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.
  2. 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 shall 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 shall 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 and door hardware) 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 COR 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 SHALL 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 COR 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 shall 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.



1. 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 shall 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 COR 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 shall 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 and Out Reader)
  - 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 and Motion Detector)
  - 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 and Local Sounder)
- 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 Shall Automatically Calculate the Remaining System Numbers.
  - 2) Footer
    - a) File Name
    - b) Date Printed
    - c) Page Number
- 4. 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.
- 5. 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 shall 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.
- 6. 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 COR documenting changes to the site, particularly those conditions that affect performance of the system shall 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 COR.
  - 2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality:
    - a. Baseline configuration
    - b. Access levels
    - c. Schedules (intrusion detection, physical access control and holidays).
    - 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 shall 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 shall deliver the test procedures to the COR 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 COR for approval. The Contractor shall 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 shall be provided.
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) Video surveillance, control and recording systems,
    - 3) 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 COR, 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 shall be used for the completed Security system. The graphics examples shall be delivered to the COR 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 COR 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 shall 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 COR 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 shall provide access to redline documents anytime during the project for review and inspection by the COR 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 shall submit the Master Redline document to the COR for review and approval of all changes or modifications to the documents. Each sheet shall have COR 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 COR. As with master relines,

Contractor shall maintain record specifications for COR 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 shall 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 COR.
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 COR prior to development of Record construction documents. The COR 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 COR, the COR shall initial and date each sheet and turn redlines over to the contractor for as built development.

- b. The Contractor shall provide the COR 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 COR. If, in the opinion of the COR, 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 COR. The Contractor shall organize into bound and labeled sets for the COR'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 shall 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. Card Readers
  - b. Facial Image Capturing Camera



- c. PIV Middleware
- d. Electromagnetically Opaque Sleeve
- e. Certificate Management
  - 1) CAK Authentication System
  - 2) PIV Authentication System
  - 3) Certificate Validator
  - 4) Cryptographic Module
- L. Approvals shall be based on complete submission of manuals together with shop drawings.
- M. After approval and prior to installation, furnish the COR 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. In addition to the requirement of SUBMITTALS, the VA reserves the right to request the manufacturer to arrange for a VA representative to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

#### **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  
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  
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 shall 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 COR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COR 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 shall 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 COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. 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 COR, 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 shall 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 shall 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 COR 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 COR 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 and Lock Power) 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 shall not 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 shall 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

#### **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 Contracting Officer Representative (COR) 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 COR 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 shall 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 shall not be described herein. Depending on the manufacturers selected by the COR, some equipment, materials and hardware shall 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 COR 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 COR shall be consulted in the event

there is any question about which supporting equipment, materials, or hardware is intended shall 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 shall 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 shall 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 COR 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 Contractor received written notification of final acceptance from the COR. 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 COR'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 COR 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.

#### **1.21 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.

### **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 shall 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 shall allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system shall 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 shall be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
- B. 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 shall be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space shall 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 shall allow it shall 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 shall 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 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.

### **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: 5H2 - 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: 5H2 - 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) Ouput 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 SUPPRESION**

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. 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 (8x20µsec)
- 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

E. 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 shall 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 manufactures' installation instructions.

F. 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, 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 shall 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 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 ,lamps and labels 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 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 COR at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for 4 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.

### **3.4 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.

### **3.5 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 COR on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the COR 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 COR 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 shall be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with COR 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 COR 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 shall 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 COR 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 COR, any additional data needed to provide a complete and operational system as described in the contract documents.
3. Contractor and COR 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 Tasks							
Descr iptio n of Syste ms	Develop System Loading Sheets	Coordina tion	Initial Set-up Configur ation	Graphic Maps	Syst em Prog ramm ing	Final Checks	Level of Effort (Typical Tasks)

SMS Setup & Confi gurat ion	e.g., program monitori ng stations , programm ing networks , intercon nections between CCTV, intercom s, time synchron ization	e.g., retrieve IP addresse s, naming conventi ons, standard event descript ions, programm ing template s, coordina te special system needs	e.g., Load system Operatin g System and Applicat ion software , general system configur ations	e.g., develop naming convent ions, develop file folders , confirm ing accurac y of AutoCAD Floor Plans, convert file into jpeg file	e.g., prog ram moni tori ng stat ions , prog ramm ing netw orks , inte rcon nect ions betw een CCTV , inte rcom s, time sync hron izat ion	e.g., check all system diagno stics (e.g., client s, 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
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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
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Intru sion Dete ction Syste ms	e.g., enter door groups & schedule s, link devices - REX, lock, & graphics	e.g., confir m g device configur ations, naming conventi ons, event descript ion and narrativ es	e.g., enter data from loading sheets; configur e componen ts, 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,
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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**

### **3.6 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 COR at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
  - b. The COR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the COR 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 COR at the conclusion of each phase of testing and prior to COR 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 COR within seven (7) calendar days after completion of each test.

#### **B. 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 COR 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 COR's acceptance testing procedures. The Contractor shall provide the COR 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 COR 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.

C. 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 COR, then the Contractor shall schedule an acceptance test to date and give the COR 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 COR. 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 shall 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 shall be present for resumption of the PVT. If the acceptance test is aborted, the re-test shall 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 COR 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 COR 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 COR's 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 COR, the Performance Verification Test shall be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT shall 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.



D. 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 COR 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 shall maintain a log of all system deficiencies. The COR shall 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 COR 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 COR. If the system experiences no failures, the Contractor shall proceed directly to Phase III testing after receiving written permission from the COR.
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 COR. 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 COR. The meeting shall not be scheduled earlier than five (5) business days after the COR 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 COR shall 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 COR.

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 COR. 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 COR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COR. 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 COR 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 COR shall provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the COR shall require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

#### E. Exclusions

1. The Contractor shall 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 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. 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.

**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 COR 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 loss test set.
  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. General: All cabling locations shall be in conduit systems as outlined in Division 28 unless a waiver is granted in writing or an exception is noted on the construction drawings.
- B. 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.
- C. Conduit and Boxes: Comply with requirements in Division 28 Section "Conduits and Backboxes for Electrical Systems." Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 4 inches (100 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.
  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. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

#### **2.5 OPTICAL FIBER CABLE**

- A. Description: Multimode, 50/125-micrometer, 24 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 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 armored type.
- 6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 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 connectors. Insertion loss shall be not more than 0.75 dB.
  - 2. Type SFF connectors shall 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 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. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 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.

## **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.

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 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, No. 18 AWG AWG.
  - 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, NTRL 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 shall 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 shall 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 shall 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 COR.
  - 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 shall 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)] 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)] long shall be neatly coiled not less than [12 inches (300 mm)] 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, shall 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 permitted.
  - 3. Signaling Line Circuits: Power-limited fire alarm cables shall 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 shall 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.

- - - E N D - - -

**SECTION 28 05 26**  
**GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies the finishing, installation, connection, testing and certification of the grounding and bonding required for a fully functional Electronic Safety and Security (ESS) system.
- B. "Grounding electrode system" refers to all electrodes required by NEC, as well as including made, supplementary, grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this specification and have the same meaning

**1.2 RELATED WORK**

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 26 41 00 - FACILITY LIGHTNING PROTECTION. Requirements for a lightning protection system.
- C. Section 28 05 00 - REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS. For general electrical requirements, quality assurance, coordination, and project conditions that are common to more than one section in Division 28.
- D. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for low voltage power and lighting wiring.

**1.3 SUBMITTALS**

- A. Submit in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Shop Drawings:
  - 1. Clearly present enough information to determine compliance with drawings and specifications.
  - 2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- C. Test Reports: Provide certified test reports of ground resistance.
- D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Contracting Officer Representative (COR):
  - 1. Certification that the materials and installation are in accordance with the drawings and specifications.
  - 2. Certification by the contractor that the complete installation has been properly installed and tested.

#### 1.4 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
  - B8-04.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
- 81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
  - C2-07.....National Electrical Safety Code
- D. National Fire Protection Association (NFPA):
- 70-11.....National Electrical Code (NEC)
  - 99-2005.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
- 44-05 .....Thermoset-Insulated Wires and Cables
  - 83-08 .....Thermoplastic-Insulated Wires and Cables
  - 467-07 .....Grounding and Bonding Equipment
  - 486A-486B-03 .....Wire Connectors

#### PART 2 - PRODUCTS

##### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm<sup>2</sup> (4 AWG) and larger shall be permitted shall be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm<sup>2</sup> (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

## **2.2 GROUND RODS**

- A. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
- B. Quantity of rods shall be as required to obtain the specified ground resistance.

## **2.3 SPLICES AND TERMINATION COMPONENTS**

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).2.4 ground connections
- B. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- C. Below Grade: Exothermic-welded type connectors.
- D. Above Grade:
  - 1. Bonding Jumpers: Compression-type connectors, using zinc-plated fasteners and external tooth lockwashers.
  - 2. Connection to Building Steel: Exothermic-welded type connectors.
  - 3. Ground Busbars: Two-hole compression type lugs, using tin-plated copper or copper alloy bolts and nuts.
  - 4. Rack and Cabinet Ground Bars: One-hole compression-type lugs, using zinc-plated or copper alloy fasteners.
  - 5. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
    - a) Pipe Connectors: Clamp type, sized for pipe.
  - 6. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## **2.4 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 with minimum dimensions of 4 mm thick by 19 mm wide (3/8 inch x ¾ inch).

## **2.5 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 screw lug-type terminal blocks.

## **2.6 SPLICE CASE GROUND ACCESSORIES**

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.

## **2.7 COMPUTER ROOM GROUND**

- A. Provide 50mm<sup>2</sup> (1/0 AWG) bare copper grounding conductors bolted at mesh intersections to form an equipotential grounding grid. The equipotential grounding grid shall form a 600mm (24 inch) mesh pattern. The grid shall be bonded to each of the access floor pedestals.

## **2.8 SECURITY CONTROL ROOM GROUND**

- A. Provide 50mm<sup>2</sup> (1/0 AWG) stranded copper grounding conductor(s) color coded with a green jacket, bolted at the Room's Communications System Grounding Electrode Cooper Plate and circulate to each equipment rack ground buss bar through the wire management system. Connect each equipment rack, wire management system's cable tray and ladder to the circulating ground wire with a minimum 25mm<sup>2</sup> (4AWG) stranded Cooper Wire, color coded with a green jacket.
  - 1. Connect each equipment rack ground buss bar to the circulating ground wire as indicated.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Ground in accordance with the NEC, as shown on drawings, and as specified herein.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
  - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- C. Equipment Grounding: Metallic structures, including ductwork and building steel, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

### **3.2 INACCESSIBLE GROUNDING CONNECTIONS**

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.



### **3.3 CORROSION INHIBITORS**

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### **3.4 CONDUCTIVE PIPING**

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

### **3.5 COMPUTER ROOM/SECURITY EQUIPMENT ROOM GROUNDING**

- A. Conduit: Ground and bond metallic conduit systems as follows:
  - 1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 16 mm<sup>2</sup> (6AWG) bonding jumpers.
  - 2. Bond at all intermediate metallic enclosures and across all joints using 16 mm<sup>2</sup> (6 AWG) bonding jumpers.

### **3.6 WIREWAY GROUNDING**

- A. Ground and Bond Metallic Wireway Systems as follows:
  - 1. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 16 mm<sup>2</sup> (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
  - 2. Install insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 16 meters (50 feet).
  - 3. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
  - 4. Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 meters.

### **3.7 LIGHTNING PROTECTION SYSTEM**

- A. Bond the lightning protection system to earth ground externally to the building. Under no condition shall the electrical system's third or fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel shall be used to connected the

lightning protection system at the direction of the COR certified by an independent certified grounding contractor.

### **3.8 EXTERIOR LIGHT/CAMERA POLES**

- A. Provide 20 ft [6.1 M] of No. 4 bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

### **3.9 GROUND RESISTANCE**

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Government. Final tests shall ensure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems shall be used to meet the required resistance, but the specified number of electrodes shall still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the COR prior to backfilling. The contractor shall notify the COR 24 hours before the connections are ready for inspection.

### **3.10 GROUND ROD INSTALLATION**

- A. Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

### **3.11 LABELING**

- A. Comply with requirements in Division 26 Section "ELECTRICAL IDENTIFICATION" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  - 1. Label Text: "If this connector or cable is loose or if it shall be removed for any reason, notify the facility manager."

### **3.12 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system shall be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  - 1. Power Distribution Units or Panel boards Serving Electronic Equipment: 3 ohm(s).
  - 2. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
BID Documents  
Project No. 246-13-C-0127

- - - 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.
- C. All cable/conductors shall be installed in Rigid raceway system for outdoor use.

**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 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

I. Section 31 20 00 - EARTH MOVING. For bedding of conduits.

### **1.3 DEFINITIONS**

- A. LFMC: Liquidtight flexible metal conduit.
- B. LFNC: Liquidtight flexible nonmetallic conduit.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. 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 COR 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, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
  - 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, shall 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 shall remain in place without separation of any parts when subjected to the seismic forces specified [and the unit shall 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.  
B. Flexible galvanized steel conduit: Shall Conform to UL 1.  
C. Liquid-tight flexible metal conduit: Shall Conform to UL 360.  
D. 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 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.

B. Flexible steel conduit fittings:

1. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
2. Clamp type, with insulated throat.

C. 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 shall incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

D. Direct burial plastic conduit fittings:

1. Fittings shall meet the requirements of UL 514C and NEMA TC3.
2. As recommended by the conduit manufacturer.

E. Surface metal raceway fittings: As recommended by the raceway manufacturer.

F. 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**

- A. Standard, 4-Mil polyethylene 76 mm (3 inches) wide tape non-detectable type, red with black letters, and imprinted with "CAUTION BURIED ELECTRONIC SAFETY AND SECURITY CABLE BELOW".

## **2.10 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. Description: Comply with SCTE 77.
  - 1. Color of Frame and Cover: Gray.

2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service. 6.

Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

7. Handholes 300 mm wide by 600 mm long (2 inches wide by 24 inches long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover:

Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover:

Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced

polyester resin, with covers of hot-dip galvanized-steel diamond plate

## **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: Stainless steel 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. WIRELINE DATA TRANSMISSION MEDIA FOR SECURITY SYSTEMS.

### **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 COR 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 COR 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 shall 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 COR.
- D. Fire Alarm:

1. Fire alarm conduit shall be painted red (a red "top-coated" conduit from the conduit manufacturer shall 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 COR 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 shall 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.
2. Conduit for conductors 600 volts and below:
  - a. Rigid steel, IMC, 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, 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
$\frac{3}{4}$	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).

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**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. Surge and tamper protection
    - d. Credential cards and readers
    - e. Push-button switches
    - f. RS-232 ASCII interface
    - j. Credential creation and credential holder database and management
    - h. Monitoring of field-installed devices
    - i. Interface with elevator control systems.
    - j. Reporting
  - 2. Security:
    - a. Video and camera control.
- C. System Architecture:
  - 1. Criticality, operational requirements, and/or limiting points of failure shall 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. PIV cards,
9. Supportive information system,
10. Door locks and sensors,
11. Power supplies,
12. Interfaces with:
  - a. Video Surveillance and Assessment System,
  - b. Gate, turnstile, and traffic arm controls,
  - c. Automatic door operators,
  - d. Intercommunication System
  - e. Elevator Controls,
- 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 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. 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.

**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 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- D. Section 10 14 00 - SIGNAGE. Requirements for labeling and signs.
- E. Section 14 21 00 ELECTRIC TRACTION ELEVATORS. Requirements for elevators.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- G. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- H. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- I. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- J. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.
- K. 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.
- L. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- M. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.

- N. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- 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.
- Q. 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 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. 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 shall 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 Contracting Officer Representative (COR) 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 shall 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 shall render satisfactory service to this installation within eight 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 shall:
      - 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 shall 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).
    - 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 shall 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 and surface).
  - 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. 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 shall 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 shall 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 and door hardware) 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 COR 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 SHALL 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 COR 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 shall 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 shall 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.

I. 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 BISC 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 COR 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 shall 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 and Out Reader)
  - 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 and Motion Detector)
  - 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 and Local Sounder)
  - 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 Shall Automatically Calculate the Remaining System Numbers.
  - 2) Footer
    - a) File Name
    - b) Date Printed
    - c) Page Number
4. 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.
5. 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 shall 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.
6. 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 COR documenting changes to the site, particularly those conditions that affect performance of the system shall 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 COR.
2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality:
  - a. Baseline configuration
  - b. Access levels
  - c. Schedules (intrusion detection, physical access control and holidays).
  - 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 shall 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 shall deliver the test procedures to the COR 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 COR for approval. The

Contractor shall 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 shall be provided.

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 COR, 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 shall be used for the completed Security system. The graphics examples shall be delivered to the COR 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 COR 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 shall 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 COR 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 shall provide access to redline documents anytime during the project for review and inspection by the COR 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 shall submit the Master Redline document to the COR for review and approval of all changes or modifications to the documents. Each sheet shall have COR 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 COR. As with master relines, Contractor shall maintain record specifications for COR 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 shall 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 COR.
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 COR prior to development of Record construction documents. The COR 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 COR, the COR shall initial and date each sheet and turn redlines over to the contractor for as built development.
  - b. The Contractor shall provide the COR 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 COR. If, in the opinion of the COR, 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, subcontractor, 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 COR. The Contractor shall organize into bound and labeled sets for the COR'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 shall 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. Card Readers
  - b. PIV Middleware
  - c. Template Matcher
  - d. Electromagnetically Opaque Sleeve
  - e. Certificate Management
    - 1) CAK Authentication System
    - 2) PIV Authentication System

3) Certificate Validator

4) Cryptographic Module

P. Approvals shall 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, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

#### 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 shall 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. Windows: Operating system by Microsoft Corporation.

BBB. 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 shall 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 COR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COR 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 shall 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 COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. 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 shall 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 SHALL 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.
- G. 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 shall be combined to share a common database.

H. Data Capacity:

1. 130 different card-reader formats.
2. 999 comments.
3. 16 graphic file types for importing maps.

I. Location Capacity:

1. 128 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.

J. 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.
4. Communications Controller shall be used as an interface between the Central Station display systems and the field device network.  
Communications Controller shall provide functions required to attain the specified network communications performance.

K. 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.

L. 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 shall 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 shall 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 COR 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 COR 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 parking garage shall be an extension of the existing access control system by Tyco Integrated Security. The contractor shall contact Tyco integrated Security/Federal Systems Division, Alexandria ,VA to provide the card readers, push plates, doors sensors and all security hardware for a complete operational system. Tyco/Federal shall provide interface and programming for all security points, also, shall test the system, Tyco/Federal Systems Division contact person is Tom Mahoney 571-338-4480, National sales Manager..
- B. 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. Controllers (Data Gathering Panel)
  6. Secondary Alarm Annunciator
  7. Keypads
  8. Card Readers
  9. Credential Cards

10. System Sensors and Related Equipment
11. Push Button Switches
12. Interfaces
13. Door and Gate Hardware interface
14. RS-232 ASCII Interface
15. Floor Select Elevator Control
16. Video and Camera Control
17. Cables: Fiber and Copper
18. Transformers
19. Controlled parking gates.

## **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 shall 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. 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. 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 different card-reader or keypad formats. Multiple reader or keypad formats shall 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 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.
- D. 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.

**2.5 PACS SERVER HARDWARE- EXISTING**

**2.6 STANDARD WORKSTATION HARDWARE- EXISTING**

**2.7 COMMUNICATIONS WORKSTATION- EXISTING**

**2.8 DOOR 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 shall 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.
    - 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, using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 5 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.
6. Controller Power: NFPA 70, Class II power supply transformer, with 12- or 24-V ac secondary, backup battery and charger.
  - a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
  - b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
  - c. Backup Power Supply Capacity: 5 minutes of battery supply. Submit battery and charger calculations.
  - d. Power Monitoring: Provide manual dynamic battery load test, initiated and monitored at the control center; with automatic disconnection of the Controller when battery voltage drops below Controller limits. Report by using local Controller-mounted LEDs and by communicating status to Central Station. Indicate normal power on and battery charger on trickle charge. Indicate and report the following:
    - 1) Trouble Alarm: Normal power off load assumed by battery.
    - 2) Trouble Alarm: Low battery.
    - 3) Alarm: Power off.

## **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 shall 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 ( PROVIDE ONE SPARE CARD READER AND 50 CARDS )**

- 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 800ms 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. Shall 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 shall encompass a wide functional range. The PACS shall 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 and supervised inputs). 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 shall 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 shall 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  $fc/64$  (~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 FOR IT ROOM**

- 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 ascending ASCII-code ordinal sequence. 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
  3. PIV authentication data (one asymmetric key pair and corresponding certificate)
- D. The credential card (PIV) shall be an ISO 14443 type smart card with contactless interface that operates at 13.56 MHZ.
- E. The credential card (PIV) shall be an ISO 7816 type smart card.

#### **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.

D. 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 shall 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 bypass. 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.

E. 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.

F. 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 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 shall 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 shall 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 shall 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 shall indicate to the system if the strike/bolt is not engaged or is unlocked when it shall 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 shall 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.



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. 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)

**2.15 INTERFACES**

A. CCTV System Interface

1. An 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. 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

## 2.17 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 shall display the camera associated with the alarm point.
- B. Display mouse-selectable icons representing each camera source, to select source shall 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 shall 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.

## 2.18 WIRES AND CABLES

- A. Comply with Division 28 Section "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY."
- B. PVC-Jacketed, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  - 1. NFPA 70, Type CM.

2. Flame Resistance: UL 1581 Vertical Tray.
- 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.
- D. RS-485 communications require 2 twisted pairs, with a distance limitation of 4000 feet (1220 m).
- E. PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
- 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.
- H. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
  1. NFPA 70, Type CM.
  2. Flame Resistance: UL 1581 Vertical Tray.
- 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.

J. Plenum-Type, Paired, Readers and Wiegand Keypads Cable: Paired, 3 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.

1. NFPA 70, Type CMP.

2. Flame Resistance: NFPA 262 Flame Test.

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.

L. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

1. NFPA 70, Type CMG.

2. Flame Resistance: UL 1581 Vertical Tray.

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.

N. Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

1. NFPA 70, Type CMG.

2. Flame Resistance: UL 1581 Vertical Tray.

O. Plenum-Type, Paired Lock 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.

- P. Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
1. NFPA 70, Type CMR.
  2. Flame Resistance: UL 1666 Riser 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.
- R. Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
1. NFPA 70, Type CMG.
- 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.

### **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 and physical equipment sizes 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 shall 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.
- D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method shall be used. Use NRTL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
- E. Install LAN cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 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 shall 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 shall 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 shall 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 shall 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 the existing Tyco security system.
2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended shall 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 COR shall be provided a full list of all equipment that shall 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 COR 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 shall 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 shall 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 shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR 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 shall 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, test, and adjust field-assembled components and equipment installation, including connections[, and to assist in field testing. Report results in writing.
- B. Testing Agency: shall Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:
- 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 6 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 shall 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 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 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.
- C. Video surveillance system Video assessment & surveillance system shall be integrated with monitoring and control system specified in Division 28 Section PHYSICAL ACCESS CONTROL that specifies systems integration.

**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 14 24 00 - HYDRAULIC ELEVATORS. Requirements for elevators.
- E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.  
Requirements for connection of high voltage.
- F. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- G. Section 26 05 41 - UNDERGROUND ELECTRICAL CONSTRUCTION. Requirements for underground installation of wiring.
- H. Section 26 56 00 - EXTERIOR LIGHTING. Requirements for perimeter lighting.
- I. 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.
- J. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- K. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- L. Section 28 05 28.33 - CONDUITS AND BACKBOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.



M. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEM. Requirements for physical access control system integration.

### **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 shall 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 COR 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 shall 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 shall render satisfactory service to this installation within eight 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 1220 x 1220 millimeters (48 x 48 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 shall:
      - 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).
  - 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 shall 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 and surface).
  - 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 shall 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. 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.
- B. 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.
- C. 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 shall 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.
- B. Minimum Protection for Communication, Signal, Control, and Low-Voltage 983 compliant as well as:

1. Shall 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 shall be utilized to complement the fixed cameras.
3. Shall be powered over Ethernet. Network switches supporting PoE cameras shall have a back-up power source to ensure cameras are still operational in the event of loss of primary power to the VASS System.
4. Shall be rated for continuous operation under the environmental conditions listed in Part 1, Project Conditions.
5. 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.
6. 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.
7. Shall be programmed to digitally flip from color to black and white at dusk and vice versa at low light conditions.
8. Shall be fitted with AI/DC lenses to ensure the image quality under different light conditions.
9. 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.
10. Dummy or fake cameras shall not be utilized at any time.
11. Appropriate signage shall be designed, provided, and posted that notifies people that an area is under camera surveillance.

### **2.3 DIGITAL BASED VIDEO MANAGEMENT SYSTEM-EXISTING**



## **2.4 VIDEO DISPLAY EQUIPMENT-EXISTING**

### **2.4 CONTROLLING EQUIPMENT**

- A. Shall be utilized to call up, operate, and program all cameras associated VASS System components.
- B. Shall 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

### **2.5 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 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

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**

- 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 1.3 lux at with the camera AGC off.
- 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. Indoor/Outdoor Fixed Mini Dome System (IP)-ELEVATORS
  - 1. The indoor/outdoor fixed mini dome system shall include a built-in 100/1000 Base-FX 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 1000BASE-TX, Auto MDI/MDI-X															
Cabling	CAT6 1000BASE-T															
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
- d. Pole adapter for wall mount

Q.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	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 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

	<p>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</p> <p>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</p> <p>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	Fiber for 1000Base-FX
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°
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16. Accessories

- a. Pendant mount
- b. Wall mount for pendant
- c. Corner adapter for wall mount
- d. Pole 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

RR. 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 9mm 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
- SS.       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.
- T. 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	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 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 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 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 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 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 Additional640 x 512, 640 x 352, 480

	x 368, 480 x 272, 320 x 256, 320 x 176
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	Fiber for 1000Base-FX
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
- d. Pole 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

V

U. 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 and parking areas.
  - 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

V. 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 shall not 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 shall 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.

W. 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 shall be unobtrusive, unable to cause personal harm, and prevents tampering and vandalism.
  - b. The mount shall contain a manual pan/tilt head that shall 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.

X. 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.

Y. Exterior Domes

1. The exterior dome shall meet all requirements outlined in the interior dome paragraph above.
2. The housing shall be constructed shall be dust and water tight, and fully operational in 100 percent condensing humidity.

Z. 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 shall 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.

**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. Power supply shall be trough PoE data switch with a minimum of 15.4watt per port.
- C. 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. Rack mount.
  7. Enclosure: NEMA 250, Type 1 and 3 .

## **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
- 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 shall be decoded and displayed on an analog monitor.
- B. If a VASS System network is going shall 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. 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 shall 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 shall 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 fiber, CAT-6 cable and RJ-45 jacks. If analog equipment is used as part of the system, then either an encoder or a decoder shall 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. Provide fiber to copper transceiver at each camera location per manufacturers recommendations.
- J. Network Switch Technical Characteristics

Protocol and standard	IEEE802.3 IEEE802.3u IEEE802.3ab
Ports	24 or 48 port 1000M SSF fiber with 2-1 Gig and 2-10 gig uplink 24 port Copper PoE with 2- 1Gig and 2-10 Gig uplink
Network media	Fiber and CAT 6
Transmission method	store-and-forward
LED	indicator power, act/link, speed


## 2.11 RECORDING DEVICES-EXISTING

### A. Digital Video Recorder (DVR)EXISTING

1 section.


## 2.12 WIRES AND CABLES

- A. Shall meet or exceed the manufactures recommendation for power and signal.
- B. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent of liquid tight.
- C. All conduits shall be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space shall be contained in either EMT conduit.
- D. All conduit, pull boxes, and junction boxes shall be clearly marked with colored permanent tape or paint that shall 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. Cables
  - 1. All camera cabling runs shall be fiber optic cable outdoor. Fiber optics as a signal carrier then the following equipment shall be utilized:
    - a. Multimode fiber optic cable a minimum size of 50 microns
    - b. Video transmitter, installed at the camera that utilizes 12 VDC or 24 VAC for power.
    - c. Video receiver, installed at the switcher.
  - 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 ( for indoor in heated area), then use a shielded UTP category 6 (CAT-VI) cable a with standard RJ-45 connector at each end. The cable with comply with the Power over Ethernet, IEEE802.3af, Standard.
    - c. All camera cabling shall be fiber optic cable unless otherwise noted. Provide a separate cable for power for all cameras.

e. CAT-6 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 6
TIA/EIA Specification	568-B.2 Category 6
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	50 or 62.5 Micron
Number of Fibers	2
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
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11. Power Cables

- a. Shall be sized accordingly and shall comply with the NEC. High voltage power cables shall be a minimum of three conductors, 14 AWG, stranded, and coated with a non-conductive polyvinylchloride (PVC) jacket. Low voltage cables shall be a minimum of 18 AWG, stranded and non-conductive polyvinylchloride (PVC) jacket.
- b. Shall 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 shall 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 shall 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 shall 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 shall 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 shall 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. 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.
  - 3. 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 shall 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 PELCO 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 shall 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 shall 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 shall 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 shall 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. 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.

P. 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.

Q. 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.
- R. Provide 12 strand single mode fiber optic cable from the parking CATV to the existing security office, provide patch panels, patch cables, Programming for a complete integration system of the new and Old, coordinate all work with the COR. The existing is a Pelco Spectra 4 cameras and Pelco 9770 matrix assembly.

**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 shall be connected to the VASS System have been verified as the correct voltage, phasing, and frequency as indicated.
- B. The Commissioning Agent shall observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing

schedules with the COR 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 shall 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 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 eight hours to instruct VA personnel in operation and maintenance of units.

-----END-----

**SECTION 28 26 00**  
**ELECTRONIC PERSONAL PROTECTION SYSTEM**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Provide and install complete Duress-Panic Alarms, Emergency Phones/ Call-Boxes, and Intercom Systems, data transmission wiring and a control station with its associated equipment, hereafter referred to as EPPS System.
- B. EPPS shall be integrated with monitoring and control system specified in Division 28 Section VIDEO SURVEILLANCE SYSTEMSPHYSICAL ACCESS CONTROL SYSTEM that specifies systems integration.

**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 14 24 00 - HYDRAULIC ELEVATORS. Requirements for elevators.
- E. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- F. Section 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- G. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- 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 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- K. Section 28 05 28.33 - CONDUITS AND BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- L. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- M. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.



### 1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the EPPS 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 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 shall 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 COR 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 shall 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 shall render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

#### **1.4 SUBMITALS**

- A. Submit below items in accordance with Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY and Master Specification Sections 01 33 23, SHOP DRAWING, 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 (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawings 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 shall:
      - 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 shall 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).
    - 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 shall 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).
  - d. Power supply or circuit breaker and power panel 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.

#### **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):  
ANSI S3.2-09.....Method for measuring the Intelligibility of  
Speech over Communications Systems
- 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 Fire Protection Association (NFPA):  
70-11.....National Electrical Code
- F. National Electrical Manufacturers Association (NEMA)  
250-08.....Enclosures for Electrical Equipment (1000 Volts  
Maximum)
- G. Underwriters Laboratories, Inc. (UL):  
305-08.....Standard for Panic Hardware  
444-08.....Safety Communications Cables  
636-01.....Standard for Holdup Alarm Units and Systems
- H. Uniform Federal Accessibility Standards (UFAS), 1984

#### **1.6 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 shall 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 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, facility interface, and signal transmission 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 COR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COR 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, check 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 shall 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 COR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COR. 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".

#### **1.8 WARRANTY OF CONSTRUCTION.**

- A. Warrant EPPS 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.

#### **1.9 GENERAL REQUIREMENTS**

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. General requirements applicable to this section include:
  - 1. Performance Requirements,
  - 2. Delivery, Handling and Storage,
  - 3. Project Conditions,
  - 4. Equipment and Materials,
  - 5. Electrical Power,
  - 6. Lightning, Power Surge Suppression, and Grounding,
  - 7. Electronic Components,
  - 8. Substitute Materials and Equipment, and
  - 9. Like Items.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT AND MATERIALS**

- A. General:
  - 1. All equipment 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 hertz (Hz) or 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 shall provide 12 hours (hrs.) of run time in the event of a loss of primary power to the security systems until a backup generator comes on-line.

3. The EPPS systems shall be designed, installed, and programmed in a manner that shall allow for easy of operation, programming, servicing, maintenance, testing, and upgrading of the system.
4. All EPPS components located in designated "HAZARDOUS ENVIRONMENT" areas where fire or explosion could occur due to the presence of natural gases or vapors, flammable liquids, combustible residue, or ignitable fibers or debris, shall be rated Class II, Division I, Group F, and installed in accordance with National Fire Protection Association (NFPA) 70, National Electrical Code Chapter 5.
5. The Contractor shall provide the Contracting Officer 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, National Electrical Code. The Contractor is responsible for providing the correct protection cable duct and/or conduit and wiring.
6. When interfacing with other communications or security subsystems the Contractor shall utilize interfacing methods that are approved by the Contracting Officer. 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 shall adhere to all standards described herein.
7. Systems shall be scaleable, not vendor specific, and allow expansion as required.
8. Wireless systems shall use ultrasonic, infrared and radio frequency waves to link distributed transmitters and receivers. Specific characteristics of particular facility shall determine best application. Contractor is responsible for determining best system using prediction program to determine where readable signals can be obtained and identify "dead spots".
9. All hardwired alarms, switches, and junction boxes shall be protected from tampering and include line supervision.

10. The installation and placement of intercom units and emergency-call boxes in strategic locations shall also require that signage be posted near these devices. The signage, in accordance with Section 10 14 00, SIGNAGE shall communicate the location of the device and its unique identification number, and brief instruction on how to access/use the device. The signage shall appear on the device, on a pole or wall near the device location and shall be printed in a manner that is easily read during daylight and hours of darkness.

## **2.2 EQUIPMENT ITEMS**

- A. All systems shall be designed to provide continuous electrical supervision of the complete and entire system.
- B. Noise filters and surge protectors shall be provided for all intercommunications equipment to ensure protection from primary AC power surges and to ensure noise interference is not induced into low voltage data circuits.
- C. All alarm and initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and Uninterrupted Power Supply (UPS) power circuits shall be supervised for any change in operating conditions (e.g. low battery, primary to back up battery, and UPS online). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the master control station and all remote locations.
- D. Control Unit: Shall consist of the components to constantly monitor and verify alarm activation; identify zone of activation and location of activation.
- E. Audible Signal Device for Duress-Panic: Provides alarm activation and audible sound for alarms, as well as supervisory and trouble signals that shall be distinctive.
- F. Assessment: This capability shall consist of electronic devices required to visually and audibly verify the validity of alarms. Assessment also includes providing indication of tampering, fail-safe, low battery, and power losses.
- G. Alarm Monitoring and Reporting: Shall annunciate 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 an alarm. The alarms shall have the capability of

operating in a silent mode, alerting personnel monitoring the system that the device has been activated.

- H. The intercom and emergency call-box systems shall be provided with normally acceptable speech intelligibility, defined as a score of at least 70% in accordance with ANSI S3.2
- I. Master Stations for Emergency Call Box and Security Intercoms:
1. All master stations shall have a "call-in" switch to provide an audible and visual indication of incoming calls from remote stations. Individual visual indication shall identify the calling station and status, and remain actuated until a call is answered by a master station.
  2. Master stations shall be equipped with a handset with a switch for private conversations.
  3. Intercom master stations shall also have an all-call feature, and have the ability to receive video from a video intercom unit.
  4. Master stations shall have the capability to selectively communicate with any remote station by actuating assigned station number on a keypad or select button for that station.
  5. Master stations shall be standalone or can be integrated with the Physical Access Control System and Database Management. The Contractor shall be responsible for the integration of the Master station with the Physical Access Control System and Database Management in accordance with OEM instructions and Section 28 13 16, PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT.
- J. Duress-Panic Alarms: In Emergency Room
1. Housing shall be a rugged corrosion-resistant housing of stainless steel or Acrylonitrile Butadiene Styrene (ABS) molded plastic or similar material that is weather and dust proof.
  2. Actuating device shall include a minimum of a plunger button whose head is recessed from the face/front edge of the housing and be designed to avoid accidental activation using switch guard or multiple buttons (i.e., requires pressing two (2) buttons simultaneously)
  3. Wireless stationary devices shall meet the same specifications as Personal Duress/Panic Alarms.
  4. Alarm switch/button shall lock-in upon activation until manually reset with key or manufacture provided device.

5. The switch shall be a positive-acting, double-pole, and double-throw switch.
6. Duress/Panic alarms shall meet UL 305 Standard for Panic Alarms. To reduce the possibility of false alarms and ensure installation functionality UL 636 Standard for Holdup Alarms standards shall be met.
7. Alarms used for concealed application requires silent alarm notification to a monitoring station. They shall annunciate at the Physical Access Control System and Database Management, monitored by a central station or direct connect to local police, depending on local ordinance requirements.
8. Shall be capable of being mounted for hand or foot use in a manner that is unable shall be viewed by the public. Larger systems use a computer that intercepts and processes alarms and displays them on a monitor. The central computer can make an announcement over facility hand held radios, pagers or telephones, or at the Physical Access Control System and Database Management so that the other security personnel can be immediately notified. These systems shall be hardwired.
9. Components:
  - a. Transmitter
  - b. Locator subsystem
  - c. Receiver
  - d. Software
10. Wiring shall be four (4) conductor #18 American Wire Gauge (AWG).
11. Duress-Panic Alarm Technical Characteristics:

Temperature Range	0° to 110°F (-17.8°C to 43.3°C)
Nominal Voltage	12 V DC @ 6 mA
Current	Max 8 mA
Operational Voltage	7 V DC to 15 V DC
Operational life	Rated for 0,000 activations
Battery Activations	500
Actuator	Dual button plunger with activation lock
LED	Bi-color - on and activated

K. Personal Duress-Panic Alarm:

1. These systems are wireless only and can be worn as a belt clip, with a neck lanyard or with a wrist band. These alarms can be either active (manually operated) or passive mode (if detached from body, or body position changes to a prone position) alarm activates. They also provide identification of individual and location.
2. Components:
  - a. Transmitter
  - b. Repeaters (for wireless and increase distance)
  - c. Locator subsystem
  - d. Receiver
  - e. Software
3. Wireless transmitters shall send a periodic check in signal to the main computer or processor. If the signal is not received according to a definable time window, a supervisory alert shall be generated. Wireless devices shall report a low battery condition well in advance to the failure of the battery.
4. Shall consist of a compact lightweight transmitter enclosed in a durable fire-retardant ABS plastic case that can be easily worn.
5. Transmitters shall use ultrasonic, radio frequency (RF), or infrared (IR) to transmit signals. Each has advantages and disadvantages. Selection of system shall be dependent on defined usage and range of communications required.
6. Sensors shall be adjustable to activate automatically when mounted on a belt and the user is in a horizontal position for longer than one (1) to fifteen (15) minutes. Adjustment capability shall not be accessible to personnel wearing the panic alarm device.
7. Radio frequencies for transmitter shall comply with Federal Communication Commission (FCC) regulations.
8. Radio frequency transmitters shall use frequency modulation signal hopping.
9. Personal Duress-Panic Alarm Technical Characteristics:

Temperature Range	0° to 110°F (-17.8°C to 43.3°C)
Nominal Voltage	12 V DC @ 6 mA
Current	Max 8 mA
Operational Voltage	7 V DC to 15 V DC
Battery Life	Regular battery 60 hour duration

	or Nickel-Metal Hydride (NiMH) rechargeable 12 hrs. 20 hr. per charge
Battery Lifespan	500 activations
Actuator	Plunger with activation lock
LED	Bi-color - on and activated
Passive Activation	Adjustable Prone position 1-15 minutes

L. Security Intercoms: AT EACH GATE

1. Shall be utilized to assist in controlling entry to a site, parking lot . They are also used for emergencies. These systems shall have both two-way voice communications and video (CCTV) capabilities built in. Intercoms shall also have key-pads that allow for specific call connections or shall provide a directory. These systems consist of both remote and master stations. Intercom shall be externally powered for distances over 1,500 feet (457.2 meters) (m) from the master control unit.
2. The Intercom shall be programmable from a remote location and have a three number dialing capability per activation button, or include a keypad for dialing authorized and published extensions.
3. The Intercom shall have an internally mounted electronics enclosure and auxiliary power.
4. The Contractor shall be responsible for integration of intercom with auxiliary output to electronic or magnetic door releases, as well as CCTV, as required.
5. Security Intercom Technical Characteristics:

Construction	12 gauge (2.8mm) #4 brushed stainless steel face plate
Operating Temperature	-4°F to +149°F (-20°C to +65°C)
Communication	2-way hands-free communication
Digital Capacity	Up to 18 digits, including pauses, for each of two (2) phone numbers
Dialing Speed	Minimum 10 tones per second
Power Source	Phone line powered or PBX
Connection	Parallel tip and ring connected to RJ11 connector for quick installation
Memory	EPROM

Circuit Protection	Lightening suppressed and full wave polarity guarded
Programming	Non-volatile EEPROM programming can be done from any telephone. No battery back-up needed
Wiring Requirements	1 twisted-shielded pair (gauge depends on distance)
Camera	Option for pin-hole color camera or Integration with existing CCTV
LED	Call confirmation
Activation	1.5 in. (38.1mm) minimum piezoelectric button
Labeling	"Information" or "Help"

### 2.3 INSTALLATION KIT

A. General: A kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, barrier strips, wiring blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps and bolts required to accomplish a neat and secure installation. Unfinished or unlabeled wire connections shall not be allowed. Contractor shall turn over to the Contracting Officer all unused and partially opened installation kit boxes, coaxial cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, and physical installation hardware. This is an acceptable alternate to the individual spare equipment requirement as long as the minimum spare items are provided in this count. The following installation sub-kits are required as a minimum:

B. System Grounding:

1. The grounding kit shall include all cable in accordance with UL 444 Communications Cables, and installation hardware required. All grounding shall be according to the NEC.
2. This includes, but is not limited to:
  - a. Coaxial Cable Shields
  - b. Control Cable Shields
  - c. Data Cable Shields
  - d. Conduits
  - e. Cable Duct
  - f. Cable Trays
  - g. Power Panels



h. Connector Panels

- C. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers and clamps required to accomplish a neat and secure installation.
- D. Wire And Cable: The wire and cable kit shall include all connectors and terminals, barrier straps, wiring blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps and labels required to accomplish a neat and orderly installation.
- E. Equipment Interface: The equipment interface kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface Systems and Subsystems according to the OEM requirements and this specification.
- F. 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 specification.
- G. 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 correctly provide the system documentation as required by this document and explained herein.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. System installation shall be installed in accordance with NFPA 731 Standards for the Installation of Electric Premises Security Systems and appropriate installation manual for each type of subsystem designed, engineered, and installed.
- B. The location and type of duress, intercom, or call-box shall be installed shall be in accordance with physical security requirements unique to each VA facility.
- C. For EPPS systems (i.e. use current panic/duress and emergency call boxes) that can operate through existing VA facility telephone system lines, software programming and hardware.
- D. Concealed duress/panic devices shall be mounted in such a way that their location is only known by the person having knowledge of the activating device location. No wiring shall be exposed to identify the location of the activation device.

- E. Floor mounted duress alarms shall be attached to millwork on floor.  
When mounted under millwork, wiring shall be routed in millwork to conduit system via flexible conduit.
- F. Hard-wired switches shall be wired to individual alarm points within the Advanced Processing Controller (apC).
- G. Wall and post mounted stations shall be mounted to meet UFAS/ADA requirements and use tamper proof bolts and screws. Testing shall be finished before installation of fasteners.
- H. Cleaning: Subsequent to installation, clean each system component of dust, dirt, grease, or oil incurred during installation in accordance to manufacture instructions.
- I. Provisions shall be made for systems in high-noise areas or areas with electrical interference environments.
- J. Adjustment/Alignment/Synchronization: Contractor shall prepare for system activation by following manufacturer's recommended procedures for adjustment, alignment, or programming. Prepare each component in accordance with appropriate provisions of the component's installation, operations, and maintenance instructions.

### **3.2 WIRELINE DATA TRANSMISSION**

- 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 shall 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 WES 12112 or equivalent.
- C. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.

- D. Transient Voltage Surge Suppressors (TVSS): The Contractor shall mount TVSS within 3 m (118 in) of equipment shall 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 shall be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- E. 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.
- F. 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.
- G. 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.

### **3.3 WIRING**

- A. Wiring Method: Install cables in raceways.
- 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.

### **3.4 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.

### **3.5 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.

### **3.6 CLEANING**

- A. Clean installed items using methods and materials recommended in writing by manufacturer.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain electronic personal protection system (EPSS) equipment.
  - 1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
  - 2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
  - 3. Review equipment list and data in maintenance manuals.
  - 4. Conduct a minimum of [four] hours' training.

### **3.8 TESTS AND TRAINING**

- A. All testing and training shall be compliant with the VA General Requirements, Section 01 00 00, GENERAL REQUIREMENTS and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.

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**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 and security.
- 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 COR or his authorized representative. Installers shall have a minimum of 2 years experience installing fire alarm systems.
- C. Fire alarm signals:
  - 1. Building(s) Parking Garage shall have an automatic digitized voice fire alarm signal with emergency manual voice override to notify occupants to evacuate. The digitized voice message shall identify the area of the building (smoke zone) from which the alarm was initiated.
  - 2. Building(s) 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 located in the security office, fire department.

- 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 as an extension of an existing addressable fire alarm system shall be designed and installed 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. 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 13 00, PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for integration with physical access control system.
- K. Section 14 24 00 Hydraulic Elevators

#### **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 Latest Release software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (COR). Bid drawing files on AutoCAD shall 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 COR 3 sets of as-built drawings and one set of the as-built drawing computer files(using AutoCAD Latest Release. 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 and 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 shall 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 COR.
- 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**

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer.

#### **1.6 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.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS, GENERAL**

- A. All addressable 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 manufacturer's requirements and that satisfactory total system operation has been achieved.
- B. The new parking garage fire alarm system shall match the existing fully addressable Edwards EST-3 fire alarm system as originally installed by Beta Systems of Virginia, 3740 Cook Blvd. P.O. Box 6277, Chesapeake, VA 23323, all connections to the existing system, as well as, integration and programming of the new devices at the existing Central Control Station located in the VA Police Control Center shall be contracted with and performed by Beta Systems of Virginia, contact person is Earp Hall 757-487-6856.

## **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 conduit shall be installed in accordance with NFPA 70.
  2. Conduit fill shall not exceed 40 percent of interior cross sectional area.
  3. All new conduit shall be 3/4 inch (19 mm) minimum.
  4. All conduits shall be painted RED.
  5. All fire alarm conduits shall be stencils every 20-30 feet.
- 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 addressable fire alarm system to extend an existing non-addressable 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 accepted 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 COR.

### **2.3 FIRE ALARM CONTROL UNIT**

#### **A. General:**

1. A fully addressable fire alarm system used as an extension of an existing non-addressable fire alarm system shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system. The addressable fire alarm control unit shall be interfaced with the existing non-addressable fire alarm control unit such that an alarm signal on one unit shall cause an alarm signal on the other unit. The addressable fire alarm control unit shall be located in the same room or space as the non-addressable fire alarm control unit.
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.

#### **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.

#### **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 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 new smoke detectors shall be taken from the addressable 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 shall 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.
- L. The new fire alarm panel shall have fiber modular and shall connect to the existing hospital panel with fiber optic cable. Provide fiber optic modular at the existing building fire alarm, coordinate all work with the COR.

#### **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 ( MODIFY AS REQUIRED FOR THE NEW GARAGE )**

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 and zone on the first line and device description and status (pull station, smoke detector, waterflow alarm or trouble condition) on the second line.
3. Where the alarm originates on the non-addressable system, the addressable system shall indicate on the LCD display "SEE \_\_\_\_\_ FIRE ALARM CONTROL PANEL" where the blank is filled in with the make and model of the existing addressable fire alarm control panel.
4. The initial alarm received shall be indicated as such.
5. A selector switch shall be provided for viewing subsequent alarm messages.
6. The display shall be UL listed for fire alarm application.
7. 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 COR.

## **2.6 VOICE COMMUNICATION SYSTEM (VCS)**

### **A. General:**

1. An emergency voice communication system shall be installed throughout Parking Garage.
2. Upon receipt of an alarm signal from the building fire alarm system, the VCS shall automatically transmit a pre-recorded fire alarm message throughout the Parking Garage throughout the floor in alarm, the floor above, and the floor below .
3. A digitized voice module shall be used to store each prerecorded message.
4. The VCS shall be arranged as a dual channel system capable of transmitting 2 different messages simultaneously single channel system.
5. The VCS shall supervise all speaker circuits, control equipment, remote audio control equipment, and amplifiers.

### **B. Speaker Circuit Control Unit:**

1. The speaker circuit control unit shall include switches to manually activate or deactivate speaker circuits grouped by floor in the system.
2. Speaker circuit control switches shall provide on, off, and automatic positions and indications.
3. The speaker circuit control unit shall include visual indication of active or trouble status for each group of speaker circuits in the system.
4. A trouble indication shall be provided if a speaker circuit group is disabled.
5. A lamp test switch shall be provided to test all indicator lamps.
6. A single "all call" switch shall be provided to activate all speaker circuit groups simultaneously.
7. A push-to-talk microphone shall be provided for manual voice messages.
8. Remote microphones shall be provided in the Main Building location of 24 hour manned location such as security office and/or telephone operators area/boiler plant/ fire department for manual "all call" messages to each individual building and throughout all buildings identify all buildings to receive voice messages at one time .

9. A voice message disconnect switch shall be provided to disconnect automatic digitized voice messages from the system. The system shall be arranged to allow manual voice messages and indicate a system trouble condition when activated.

C. Speaker Circuit Arrangement:

1. Speaker circuits shall be arranged such that there is one speaker circuit per smoke zone.
2. Audio amplifiers and control equipment shall be electrically supervised for normal and abnormal conditions.
3. Speaker circuits shall be either 25 VRMS or 70.7 VRMS with a minimum of 50 percent spare power available.
4. Speaker circuits and control equipment shall be arranged such that loss of any one speaker circuit shall not cause the loss of any other speaker circuit in the system.

D. Digitized Voice Module (DVM):

1. The Digitized Voice Module shall provide prerecorded digitized evacuation and instructional messages. The messages shall be professionally recorded and approved by the COR prior to programming.
2. The DVM shall be configured to automatically output to the desired circuits following a 10-second slow whoop alert tone.
3. Prerecorded magnetic taped messages and tape players are not permitted.
4. The digitized message capacity shall be no less than 15 second in length.
5. The digitized message shall be transmitted 3 times.
6. The DVM shall be supervised for operational status.
7. Failure of the DVM shall result in the transmission of a constant alarm tone.
8. The DVM memory shall have a minimum 50 percent spare capacity after those messages identified in this section are recorded. Multiple DVM's shall be used to obtain the required capacity.

E. Audio Amplifiers:

1. Audio Amplifiers shall provide a minimum of 50 Watts at either 25 or 70.7 VRMS output voltage levels.
2. Amplifiers shall be continuously supervised for operational status.

3. Amplifiers shall be configured for either single or dual channel application.
4. Each audio output circuit connection shall be configurable for Style X.
5. A minimum of 50 percent spare output capacity shall be available for each amplifier.

F. Tone Generator(s):

1. Tone Generator(s) shall be capable of providing a distinctive 3-pulse temporal pattern fire alarm signal as well as a slow whoop.
2. Tone Generator(s) shall be continuously supervised for operational status.

**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.
4. Each speaker circuit shall have a minimum of 20 percent spare capacity.

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 shall be combined with the audible notification appliances specified herein.

## **2.7 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 dual 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.
6. Stations identified as key operated only shall have a single standardized lock and key separate from the control equipment.

### **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. Heat Detectors:

1. Heat detectors shall be of the addressable restorable rate compensated fixed-temperature spot type.
2. Detectors shall have a minimum smooth ceiling rating of 2,500 square feet (230 square meters).
3. Ordinary temperature (135 degrees F (57 degrees C)) heat detectors shall be utilized in elevator shafts and elevator mechanical rooms. Intermediate temperature rated (200 degrees F (93 degrees C)) heat detectors shall be utilized in all other areas.
4. Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector - Elevator P-\_\_\_\_\_ ) for each elevator group. Locate key test station in plain view on elevator machine room wall.

## **2.8 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.

## **2.9 ADDRESS REPORTING INTERFACE DEVICE**

- A. Shall have unique addresses that reports directly to the addressable 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.

## **2.10 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 COR.

## **2.11 SPARE AND REPLACEMENT PARTS**

- A. Provide spare and replacement parts as follows:
  1. Manual pull stations - 3
  2. Key operated manual pull stations - 3
  3. Heat detectors - 2 of each type
  4. Fire alarm strobes - 3
  5. Fire alarm bells - 1
  6. Smoke detectors - 2
  7. Control equipment utility locksets - 5
  8. Control equipment keys - 25
  9. Key operated manual pull station keys - 20
  10. 2.5 oz containers aerosol smoke - 6
  11. Monitor modules - 3



- 12. Control modules - 3
- 13. Fire alarm SLC cable (same as installed) - 500 feet (152 m)
- B. Keys for key-operated manual pull stations shall be provided 30 days prior to actual installation.
- C. Spare and replacement parts shall be in original packaging and submitted to the COR.
- D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock shall be provided by the VA. Location of cabinet shall be determined by the COR.
- E. 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.

**2.13 INSTRUCTION CHART:**

- A. Provide a 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 shall 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 COR 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 shall 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.
- E. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and shall be surface mounted when located in unfinished areas. Exact locations shall be approved by the COR.
- F. 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 shall be surface mounted in unfinished areas.
- G. 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.
- H. 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.
- I. 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.
- J. 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.
- K. Connect flow and tamper switches installed under Section 21 13 13, WET-PIPE SPRINKLER SYSTEMS.
- L. 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 Buildings indicate buildings . 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 Buildings Parking Garage.
  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. Heat detectors in elevator machine rooms shall, in addition to the above functions, disconnect all power to all elevators served by that machine room after a time delay. The time delay shall be programmed within the fire alarm system programming and be equal to the time it takes for the car to travel from the highest to the lowest level, plus 10 seconds.
- C. Smoke detectors in the primary elevator lobbies of Buildings Parking Garage where there is Phase I elevator recall shall, in addition to the above functions, return all elevators in the bank to the secondary floor.
- E. 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. Operation of a smoke detector at a shutter used for automatic closing shall also release only the shutters on that floor in that smoke zone.
- F. 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.
- G. 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.
- H. 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 COR.
- 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 COR. 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 COR, the contractor shall 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 shall be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance shall 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 shall 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 shall be able to quickly and easily determine what output shall 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:**

A. provide smoke zone as directed by the CORT.

### **4.2 DIGITIZED VOICE MESSAGES:**

A. Digitized voice messages shall be provided for each smoke zone of Buildings Parking Garage. The messages shall be arranged with a 3 second alert tone, a "Code Red" message and a description of the fire

alarm area (building number, floor, level and smoke zone). A sample of such a message is as follows:

Alert Tone

Code Red

Building One, Second Floor, East Wing

Code Red

Building One, Second Floor, East Wing

Code Red

Building One, Second Floor, East Wing

#### **4.3 LOCATION OF VOICE MESSAGES:**

- A. Upon receipt of an alarm signal from the building fire alarm system, the voice communication system shall automatically transmit a 3 second tone alert and a pre-recorded fire alarm message throughout the floor in alarm, the floor above and the floor below the building .

- - END - -

**SECTION 31 20 00**  
**EARTHWORK**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK:**

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:

1. Site preparation.
2. Excavation.
3. Filling and backfilling.
4. Grading.
5. Soil Disposal.
6. Clean Up.

**1.2 DEFINITIONS:**

A. Unsuitable Materials:

1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D1557.
2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to Resident Engineer's approval.

B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.

C. Trench Earthwork: Trenchwork required for utility lines.

- D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
- E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D6938.
- F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.
- G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
- H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
- I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Government's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
- J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
- K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
- O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.



- P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.
- R. Contaminated soils: Soil that contains contaminants as defined and determined by the Resident Engineer or the Government's testing agency.

**1.3 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.
- F. Site preparation: Section 02 41 00, DEMOLITION.
- G. Foundation system requirements: AUGER CAST GROUT PILES, Section 31 63 26,
- H. Paving sub-grade requirements: Section 32 12 16, ASPHALT PAVING.

**1.4 CLASSIFICATION OF EXCAVATION:**

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

**1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:**

- A. Measurement: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. Quantities should be computed by a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. The measurement will include authorized excavation of

satisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to taking of elevations and measurements of the undisturbed grade.

**1.6 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Rock Excavation Report:
  - 1. Certification of rock quantities excavated.
  - 2. Excavation method.
  - 3. Labor.
  - 4. Equipment.
  - 5. Land Surveyor's or Civil Engineer's name and official registration stamp.
  - 6. Plot plan showing elevation.
- C. Furnish to Resident Engineer:
  - 1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
  - 2. Soil samples.
    - a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
    - b. Laboratory compaction curve in accordance with ASTM D1557 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
    - c. Test reports for compliance with ASTM D2940 requirements for subbase material.
    - d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.

- e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.
3. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material.
- Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

**1.7 APPLICABLE PUBLICATIONS:**

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
- T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop
- C. American Society for Testing and Materials (ASTM):
- C33-03.....Concrete Aggregate
- D448-08.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction
- D698-07e1.....Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft<sup>3</sup> (600 kN m/m<sup>3</sup>))
- D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
- D1556-07.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
- D1557-09.....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>))
- D2167-08.....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- D2487-11.....Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2940-09.....Standard Specifications for Graded Aggregate  
Material for Bases or Subbases for Highways or  
Airports

D6938-10.....Standard Test Method for In-Place Density and  
Water Content of Soil and Soil-Aggregate by  
Nuclear Methods (Shallow Depth)

D. Society of Automotive Engineers (SAE):

J732-07.....Specification Definitions - Loaders

J1179-08.....Hydraulic Excavator and Backhoe Digging Forces

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS:**

- A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.
- B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m<sup>3</sup> (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.
- C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.
- D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.
- E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.
- F. Granular Fill:
  - 1. Under concrete slab, - granular fill shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine

- aggregate grading shall conform to ASTM C 33 with a maximum of 3 percent by weight passing ASTM D 1140, 75 micrometers (No. 200) sieve and no more than 2 percent by weight passing the 4.75 mm (No. 4) size sieve.
2. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D2940.
- G. Requirements for Offsite Soils: Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site.
- H. Buried Warning and Identification Tape: Warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:
- |         |                                    |
|---------|------------------------------------|
| Red:    | Electric                           |
| Yellow: | Gas, Oil, Dangerous Materials      |
| Orange: | Telephone and Other Communications |
| Blue:   | Water Systems                      |
| Green:  | Sewer Systems                      |
| White:  | Steam Systems                      |
| Gray:   | Compressed Air                     |
- I. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.076 mm (0.003 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise, and 8.6 MPa (1250 psi) crosswise, with a maximum 350 percent elongation.

- J. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m (3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- K. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

### **PART 3 - EXECUTION**

#### **3.1 SITE PREPARATION:**

- A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Medical Center.
- B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by Resident Engineer. Remove materials from Medical Center Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, than farthest extension of their limbs.
- D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m<sup>3</sup> (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove

foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed. E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Medical Center.

F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing elevations indicated on plans are from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.
3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
4. Finish grading is specified in Section 32 90 00, PLANTING.

G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals

shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

**3.2 EXCAVATION:**

- A. Shoring, Sheet piling and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.
1. Design of the temporary support of excavation system is the responsibility of the Contractor. The Contractor shall submit a Shoring and Sheet piling plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheet piling of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheet piling shall be removed as excavations are backfilled, in a manner to prevent caving.
  2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.
  3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
  4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support in compliance with specifications Section 31 23.33, FLOWABLE FILL, under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.
  5. The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheet piling and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor



- and Resident Engineer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Resident Engineer at any time throughout the contract duration.
- B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 0.9 m (3 feet) of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least (5 feet) below the working level. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in pervious zones below subgrade elevation in layered soils to prevent uplift.
- C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.
- D. Proofrolling:
1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.

2. Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a dump truck loaded with 6 cubic meters (4 cubic yards) of soil or 13.6 meter tons (15 ton), pneumatic-tired roller.// Operate the roller or truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour (2 1/2 to 3 1/2 mph). When proof rolling, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Resident Engineer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Resident Engineer. Rutting or pumping of material shall be undercut as directed by the Resident Engineer. Maintain subgrade until succeeding operation has been accomplished.

F. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft materials to a solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
5. Do not tamp earth for backfilling in footing bottoms, except as specified.
6. Slope grades to direct water away from excavations and to prevent ponding.
7. Capillary water barrier (granular fill) under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.
8. Ensure that footing subgrades have been inspected and approved by the Resident Engineer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Resident Engineer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

G. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
  - a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.

- b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
- c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.
- d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.
- e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
- f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
  - 1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

- 2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2. Sanitary and storm sewer trenches:

- a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including 300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
  - 1) Bed bottom quadrant of pipe on suitable undisturbed soil or granular fill. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
  - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
- c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bedding where rock or rocky materials are excavated.
- e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
- f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend

up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

- 1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- 2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

- H. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus (1/2 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the contractor shall obtain samples of the material, under the direction of the Resident Engineer, and the materials shall be examined by an independent testing laboratory for soil classification to

determine whether it is unsuitable or not. Testing of the soil shall be performed by the VA Testing Laboratory. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:

- a. Provide a smooth transition between adjacent existing grades and new grades.
- b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
  - 1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
  - 2) Walks: Plus or minus 13 mm (1/2 inch).
  - 3) Pavements: Plus or minus 13 mm (1/2 inch).
- d. Grading Inside Building Lines: Finish subgrade to a tolerance of 13 mm (1/2 inch) when tested with a 3000 mm (10 foot) straightedge.

**3.3 FILLING AND BACKFILLING:**

- A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.
- B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill

- a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade and each layer of backfill or fill material in accordance with ASTM D6938 to 95 percent.
- b. Curbs, curbs and gutters, ASTM D6938 to 95 percent//.
- c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D6938 to 95 percent.
- d. Landscaped areas, top 400 mm (16 inches), ASTM D6938 to 85 percent.
- e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D6938 to 90 percent.

2. Natural Ground (Cut or Existing)

- a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D6938 to 95 percent.
- b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D6938 to 95 percent.
- c. Under sidewalks, top 150 mm (6 inches), ASTM D6938 to 95 percent.

D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas within the limits of the project site, selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear

the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

- E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the Resident Engineer sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

#### **3.4 GRADING:**

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.
- C. Slope backfill outside building away from building walls for a minimum distance of 1800 mm (6 feet).
- D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.
- E. Finished grade shall be at least 150 mm (6 inches) below bottom line of window or other building wall openings unless greater depth is shown.
- F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.
- G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been



accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.

- H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

**3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- B. Disposal: Transport surplus satisfactory soil to designated storage areas on Medical Center property. Stockpile or spread soil as directed by Resident Engineer.
  - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Medical Center property.
- C. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- D. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- E. Segregate all excavated contaminated soil designated by the Resident Engineer from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

**3.6 CLEAN UP:**

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Medical Center.

----- E N D -----

**SECTION 31 23 19**  
**DEWATERING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION:**

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

**1.2 SUMMARY:**

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
  - 1. Implementation of the Erosion and Sedimentation Control Plan.
  - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

**1.3 REQUIREMENT:**

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 300 mm (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
  - 1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase

and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.

2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

**1.4 RELATED WORK:**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING.

**1.5 SUBMITTALS:**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
  1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
  2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
  3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
  4. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 INSTALLATION:**

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 300 mm (1 foot) below prevailing excavation surface at all times.

**3.2 OPERATION:**

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

**3.3 WATER DISPOSAL:**

- A. Dispose of water removed from the excavations in such a manner as:
  - 1. Will not endanger portions of work under construction or completed.
  - 2. Will cause no inconvenience to Government or to others working near site.
  - 3. Will comply with the stipulations of required permits for disposal of water.
  - 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:

1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
  2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
  3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
  4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

**3.4 STANDBY EQUIPMENT:**

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

**3.5 CORRECTIVE ACTION:**

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

**3.6 DAMAGES:**

Immediately repair damages to adjacent facilities caused by dewatering operations.

**3.7 REMOVAL:**

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

----- E N D -----

**SECTION 31 63 16  
AUGER CAST GROUT PILES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies excavation and concrete required for construction of auger-placed concrete piles.

**1.2 DEFINITION**

Auger-placed concrete pile (ACP): Pile formed by rotation of a continuous flight hollow-shaft pile augured into the ground to the indicated depth. Grout is injected through auger shaft as auger is being withdrawn in such a way as to exert removing pressure on withdrawing earth-filled auger as well as lateral pressure on soil surrounding hole.

**1.3 RELATED WORK**

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Subsurface investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

**1.4 CONTRACT BASIS**

- A. Contract price for ACP's shall be based upon total length of piles shown on the Contract Documents and number of pile load tests indicated in the Contract Documents. Length of piles shall be measured as shown.
  - 1. Adjustment of contract price shall be based upon total length of piles placed, and not on length of individual piles placed. When total length of completed piles is greater or less than length shown, contract price adjustment shall be made in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.
  - 2. Contract price and time shall be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable when artificial materials that are not shown are encountered.

### **1.5 CONTRACTOR QUALIFICATIONS**

- A. Approval by Contracting Officer is required of service of proposed Contractor and shall be based upon submission by Contractor of certification that:
1. Contractor has technical qualifications, experience, trained personnel and facilities to install auger placed concrete piles as specified. Approval shall not be given, however, where an experience record is one of unsatisfactory performance.
  2. Contractor has installed ACP's on three installations similar and equivalent to this project for 5 years. Submit list of installations.

### **1.6 TOLERANCES**

Locate piles where indicated. The maximum permissible variation of the center of each pile from the required locations is 50 mm (2 inches) at the ground surface. No pile shall be out of required axial alignment by more than 2 percent. Periodically check the required axial alignment of each pile during the drilling operation and after reaching the required tip elevation with not less than 1.5 m (5 feet) of the auger flight extending above the ground surface.

### **1.7 DESIGN MODIFICATIONS**

- A. Where piles are installed exceeding specified tolerances for plumb or location, the foundation design shall be analyzed by the A/E and if necessary redesigned by A/E. Costs for analysis, redesign, and remediation shall be responsibility of Contractor.
- B. Additional piles and pile cap modifications necessitated by redesign shall be furnished and installed, at no additional cost to the Government.

### **1.8 SUBMITTALS**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certification to Examination of Site and Records: Before proceeding with the Work, submit copy of certification in acceptable form signed by the Contractor, stating that careful examination has been made of the site, existing structures, and records of utility lines, test boring records, soil samples, and subsurface exploration reports by the Owner's Geotechnical Engineer, Drawings, and Specifications.

C. Shop Drawings and Miscellaneous Submittals:

1. Description of pile drilling equipment.
2. Description of grout pump and pressure gage calibration reports.
3. Pile Installation Recorder (PIR) calibration reports.
4. Complete description of method for ACP pile installation with a pile layout plan referenced to the structural plans, including a numbering system capable of identifying each individual pile, pile sizes, including pile length and tip elevations, reinforcing steel, and waterproofing details. In addition, furnish a detailed description of construction procedures, including steel shells, if used, and auguring methods.
5. Steel Reinforcement Shop Drawings: Comply with ACI 315. Furnish shop drawings prepared by a Professional Engineer licensed in the state of installation that include placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
  - a. Prior to fabrication: Indicate steel grades, sizes, bending details, protective coatings, spacing, placement and supports.
  - b. Supplementary Product Literature: Furnish manufacturer's literature describing general properties of each product to be used in the Work.
  - c. Certifications: Furnish manufacturer's certified reports of mill tests for reinforcing steel and anchorage devices, including physical and chemical analysis.
6. Pile Installation records for all ACP's.

D. Reports:

1. Installation of each pile
2. Pile location and plumbness
3. Total quantity of grout placed
4. Load Test

E. Product Data: Submit copies of manufacturers' specifications for the following products, including copies of laboratory test reports and other data as shall be required to show compliance with these specifications.



1. Fly Ash or Ground Granulated Blast Furnace Slag: ASTM C618, Class C or F and ASTM C989, Grade 100 or 120, respectively.
  2. Plasticizing admixture: ASTM C1017/C1017M, Type II.
  3. Grout Fluidifier: ASTM C937
  4. Aggregate sieve analysis: ASTM C33.
  5. Aggregate sodium sulfate soundness tests: ASTM C88.
  6. Portland cement: ASTM C150, Type I, Test Piles Type III.
  7. Reinforcing Steel: ASTM A615/A615M, Grade
  8. Steel Casing: ASTM A572, Grade 50
- F. Certificates: Contractor's qualifications as specified: Experienced specialty piling subcontractor having a minimum of 5 years successful experience installing Work of same type required for this project, and evidence of satisfactory completion of at least ten ACP installations comparable in scope of the Work and subsurface conditions. Employ only skilled tradesmen who are thoroughly experienced with the materials and equipment to be used in the Work.
- G. Contractor's Concrete Testing: Submit 3 copies of the laboratory testing reports to the A/E, the owner's Geotechnical Consultant, and other pertinent parties.
1. Submit report and certification of aggregate.
  2. Laboratory Test Reports: Submit for evaluation grout materials and mix designs.
- H. Pile Load Testing:
1. A schedule and sequencing plan for pile testing and installation.
  2. Pile Installation Recorder (PIR) details.
  3. Pile Installation Recorder (PIR) reports.
  4. Pile Load Test Work Plan:
    - a. At least two weeks before commencing pile load testing work, the Contractor shall submit a pile load test work plan describing the equipment, apparatus, procedures, and schedule for testing ACP's in accordance with ASTM D1143, ASTM D3689, ASTM D3966 and as specified herein, to verify the design pile capacity. The work plan shall also include the proposed instrumentation of the test pile indicating depth, location, and details of the pile.
    - b. As part of the Pile Load Test Work Plan, submit shop drawings and other information describing the loading and test monitoring arrangement for pile load tests, including the following:

- 1) Structural design of the test load support/reaction frame.
  - 2) Details of equipment and apparatus to be used for the monitoring load and pile movements.
  - 3) Data on testing and measuring equipment including required jack, load cell and/or gauge calibrations.
  - 4) Sample field data recording sheets or examples of automated data acquisition records proposed for recording load test data.
- I. Independent Testing and Inspection Agency: The Contractor shall retain an Independent Testing and Inspection Agency (Agency) to document, monitor, and observe load test, probe pile, test pile, and production pile work. This Agency shall submit field reports and test results required by Section 3.2 for pile load tests, pile installations, and grout testing and inspection. They shall submit a pile installation report for each pile no later than three days after the installation is complete.
- J. Welding Certificates.
- K. Qualification Data: For Installer, Land Surveyor, and Testing and Inspection Agency.
- L. Upon completion of ACP installations, the Contractor shall submit five copies of drawings indicating actual in-place pile locations. The Contractor shall pay for all surveying costs. Drawings shall be submitted prior to beginning any pile cap or mat installation. One electronic copy of the drawings shall be submitted in AutoCAD DWG format on CD-ROM.
- M. Record drawings at Project closeout according to Division 01 Section "Closeout Procedures."

#### **1.9 QUALITY CONTROL**

- A. Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.
- B. A Quality Control Program shall be submitted by the Contractor at least two weeks prior to the commencement of work. The implementation of a Contractor Quality Control Program does not relieve the Contractor from the responsibility to provide work in accordance with the Contract Documents, applicable codes, regulations, and Governing Authorities.
- C. Contractor's Independent Testing and Inspection Agency (Agency): The Contractor shall retain at his own expense, the services of a qualified

Independent Testing and Inspection Agency, licensed in the state of the project, to provide testing and inspection services during the installation of all foundation piling involved in this Work. This firm shall also provide consultation services to the Contractor if problems are encountered during the execution of the Work. The Agency shall be primarily concerned with the testing and construction methods which shall result in finished foundation piling of the required quality and strength. The Agency shall also be concerned with preventing settlement and/or damage to surrounding structures, roads, utilities, embankments, both within the property lines and on adjoining properties during the construction.

- D. The Agency shall be experienced in the testing and installation of ACP foundations. It shall have been involved in at least 8 different ACP projects in the last 5 years, and shall have experience in recommending, testing, and specifying ACP's for similar subsurface conditions.
- E. Survey Work: The Contractor shall engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for ACP's. The surveyor shall record actual measurements of each ACP's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
- F. Contractor's Grout Mix Designer: The Contractor shall employ, at his own expense, a testing laboratory to design grout mixes, conduct tests and submit reports for the design mixes. The Grout Mix Designer shall be qualified according to ASTM C1077 and ASTM E329 to perform material evaluation tests and to design concrete mixes.
- G. Welding Standards: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1
  - 2. AWS D1.4
- H. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

#### **1.10 QUALITY ASSURANCE**

- A. The Owner shall retain the services of a Geotechnical Consultant (Consultant) to provide general observation of all pile operations and

to provide technical advice to the Owner with regard to pile operations and performance.

- B. The Consultant shall have been involved in at least 8 different ACP projects in the last 5 years, and shall have experience in recommending, testing, and specifying ACP's for similar subsurface conditions.

#### **1.11 APPLICABLE PUBLICATIONS**

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

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

A572/A572M-07.....Standard Specification for High Strength Low Alloy Columbium-Vanadium Structural Steel

A615/A615M-09-b.....Standard Specification for Deformed and Plain Carbon-Steel Bar for Concrete Reinforcement

A722/A722M-07.....Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C88-05.....Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

C109/C109M-11b.....Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in. or [50 mm] Cube Specimens)

C150-11.....Standard Specification for Portland Cement

C404-11.....Standard Specification for Aggregates for Masonry Grout

C618-12.....Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C937-10.....Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete

C942-10.....Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

- C989/C989M-11.....Standard Specification for Ground Granulated  
Blast-Furnace Slag for Use in Concrete and  
Mortars
- C1017/C1017M-07.....Standard Specification for Chemical Admixtures  
for Use in Producing Flowing Concrete
- C1077-11c.....Standard Practice for Agencies Testing Concrete  
and Concrete Aggregates for Use in Construction  
and Criteria for Testing Agency Evaluation
- D1143/D1143M-07.....Standard Test Methods for Deep Foundations  
Under Static Axial Compressive Load
- D3689-07.....Standard Test Method for Deep Foundations Under  
Static Axial Tensile Load
- D3966-07.....Standard Test Methods for Deep Foundations  
Under Lateral Loads
- E329-11.....Standard Specification for Agencies Engaged in  
Construction Inspections, Testing, or Special  
Inspections
- C. American Concrete Institute (ACI):
- 315-99.....Details and Detailing of Concrete Reinforcement
- D. American Welding Society (AWS):
- D1.1 (2010).....Structural Welding Code - Steel
- D1.4 (2011).....Structural Welding Code - Reinforcing Steel

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Portland Cement: ASTM C150, Type I, Test piles Type III.
- B. Grout Fluidifier: ASTM C937.
- C. Plasticizing admixture: ASTM C1017/C1017M, Type II
- D. Ash or Ground Granulated Blast Furnace Slag: ASTM C618, Class C or F  
and ASTM C989, Grade 100 or 120, respectively.
- E. Water: Fresh, clean, and potable.
- F. Aggregate: ASTM C404, Size No. 1 or Size No. 2.
- G. Reinforcing Steel: ASTM A615, Grade 60.
- H. Fine Aggregate: ASTM C33.
- I. High Strength Reinforcing Steel: ASTM A722, Type II, Thread Bar Type.
- J. Casings: ASTM A572, Grade 50 or 60.
- K. Except for probe pile, pile load test and test pile purposes, no pile  
materials shall be ordered or delivered to the job site until the

required load tests have been made and are acceptable to the A/E.  
Materials ordered or delivered to the project site prior to  
verification of the assumed pile length, shall be at the Contractor's  
risk.

L. After pile lengths are verified by the pile load test program, deliver  
materials to the project site in such quantities and at such times to  
assure the continuity of pile augering operations to the project  
schedule.

M. Clearly mark pile leads in 300 mm (1 foot) increments.

## **2.2 MIXES**

- A. Concrete: The grout used shall consist of a mixture of portland cement, sand, fluidifier, and water so proportioned and mixed to be pumped and to fill all voids in the foundation material. Mixture shall be proportioned to provide a minimum compressive strength of 27.6Mpa (4000psi) at 28 days.
- B. Mix Design: Testing Laboratory, retained by Contractor, shall design a mix to produce concrete as specified and perform tests as required. Certified test reports (duplicate) shall be submitted. Reports shall include proportions of design mix.
- C. Concrete-mix design adjustments shall be considered if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval from the A/E of proposed changes to concrete-mix design.
- D. Improper Mix: Immediately notify the Concrete Testing Laboratory and the A/E if at any time during construction the accepted mix design proves to be unsatisfactory for any reason. The Contractor's Concrete Mix Designer shall modify the design, subject to the review of the A/E, until a satisfactory mix is obtained.

## **2.3 EQUIPMENT**

A. Augering Equipment:

- 1. Equipment shall consist of a continuous-flight, hollow-shaft auger which shall be rotated into the ground to the required pile depth as established by the pile load tests. Advance the auger at a continuous rate that prevents removal of excess soil. Stop advancement after reaching the required depth. The hole in the bottom of the auger shall be closed with a suitable plug while being advanced into the ground. The plug shall be removed by grout or

with a reinforcing bar. At the start of pumping grout, raise the auger from 150 to 300 mm (6 to 12 inches) and after the grout pressure builds sufficiently, redrill the auger to the previously established tip elevation. Cement grout shall then be injected through the auger shaft as the auger is being withdrawn, in such a way as to exert removing pressure on the withdrawing earth filled auger flights as well as lateral pressure on the soil surrounding the grout-filled pile hole. Grout pumping pressures shall be measured and shall be maintained high enough at all times to offset hydrostatic and lateral earth pressures. The auger shall rotate in a positive direction and shall be withdrawn in a steady continuous motion.

2. The auger flighting shall be continuous from the auger head to the top of auger without gaps or other breaks. The auger flighting shall be uniform in diameter throughout its length and shall be the diameter specified for the piles less a maximum of 3 percent.
3. The hole through which the high-strength grout is pumped during the placement of the pile shall be located at the bottom of the auger head below the bar containing the cutting teeth.
4. Augers over 12000 mm (40 feet) in length shall contain a middle guide.
5. The piling leads shall be prevented from rotating by a stabilizing arm or by firmly placing the bottom of the leads into the ground or by some other acceptable means. Leads shall be marked at 300 mm (1 foot) intervals to facilitate measurement of auger penetration.

**B. Mixing and Pumping Equipment:**

1. Only approved pumping and mixing equipment shall be used in the preparation and handling of the grout. A screen to remove over-size particles shall be placed at the pump inlet. All oil or other rust inhibitor shall be removed from mixing drums and grout pumps. All materials shall be such as to produce a homogeneous grout of the desired consistency.
  - a. The grout pump shall be a positive displacement piston type pump capable of developing displacing pressures at the pump not less than 2.5 Mpa (350 psi). The grout pump shall be provided with a pressure gauge in clear view of the equipment operator. The grout pump shall be calibrated at the beginning of the work to

determine the volume of grout pumped per stroke. A positive method of counting grout pump strokes shall be provided by the Pile Contractor. Such methods shall include digital or mechanical stroke counters or other acceptable methods.

C. Pile Installation Recorder (PIR):

1. The Contractor shall provide a PIR for ACP's for use by the Agency and the Consultant during pile installation. The PIR shall be used for each piling rig. The PIR shall record appropriate information during both the augering phase and during the grouting phase of the installation to assure minimum grout volume pumped per unit depth increment, and shall print results immediately upon completion of each pile.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Survey: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and levels and stake pile locations.
- B. Before installing piles adjacent to any existing utilities, the Contractor shall notify the utility owner to ensure that protective Work shall be coordinated and performed in accordance with the requirements of the utility owner. If any existing service lines, utilities and utility structures to remain in service are uncovered or encountered during these operations, protect, from damage and provide support if necessary.
- C. Shall uncharted or incorrectly charted piping or other utilities be encountered during piling operations, immediately notify the A/E and the utility owner. Cooperate with the utility owner in keeping their respective services, utilities and facilities in operation.
- D. After all ACP's are in place, the Surveyor shall make a field survey of completed piles and shall submit a drawing to the A/E showing the plumbness of the piles and the actual pile locations with respect to planned pile locations.
- E. Pile Record: Submit complete and accurate record of all auger-placed piles to the A/E. Record shall indicate the pile location, diameter, length, elevation of bottom and top of pile, and the quantity of grout used in each pile. Any unusual conditions encountered during pile installation shall also be noted.



F. Completion Certificate: The Contractor shall provide a written statement, stamped by a Professional Engineer registered in the State of the Work, verifying that the piles were installed per the Contract Documents, and that any piles not installed per the Contract Documents were installed in such a manner that they shall not have a negative impact on the proposed structure.

### **3.2 ALLOWABLE LOAD ON PILES**

#### **A. Probe Piles:**

1. A minimum of ten probe piles shall be installed prior to the installation of the production piles in manner utilizing identical equipment, methods, and materials for all piling.
2. Probe piles shall be used by the Contractor to refine the operations of the equipment and shall not be installed at production pile locations.
3. The location of the probe piles shall be submitted to the A/E prior to their installation. If, in the opinion of A/E, the probe pile locations shown are not representative of the area, alternate locations shall be provided by A/E.
4. Reaction piles for the load test pile shall be used as probe piles.

#### **B. Load test piles:**

1. Load tests shall be performed on a minimum of 2 probe piles. The data from the load test shall be used to verify pile design load.
2. Contractor shall conduct load tests in accordance with ASTM D1143, ASTM D3689, ASTM D3966 standard loading procedure. These tests shall be conducted at no additional cost to the Government. No additional piles shall be installed until test reports of test piles are received and approved by A/E.
3. Additional load tests or an increase in production pile length shall be required if the test pile fails the load test.

### **3.3 INSTALLATION**

- A. The length and drilling criteria of production piles shall be determined by the A/E from the installation of the probe piles, reaction piles, test piles, and the pile load tests. The installation shall be performed in an orderly sequence.
- B. Advance the auger at a continuous rate that prevents removal of excess soil. Stop advancement after reaching the required depth or refusal criteria.

- C. Auger refusal is defined as a rate of auger penetration of less than 300 mm (1 foot) per minute of drilling.
- D. The hole in the bottom of the auger shall be closed while being advanced into the ground with a suitable plug. The plug shall be removed by grout pressure or with the reinforcing bar.
- E. Place continuous center reinforcing through the hollow-stemmed auger prior to placement of grout. Tie top of reinforcing in place after removal of auger. Use bar spacers to center reinforcing bars.
- F. At the start of pumping grout, raise the auger from 150 to 300 mm (6 to 12 inches) and after the grout pressure builds up sufficiently, redrill the auger to the previously established tip elevation.
- G. Maintain at least 3000 mm (10 feet) of grout on the auger flighting above the injection point during raising of the auger. Positive rotation of the auger shall be maintained throughout placement of the grout. Rate of grout injection and rate of auger withdrawal from the soil shall be coordinated as to maintain at all times the minimum grout head and a positive pressure on the gauges. The total volume of grout shall be at least 115 percent of the theoretical volume for each pile, except, after grout is flowing at the ground surface from the auger flighting, the rate of grout injection and auger withdrawal shall be coordinated so that there is a constant grout flow at the surface. If pumping of grout is interrupted for any reason, the Contractor shall reinsert the auger at least 1500 mm (5 feet) into the pile and regROUT.
- H. Minimum volume of grout placed in hole shall be at least the nominal volume plus 15 percent of hole. Volume of grout per linear meter (linear foot) of pile shall be not less than volume of grout per meter (volume of grout per foot) of the load test pile. Make volume measurements in the presence of A/E.
- I. Auger hoisting equipment shall be provided that shall enable the auger to be rotated while being withdrawn smoothly and steadily.
- J. The spoil that accumulates around the auger during injection of the grout shall be promptly cleared away upon completion of the installation.
- K. Provide OSHA protective caps on all projecting reinforcement.
- L. Materials shall be accurately measured by volume or by weight as they are fed to the mixer. Order of placing the materials in mixer shall be as follows: (1) water, (2) fluidifier, and (3) other solids in order of

increasing particle size. Provide grout injection equipment with a pressure gage in clear view of the equipment operator. A second pressure gauge shall be located near auger rig where it can be observed. Rate of injection and rate of auger withdrawal from soil shall be so coordinated as to maintain at all times a positive pressure on gage which shall indicate existence of a removing pressure on bottom of auger flight. Magnitude of this pressure and performance of other augering and grouting procedures, such as rate of augering, rate of grout injection, and control of grout return around the auger flight, are dependent on soil conditions, and equipment capability shall be at option of Contractor, subject to approval of A/E. Equipment for pumping grout shall be positive displacement pump capable of developing a pressure at pump not less than 2.5 MPa (350 psi). Pump shall be calibrated by an approved method to verify accuracy of indicated discharge. Remove oil or other rust inhibitors from mixing drums and pumps. Auger hoisting equipment shall be capable of withdrawing auger smoothly and at a constant rate. If the auger jumps upward during withdrawal, it shall be reinserted, and rate of withdrawal decreased to prevent further jumping.

- M. Locate piles as shown unless otherwise directed by A/E. Do not place piles closer than 1050 mm (3.5 feet) center to center until grout in adjacent piles has set for 24 hours. In locations where there are no concrete slabs or other means of distributing load of the equipment placing piles, the equipment shall be kept at least 3000 mm (10 feet) away from pile location, or upper 3000 mm (10 feet) of pile shall be cased.
- N. Where pile top is near surface or above bottom of excavation, place metal sleeves of proper diameter around pile top.
- O. Cut off the tops of piles, square with pile axis and at the elevations indicated by removing fresh grout from the top of the pile or by cutting off hardened grout down to final cutoff point at any time after initial set has occurred. Where the pile cut-off is near the surface or above the bottom of the excavation, sleeves or casing of the proper diameter and at least 457 mm (18 inches) in length shall be placed around the pile tops. (Special conditions shall require metal sleeves of additional length).

- P. Redrill the pile to the original depth at no additional cost to the Owner if any of the following occurs:
1. The design pile reinforcement cannot be placed manually in the top of any pile following completion of grouting.
  2. The trap door at the bottom discharge outlet fails to open completely, effectively creating a side discharge condition.
  3. Loss of grout head occurs for any reason during pile installation.
  4. There is more than a twenty-minute delay during the grouting of any individual pile.
  5. There is a drop in grout level after completion of the pile, which exceeds the average for the remainder of the pile installations by more than 600 mm (2 feet).
- Q. The Contractor shall install additional piles at no additional cost for damaged, misaligned and/or mislocated piles. Contractor shall also be responsible for costs of concrete and reinforcing for required modifications to pile caps/grade beams due to damaged piles and/or misaligned or mislocated piles.
- R. If the grout level in any completed pile drops, the pile shall be rejected and replaced.
- S. No pile shall be loaded until the grout has attained full design strength.

**3.4 OBSTRUCTIONS:**

- A. The advancement of the augers through naturally occurring materials such as cobbles, boulders and rock ledges, as outlined in the Geotechnical Report, is the responsibility of the Contractor. The Contractor is responsible for providing the necessary means and methods of advancing the augers through this material. The length of short piles terminated due to such foreseeable material shall not be included in the total length of pile for payment at the unit price. Additional adjacent piles, as required by the A/E, shall also not be included in the total length of piles for payment.
- B. In the event that unforeseen non-augerable material is encountered, such as cobbles, boulders, rock ledge, metal timbers or debris which causes the rate of penetration to be reduced to less than 300 mm (1 foot) per minute above the desired tip elevation, or causes the pile to drift from its location, then the pile shall be completed to the depth of the non-augerable material in accordance with these specifications.

The length of such short piles shall be included in the total length of pile for payment at the unit price. If required by the A/E, additional adjacent piles shall be placed and the length of these additional piles shall also be included in the total length of piles for payment.

**3.5 QUALITY CONTROL AND ASSURANCE:**

- A. The Contractor shall retain the services of a qualified Independent Testing and Inspection Agency (Agency), licensed in the state of the project, to provide Quality Control through testing and inspection services during the installation of all foundation piling involved in this Work.
- B. The Owner shall employ a Geotechnical Consultant (Consultant) to provide Quality Assurance through general observation and consultation of all pile operations.
- C. The Contractor and their Agency shall cooperate with the Consultant and the A/E in the performance of the Work. The presence of Consultant shall in no way relieve the Contractor of his obligation to perform the pile installation in accordance with the Contract Documents and these Specifications.
- D. Grout Mix: The grout mix shall be tested by making a minimum of nine, 50 mm (2 inches) cubes for each day during which piles are placed. A set of nine cubes shall consist of three cubes to be tested at seven days, and three cubes to be tested at 28 days and three cubes held in reserve. Test cubes shall be cured and tested in accordance with ASTM C109/C109M. Cube specimens shall be restrained from expansion as described in ASTM C942.
- E. Pile Acceptance: The Agency shall immediately notify the Consultant and the A/E if any pile is not in conformance with these Specifications. The volume of grout placed in each pile shall be a minimum of 115% of theoretical volume of the pile. The amount of grout placed in each 1500 mm (5 feet) increments of the pile shall be checked continuously during installation. The cost of removing and replacing Auger Cast Piles, which are not in conformance, shall be borne by the Pile Contractor.
- F. Reports: The Agency shall maintain an installation record of each pile. The record shall note the project name and number, name of Contractors, pile location, design pile capacity, pile tip elevation, pile top elevation, depth of auger advancement, (total and continuous) quantity

of grout placed, reinforcing steel placement, and any unusual occurrences during the pile installation. The grout quantity shall be determined by recording grout pump displacement or by other acceptable means. The Consultant shall also maintain a daily report, which summarizes all work performed by the Contractor.

**3.6 CORRECTIONS OF DEFICIENCIES:**

- A. The contractor shall notify the A/E in writing, of the failure of a pile to meet any requirement of the Section. Such written notification shall include all information required for the evaluation of remedial measures, including all information required for redesign.
- B. Based on the survey provided, if a pile fails to comply with the location or tolerance requirements of 1.6, or the design load requirements noted on the Contract Documents, the A/E shall calculate the load capacity requirements of that pile or, if in a pile group, each pile in that pile group, based on the actual, "as-driven" locations and inclinations. If the calculation indicates that the loading on that pile or, if in a pile group, on any pile in that pile group, exceeds the design load, then the Contractor shall perform such remedial work as the A/E in his sole discretion shall require furnishing and installing additional piles at locations approved by the A/E and modifying concrete or reinforcement steel. These corrective measures shall be performed solely at the Contractor's expense.
- C. If a pile fails to comply with the requirements of this Section and the A/E of record determines that modification to concrete or reinforcement steel, or the driving of additional piles is necessary, the Engineer of record shall perform all required reanalysis, redesign and detailing. All reanalysis, redesign and redetailing costs shall be the responsibility of the contractor and reimbursed as a change to the contract.
- D. The Contractor, at his option and at any time that he determines that a pile shall not satisfy the requirements of this Section for a reason other than encountering an unforeseen underground obstruction, shall, subject to the provisions of this specification, abandon such pile and replace it with a new pile or piles rather than await direction or approval from the A/E. However, the Contractor, in exercising this option, assumes the risk that such replacement pile or piles shall be acceptable to the Engineer.

- E. Abandoned piles shall be cut off 300 mm (1 foot) below the elevation of the bottom of the pile cap or mat as shown on the Contract Drawings and shall not be paid for.

**3.7 CLEAN UP:**

- A. All debris from excavation of objectionable material, removal of obstructions, and any material not to remain as part of the construction shall be removed and disposed of by the subcontractor in a legal manner at no additional cost to the Owner.
- B. The site shall be cleaned at frequent intervals and no material shall be stored on the site in a manner, which would obstruct the easy access of equipment and personnel.

- - - E N D - - -

**SECTION 32 05 23  
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown on the Drawings. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter.
- C. Pedestrian Pavement: Walks, grade slabs, pedestrian crossings, wheelchair curb ramps.
- D. Vehicular Pavement: Service courts.
- E. Equipment Pads: Transformers and generator pads.

**1.2 RELATED WORK**

- A. Section 00 72 00, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Section 31 20 00, EARTHWORK.

**1.3 DESIGN REQUIREMENTS**

Design all elements with the latest published version of applicable codes.

**1.4 WEATHER LIMITATIONS**

- A. Hot Weather: Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.
- B. Cold Weather: Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

**1.5 SUBMITTALS**

Contractor shall submit the following.



- A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
  - 1. Expansion joint filler
  - 2. Hot poured sealing compound
  - 3. Reinforcement
  - 4. Curing materials
- B. Jointing Plan for all concrete areas.
- C. Concrete Mix Design.
- D. Concrete Test Reports
- E. Construction Staking Notes from Surveyor.
- F. Data and Test Reports: Select subbase material.
  - 1. Job-mix formula.
  - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

#### 1.6 APPLICABLE PUBLICATIONS

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. Refer to the latest edition of all referenced Standards and codes.

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
  - M148-05-UL.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
  - M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)
  - M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton Mats
- B. American Society for Testing and Materials (ASTM):
  - A82/A82M-07.....Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
  - A185/185M-07.....Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
  - A615/A615M-12.....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
  - A653/A653M-11.....Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process

A706/A706M-09b.....Standard Specification for Low Alloy Steel  
Deformed and Plain Bars for Concrete  
Reinforcement

A767/A767M-09.....Standard Specification for Zinc Coated  
(Galvanized) Steel Bars for Concrete  
Reinforcement

A775/A775M-07b.....Standard Specification for Epoxy Coated  
Reinforcing Steel Bars

A820/A820M-11.....Standard Specification for Steel Fibers for  
Fiber Reinforced Concrete

C31/C31M-10.....Standard Practice for Making and Curing Concrete  
Test Specimens in the field

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength of  
Cylindrical Concrete Specimens

C94/C94M-12.....Standard Specification for Ready Mixed Concrete

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic  
Cement Concrete

C150/C150M-12.....Standard Specification for Portland Cement

C171-07.....Standard Specification for Sheet Materials for  
Curing Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed  
Concrete

C173/C173M-10b.....Standard Test Method for Air Content of Freshly  
Mixed Concrete by the Volumetric Method

C192/C192M-07.....Standard Practice for Making and Curing Concrete  
Test Specimens in the Laboratory

C231/C231M-10.....Standard Test Method for Air Content of Freshly  
Mixed Concrete by the Pressure Method

C260/C260M-10a.....Standard Specification for Air Entraining  
Admixtures for Concrete

C309-11.....Standard Specification for Liquid Membrane  
Forming Compounds for Curing Concrete

C494/C494M-12.....Standard Specification for Chemical Admixtures  
for Concrete

C618-12.....Standard Specification for Coal Fly Ash and Raw  
or Calcined Natural Pozzolan for Use in Concrete

C666/C666M-03(2008).....Standard Test Method for Resistance of Concrete  
to Rapid Freezing and Thawing

D1751-04(2008).....Standard Specification for Preformed Expansion  
Joint Filler for Concrete Paving and Structural  
Construction (Non-extruding and Resilient  
Bituminous Types)

D4263-83(2012).....Standard Test Method for Indicating Moisture in  
Concrete by the Plastic Sheet Method.

D4397-10.....Standard Specification for Polyethylene Sheeting  
for Construction, Industrial and Agricultural  
Applications

C. American Welding Society (AWS):

D1.4/D1.4M (2005).....Structural Welding Code - Reinforcing Steel

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. Concrete Type: Concrete shall be as per Table 1 - Concrete Type, air  
entrained.

TABLE I - CONCRETE TYPE

	Concrete Strength		Non-Air- Entrained	Air-Entrained	
	Min. 28 Day Comp. Str. Psi (MPa)	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio	Min. Cement lbs/c. yd (kg/m <sup>3</sup> )	Max. Water Cement Ratio
Type A	5000 (35) <sup>1,3</sup>	630 (375)	0.45	650 (385)	0.40
Type B	4000 (30) <sup>1,3</sup>	550 (325)	0.55	570 (340)	0.50
Type C	3000 (25) <sup>1,3</sup>	470 (280)	0.65	490 (290)	0.55
Type D	3000 (25) <sup>1,2</sup>	500 (300)	*	520 (310)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi (8.3 MPa) in excess of the compressed strength. For concrete strengths above 5000 psi (35 Mpa), the proposed mix design shall achieve a compressive strength 1400 psi (9.7 MPa) in excess of the compressed strength.
2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

- B. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP - INCHES (MM)

TYPE	MAXIMUM SLUMP*
Curb & Gutter	3 inches (75 mm)
Pedestrian Pavement	3 inches (75 mm)
Vehicular Pavement	2 inches (50 mm) (Machine Finished) 4 inches (100 mm) (Hand Finished)
Equipment Pad	3 to 4 inches (75 to 100 mm)
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

## 2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.

## 2.3 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 1/8 inch (3 mm) in any ten foot (3000 mm) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 2 inches (50 mm) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

## 2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
1. Burlap having a weight of seven ounces (233 grams) or more per yard (square meter) when dry.
  2. Impervious Sheeting conforming to ASTM C171.
  3. Liquid Membrane Curing Compound conforming to ASTM C309, Type 2 and shall be free of paraffin or petroleum.

## 2.5 EXPANSION JOINT FILLERS

Material shall conform to ASTM D1751-04.

### **PART 3 - EXECUTION**

#### **3.1 SUBGRADE PENETRATION**

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

#### **3.2 SETTING FORMS**

- A. Base Support:
  - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
  - 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
  - 1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
  - 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
  - 3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) at any point.
  - 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
  - 5. Clean and oil forms each time they are used.
  - 6. Make necessary corrections to forms immediately before placing concrete.
  - 7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish the control, alignment and the grade elevations of the forms or concrete slipforming machine operations. Staking notes shall be submitted for approval to the Resident Engineer prior to placement of concrete. If discrepancies exist between the field conditions and the Drawings, Contractor shall notify Resident Engineer immediately. No placement of concrete shall occur if a discrepancy greater than 1 inch (25 mm) is discovered.

### **3.3 EQUIPMENT**

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

### **3.4 PLACING REINFORCEMENT**

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement. All reinforcement shall be supported for proper placement within the concrete section.
- B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement placement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown on the Drawings.

### **3.5 PLACING CONCRETE - GENERAL**

- A. Obtain approval of the Resident Engineer before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.
- H. Cracked or Chipped Concrete Surfaces and Bird Baths. Cracked or chipped concrete and bird baths will not be allowed. Concrete with cracks or chips and bird baths will be removed and replaced to the nearest joints, and as approved by the Resident Engineer, by the Contractor with no additional cost to the Government.

**3.6 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS**

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

**3.7 PLACING CONCRETE FOR VEHICULAR PAVEMENT**

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.
- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

**3.8 CONCRETE FINISHING - GENERAL**

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
  - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
  - 2. Maintain finishing equipment and tools in a clean and approved condition.

**3.9 CONCRETE FINISHING CURB AND GUTTER**

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch (6 mm) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form

marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.

- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch (3 mm) for gutter and 1/4 (6 mm) for top and face of curb, when tested with a 10 foot (3000 mm) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain. See Article 3.6, Paragraph H, above.
- H. Visible surfaces and edges of finished curb, gutter, and/or combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

### **3.10 CONCRETE FINISHING PEDESTRIAN PAVEMENT**

- A. Walks, Grade Slabs, Wheelchair Curb Ramps:
  - 1. Finish the surfaces to grade and cross section with a metal float, troweled smooth and finished with a broom moistened with clear water.
  - 2. Brooming shall be transverse to the line of traffic.
  - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
  - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 1/16 inch (2 mm) in depth.
  - 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 3/16 inch (5 mm) when tested with a 10 foot (3000 mm) straightedge.
  - 6. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
  - 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints at no additional cost to the Government.

### **3.11 CONCRETE FINISHING FOR VEHICULAR PAVEMENT**

- A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet (3000 mm) long and 6 inches (150 mm) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.



- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet (1500 mm) in length, and straightedges, 10 feet (3000 mm) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 10 foot (3000 mm) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.
- D. The finished surface of the pavement shall not vary more than 1/4 inch (6 mm) in both longitudinal and transverse directions when tested with a 10 foot (3000 mm) straightedge.
- E. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 18 inches (450 mm) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1/8 inch (3 mm) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.
- G. The finish surfaces of new and existing abutting pavements shall be flush and in alignment at their juncture.

### **3.13 CONCRETE FINISHING EQUIPMENT PADS**

- A. After the surface has been struck off and screeded to the proper elevation, provide a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch (3 mm) when tested with a 10 foot (3000 mm) straightedge.
- D. Correct irregularities exceeding the above. See Article 3.6, Paragraph H, above.

### **3.12 JOINTS - GENERAL**

- A. Place joints, where shown on the Shop Drawings and Drawings, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

### **3.13 CONTRACTION JOINTS**

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curbs and gutters by inserting 1/8 inch (3 mm) steel plates conforming to the cross sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

### **3.14 EXPANSION JOINTS**

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
  - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
  - 2. Using joint filler of the type, thickness, and width as shown.
  - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

### **3.15 CONSTRUCTION JOINTS**

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown on the Shop Drawing jointing plan and Drawings.
- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.

- C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

### **3.16 FORM REMOVAL**

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

### **3.17 CURING OF CONCRETE**

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils (0.1 mm) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches (300 mm). Securely anchor sheeting.
- D. Liquid Membrane Curing:
  - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon (5 m<sup>2</sup>/L) for both coats.
  - 2. Do not allow the concrete to dry before the application of the membrane.
  - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.

4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

### **3.18 CLEANING**

#### **A. After completion of the curing period:**

1. Remove the curing material (other than liquid membrane).
2. Sweep the concrete clean.
3. After removal of all foreign matter from the joints, seal joints as specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

### **3.19 PROTECTION**

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

### **3.20 FINAL CLEAN-UP**

Remove all debris, rubbish and excess material from the Station.

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**SECTION 32 12 16**  
**ASPHALT PAVING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

The State Highway Spec will be used to cover the work of this Section. Where the Highway Spec calls for "Test", items "Designated", items to be "Established" and other such delegated duties to be performed by a State "Commission", "Engineer", "Laboratory" or other authorized agent; the responsibility for these items to be that of the Contractor. The Contractor shall retain and reimburse a laboratory to perform said duties; or to obtain a certification from the authorized representative of the State; or to obtain certification from the asphalt paving producer. Certificate of compliance shall cover quality and gradation of aggregate base, quality and grades of asphalt course materials, and that the job-mixture meets or exceeds the State requirements.

**1.2 RELATED WORK**

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.
- C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

**1.3 INSPECTION OF PLANT AND EQUIPMENT**

The Resident Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

**1.4 ALIGNMENT AND GRADE CONTROL**

The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

## **1.5 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
  - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
  - 2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
  - 3. Job-mix formula.
- C. Certifications:
  - 1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
  - 2. Asphalt cement certificate of conformance to State Highway Department requirements.
  - 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of State Highway Department Specifications.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Aggregate base and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA Resident Engineer or VA Contracting Officer.

### **2.2 AGGREGATES**

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate maximum size:
  - 1. Base course over 152mm(6") thick: 38mm(1-1/2");
  - 2. Other base courses: 19mm(3/4").
- D. Asphaltic base course:
  - 1. Maximum particle size not to exceed 25.4mm(1").

2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

<u>Sieve Sizes</u>	<u>Percentage Passing</u>
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

### **2.3 ASPHALTS**

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

### **2.4 SEALER**

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

### **3.2 MIXING ASPHALTIC CONCRETE MATERIALS**

A. Provide hot plant-mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

### **3.3 SUBGRADE**

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

### **3.4 BASE COURSES**

- A. Subbase (when required)
  1. Spread and compact to the thickness shown on the drawings.
  2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Base
  1. Spread and compact to the thickness shown on the drawings.
  2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
  3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

### **3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING**

- A. Remove all loose materials from the compacted base.



- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
  - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
  - 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
  - 1. Spread material in a manner that requires the least handling.
  - 2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.
- E. Rolling:
  - 1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
  - 2. Roll in at least two directions until no roller marks are visible.
  - 3. Finished paving smoothness tolerance:
    - a. No depressions which will retain standing water.
    - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

### **3.6 APPLICATION OF SEAL COAT**

- A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- B. Apply one coat of the specified sealer.
- C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

### **3.7 PROTECTION**

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

### **3.8 FINAL CLEAN-UP**

Remove all debris, rubbish, and excess material from the work area.

- - - E N D - - -

**SECTION 32 17 23**  
**PAVEMENT MARKINGS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This work shall consist of furnishing and applying paint and reflective glass beads on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the drawings. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

**1.2 RELATED WORK**

- A. The following Work is related to this Section:
1. Shop Drawings, Product Data, and Samples, Section 01 33 23
  2. Cast-in-Place Concrete, Section 03 30 00
  3. Deck Coating, Section 07 18 16
  4. Silane Water Repellents, Section 07 19 16
  5. Joint Sealants, Section 07 92 00
  6. Expansion Joint Cover Assemblies, Section 07 95 13

**1.3 SUBMITTALS**

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.
- B. Paint.
- C. Reflective Glass Beads
- D. Submit for review and approval Manufacturer's Spec Data Sheets of each product to be used.
- E. Submit for record Material Safety Data Sheets of each product, solvent, or related chemicals to be used, and certification that the materials conform to local, state, and federal environmental and worker's safety laws and regulations.
- F. Submit for record standard color chip.
- G. Submit for review and approval shop drawings indicating stall size, spacing, etc.

#### 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. Federal Specifications (Fed. Spec.):
  - TT-B-1325C.....Beads (Glass Spheres); Retro-Reflective
  - TT-P- TT-P-115F.....Paint, Traffic, Highway, White and Yellow
- C. Master Painters Institute (MPI):
  - Approved Product List - 2014

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Manufacturer and Installer are required to confirm that all materials used in accordance with this Section conform to local, state, and federal environmental and workers' safety laws and regulations.
  - 1. VOC content of materials shall not exceed the limits per Environmental Protection Agency National Volatile Organic Compound Emission Standards for Architectural Coatings (40CFR59).
- B. The Installer is solely responsible for fume control and shall take all necessary precautions against injury to personnel or adjacent building occupants during application. As a minimum, Installer shall take the following precautions:
  - 1. Provide and maintain barricades.
  - 2. Locate and protect building air intakes during application.
  - 3. Follow all state, federal, and local safety regulations.
  - 4. Follow all Manufacturers' safety requirements.
  - 5. Dispose empty containers immediately and properly.
  - 6. Use protective equipment.
  - 7. Ensure work area is well vented to the exterior.

#### 1.6 TRANSPORTATION AND HANDLING

- A. Deliver all materials to site in original, unopened containers bearing the following information:
  - 1. Name of Product.
  - 2. Name of Manufacturer.
  - 3. Date of Manufacture.
  - 4. Lot or Batch Number.
- B. Store materials under cover and protected from the weather.
- C. Replace containers showing any signs of damage with new material at no additional cost to Owner.
- D. Mix and prepare coatings only in areas designated by the Contractor for that purpose.
- E. Take precautions to prevent fire in or around coatings materials. Provide and maintain hand fire extinguisher near storage and mixing area.

## **PART 2 - PRODUCTS**

### **2.1 PAINT**

- A. Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 32, color as shown. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

### **2.2 REFLECTIVE GLASS BEADS**

- A. Beads shall conform to Fed. Spec. TT-B-1325C, Type I, Gradation A. When used in regions of high humidity, coat beads with silicone or other suitable waterproofing material to assure free flow. Furnish the glass beads in containers suitable for handling and strong enough to prevent loss during shipment. A certificate shall accompany each batch of beads stating compliance with this section.

### **2.3 PAINT APPLICATOR**

- A. Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. If the equipment does not have a glass bead dispenser, use a separate piece of equipment. Adjust and synchronize the equipment with the paint applicator so that the reflective beads are distributed uniformly on the paint lines within ten seconds without any waste. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

### **2.4 SANDBLASTING EQUIPMENT**

- A. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m<sup>3</sup>/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION AND LAYOUT**

- A. Inspect surfaces to which paint will be applied and report immediately in writing to the Engineer as required in the General Conditions any conditions detrimental to the proper execution of this work.
- B. Do not proceed until unsatisfactory conditions are acceptably remedied. Commencement of work implies acceptance of related work.
- C. Lay out all striping on each level, using dimensions indicated on the Drawings. Report any discrepancies, interferences or changes in striping due to field conditions to the Engineer prior to painting.

#### **3.2 SURFACE PREPARATION**

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Engineer has reviewed the surface. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

### 3.3 MIXING

- A. Do not mix different types of materials or materials from different Manufacturers.
- B. Do not thin material except as recommended by Manufacturer for spray application.
- C. Mix paint thoroughly by boxing, stirring or power agitation before use.

### 3.4 APPLICATION

- A. Apply uniformly painted and reflective, where applicable, pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. Temperature of the surface to be painted and the atmosphere shall be above 10°C (50°F) and less than 35°C (95°F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Disperse reflective glass beads evenly on the wet paint, where applicable, at a rate of 720 g/L (6 pounds per gallon) of paint. Apply paint in one coat. If required by the Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, faulty distribution of beads, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.
- B. Parking space striping dimensions indicated on the Drawings are nominal dimensions. Tolerances shall be as follows:
  - 1. Parking space length shall equal indicated length  $\pm$  2 inches (50mm).
  - 2. Parking space width (or base line dimension) shall equal indicated width  $\pm$  1 inch (25mm).
  - 3. A string of parking spaces shall equal indicated  $\pm$  2 inches (50mm) per run.
  - 4. Stripe width shall equal 4 inches (100mm)  $\pm$   $\frac{1}{4}$  inch.
- C. For traffic arrows, walkways stripes, and floor text add glass beads on wet paint so that proper bead embedment and retention is achieved.

### **3.5 PROTECTION**

- A. Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

### **3.6 DETAIL PAVEMENT MARKING**

- A. Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown on the Drawings. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

### **3.7 FINAL CLEAN-UP**

- A. Remove all debris, rubbish and excess material from the VA property.

---END---

**SECTION 32 90 00  
PLANTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The work in this section consists of furnishing and installing plant, soils, edging turf, grasses and landscape materials required as specified in locations shown.

**1.2 RELATED WORK**

- A. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.  
B. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.  
C. Stripping Topsoil, Stock Piling and Topsoil Materials: Section 31 20 00, EARTH MOVING.

**1.3 DEFINITIONS**

- A. Backfill: The earth used to replace earth in an excavation.  
B. Balled and Burlapped Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball.  
C. Balled and Potted Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.  
D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.  
E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.  
F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is



not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

K. Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, turf and grasses, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

A. Notify the Contracting Officer's Representative of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.

B. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
  2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- D. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- F. Handle planting stock by root ball.
- G. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
- H. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Heel-in bare-root stock: Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
  2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet, condition.

J. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.

K. Deliver sprigs in air tight bags to keep from drying out. Sprigs delivered unwrapped, shall be kept moist in burlap or other accepted material until planting.

L. Deliver plugs within 24 hours of harvesting, keep moist until planting.

M. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer's application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

#### **1.5 PROJECT CONDITIONS**

A. Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during one of the following periods:

1. Spring Planting: March 15 to June 1.

2. Fall Planting: September 1 to November 15.

C. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

#### **1.6 QUALITY ASSURANCE:**

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 5 years experience in landscape installation.
  2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  3. Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the Contracting Officer's Representative:
    - a. Certified Landscape Technician (CLT) - Exterior
    - b. Certified Ornamental Landscape Professional, designated COLP.
  4. Pesticide Applicator: Licensed in state of project, commercial.
- C. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, "Diagnosis and Improvement of Saline and Alkali Soils".
  2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer's Representative. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  3. Report suitability of tested soil for plant growth.

- a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
  - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- E. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.
- F. Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Measure trees and shrubs with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4 inch (100 mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
  2. Measure other plants with stems, petioles, and foliage in their normal position.
- G. Contracting Officer's Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Contracting Officer's Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Contracting Officer's Representative of plant material sources 10 days in advance of delivery to site.
- H. Include product label and manufacturer's literature and data for pesticides and herbicides.

#### **1.7 SUBMITTALS**

- A. Submit product data for each type of product indicated, including soils:
1. Include quantities, sizes, quality, and sources for plant materials.

2. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.
  3. Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of 3 photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Submit samples and manufacturer's literature for each of the following for approval before work is started.
1. Organic and Compost Mulch: 1 gallon volume of each organic and compost mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  2. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.
    - a. Weed Control Barrier: 12 by 12 inches (300 by 300 mm).
  3. Amended Soil for Rain Garden: Supplier's certified list of amended soil content of clay, sand, organic material and topsoil.
- C. Qualification data for qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the Contracting Officer's Representative for approval:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
  2. Seed and Turf Materials notarized certificate of product analysis.
  3. Manufacturer's certified analysis of standard products.
  4. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing native surface topsoil existing in-place surface soil, and imported or manufactured topsoil.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

#### **1.8 PLANT AND TURF ESTABLISHMENT PERIOD**

- A. The establishment period for plants and turf shall begin immediately after installation, with the approval of the Contracting Officer's Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain the plants and turf as required in Part 3.

#### **1.9 PLANT AND TURF MAINTENANCE SERVICE**

- A. Provide initial maintenance service for trees, shrubs, ground cover and other plants by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: 3 months from date of Substantial Completion.
- B. Obtain continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

#### **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 basic designation only.
- B. American National Standards Institute (ANSI):

Z60.1-04.....Nursery Stock

C. American Society For Testing And Materials (ASTM):

D5268-07.....Topsoil Used for Landscaping Purposes

#### **1.11 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance, unless noted otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

1. Plant and Turf Warranty Periods will begin from the date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.

b. Ground Covers, Biennials, Perennials, Turf, and Other Plants: 12 months.

2. The Contractor shall have completed, located, and installed all plants and turf according to the plans and specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.

3. The Contractor will replace any dead plant material and any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement plant and turf warranty will begin on the day the work is completed.

4. Replacement of relocated plants, that the Contractor did not supply, is not required unless plant failure is due to improper handling and care during transplanting. Loss through Contractor negligence requires replacement in plant type and size.

5. The Government will reinspect all plants and turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty Period will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:

a. Replace plants that are more than 25 percent dead, missing or defective plant material prior to final inspection.



- b. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
  - c. Mulch and weed plant beds and saucers. Just prior to final inspection, treat these areas to a second application of approved pre-emergent herbicide.
  - d. Complete remedial measures directed by the Contracting Officer's Representative to ensure plant and turf survival.
  - e. Repair damage caused while making plant or turf replacements.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
- 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    - b. Structural failures including plantings falling or blowing over.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- A. Plant and turf materials: ANSI Z60.1; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants and turf material true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on Drawings; healthy, normal and unbroken root systems developed by transplanting or root pruning; well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf; free of disease, pests, eggs, larvae, and defects such as knots, sun scald, windburn, injuries, abrasions, and disfigurement.
- 1. Trees-deciduous and evergreen: Single trunked with a single leader, unless otherwise indicated; symmetrically developed deciduous trees and shrubs of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees and shrubs with well developed symmetrical tops, with typical spread of branches for

each particular species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.

2. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Contracting Officer's Representative, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
  3. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
  4. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
  5. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
  6. Make substitutions only when a plant (or alternates as specified) is not obtainable and the Contracting Officer's Representative authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant with the same essential characteristics and an equitable adjustment of the contract price.
  7. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Label at least one plant of each variety, size, and caliper with a securely attached, waterproof and weather-resistant label bearing legible the correct designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as indicated in the Plant Schedule or Plant Legend shown on the Drawings. Labels shall be securely attached and not be removed.

## **2.2 INORGANIC SOIL AMENDMENTS**

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through No. 60 (0.25 mm) sieve.
  2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36 mm) sieve and a minimum of 55 percent passing through No. 60 (0.25 mm) sieve.
  3. Provide lime in form of ground, palletized, or pulverized, manufactured to meet agricultural standards and contain a maximum of 60% oxide.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35 mm) sieve and a maximum of 10 percent passing through No. 40 (0.425 mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: ASTM C549, horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30 mm) sieve.
- G. Coarse Sand shall be concrete sand, ASTM C33 Fine Aggregate, clean, sharp free of limestone, shale and slate particles, and toxic materials.
- H. Vermiculite: ASTM C516, horticultural grade and free of any toxic materials.
- I. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

## **2.3 ORGANIC SOIL AMENDMENTS**

- A. Organic matter: Commercially prepared compost. Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4 inch (19 mm) sieve; soluble salt content of 1:2 soil:water ratio, measured in millimho/cm; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

#### **2.4 PLANT AND TURF FERTILIZERS**

- A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of Contracting Officer's Representative for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- D. Plant Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
  1. Size: As recommended by manufacturer per results of soil tests.
  2. Nutrient Composition shall be determined by results of soil tests.

#### **2.5 PLANTING SOILS**

- A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1/2 inch (25 mm)

or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with the following soil amendments as recommended by the soils analysis.

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with planting soil when quantities are insufficient.

2. Mix existing, native surface topsoil with the following soil amendments as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the Contracting Officer's Representative of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs, or marshes.

## **2.6 AMENDED SOIL FOR RAIN GARDEN**

A. Amended Soil for Rain Garden: Shall be composed of the following quantities:

1. Clay content: Less than 5%

2. Sand content: 50-60%

3. Leaf compost or aged leaf mulch: 20-30%

4. High quality topsoil: 20-30%

B. Planting soil shall have a permeability of at least 1.0 feet per day (0.5 inches per hour)

C. Planting soil shall be free of stones, stumpsroot, or other woody material over 1 inch in diameter and be free of brush and seeds from noxious weeds.

D. All mixing shall take place in the Contractor's yard, using commercial mixing equipment sufficient to thoroughly mix all components uniformly.

## **2.7 BIOSTIMULANTS**

- A. Biostimulants: Contain soil conditioners, VAM fungi, and endomycorrhizal and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions.

## **2.8 LANDSCAPE MEMBRANES**

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.
- B. Composite Fabric shall be woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

## **2.9 MULCH**

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Shredded hardwood.
    - a. Straw for lawn seed bed mulch: Stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air dry condition and suitable for placing with blower equipment.
    - b. Wood cellulose fiber for use with hydraulic application of grass seed and fertilizer: Consist of specially prepared wood cellulose fiber, processed to contain no growth or germination inhibiting factors, and dyed an appropriate color to facilitate visual metering of the application of materials. On an air dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus 3 percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber shall be manufactured so that:
      - 1) After addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved additives, the fibers in the material will become uniformly suspended to form an homogeneous slurry.
      - 2) When hydraulically sprayed on the ground, the material will form a blotter like cover impregnated uniformly with grass seed.

- 3) The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.
  2. Size Range shall be 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
  3. Color shall be natural.
- B. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:
1. Type: Rounded riverbed smooth-faced stone.
  2. Size Range: 3 inches maximum 2 inch minimum in accordance with ASTM C136.
  3. Color: Uniform color range acceptable to Contracting Officer's Representative.

#### **2.10 EROSION CONTROL**

- A. Erosion control blankets: Biodegradable wood excelsior, straw, or coconut fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.
- B. Erosion control fiber mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.
- C. Erosion control mats: Cellular, non-biodegradable slope stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4 inch (100 mm) nominal mat thickness. Include manufacturer's recommended biodegradable anchorage system for slope conditions.

#### **2.11 WATER**

- A. Water shall not contain elements toxic to plant life. Water to be obtained from at no cost to the Contractor.

#### **2.12 ANTIDESICCANT**

- A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

#### **2.13 TURF SELECTIONS**

- A. Grasses for Cool Regions shall be:
1. Bluegrasses: Kentucky (Poa pratensis)
  2. Fescue: Red (Festuca rubra)

## **2.14 SEED**

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with "AOSA, Rules for Testing Seed" for purity and germination tolerances. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable.
- B. Seed Species: Not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.
  - 1. Sun and Partial Shade: Proportioned by weight as follows:
    - a. 90 percent Turf-type tall fescue.
    - b. 10 percent Kentucky Blue Grass.

## **2.15 PESTICIDES**

- A. Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of Chief Engineer for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner,



turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
  5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the Contracting Officer's Representative stating the special conditions and proposal variance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Contracting Officer's Representative and replace with new planting soil.

### **3.2 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain approval by the Contracting Officer's Representative of layout before excavating or planting. The Contracting Officer's Representative may approve adjustments to plant material locations to meet field conditions.
- D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

### **3.3 PLANTING AREA ESTABLISHMENT**

A. Loosen subgrade of planting areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 1/2 inch (12.5mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading.
  - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
  - b. Mix lime with dry soil before mixing fertilizer.
3. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
  - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Contracting Officer's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### **3.4 RAIN GARDEN**

- A. Pre-Installation Conference: Conduct conference at Project Site
- B. Rain garden shall be installed near the end of construction activities. All adjacent surface should receive pavement prior to installation of the rain garden.
- C. All native soil, fill and any sediment that accumulates during construction shall be removed prior to the installation of the rain garden to allow it to perform as designed.

- D. Prior to the installation or modification of topsoil and planting mix, install subsurface drains, irrigation main lines, lateral lines, irrigation risers other utility work shown on the drawings.
- E. Do not proceed with the installation of topsoil and planting mix until all utility work in the area has been installed.
- F. Place planting soil mix in loosely compacted 12" lifts.
- G. Protect adjacent walls, walks, and utilities from damage or staining by the soil. Use 1/2-inch plywood and/or plastic sheeting as directed to cover existing concrete, metal, masonry work, and other items as directed during the progress of the work.
- H. Clean up any soil or dirt spilled on any paved surface at the end of each working day.
- I. Any damage to the paving or architectural work caused by the soils installation contractor shall be repaired by the general contractor at the soils installation contractor's expense.
- J. Protect soil from over-compaction after placement. An area that becomes over-compacted shall be tilled to a depth of 6 inches. Uneven or settled areas shall be filled and re-graded.

### **3.5 EXCAVATION FOR TREES AND SHRUBS**

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45 degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 1. Excavate approximately 3 times as wide as ball diameter for balled and burlapped stock.
  - 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  6. Maintain supervision of excavations during working hours.
  7. Keep excavations covered or otherwise protected after working hours.
  8. Use topsoil to form earth saucers or water basins for watering around plants. Basins to be 2 inches (50 mm) high for shrubs and 4 inches (100 mm) high for trees.
- B. Subsoil and topsoil removed from excavations may be used as planting soil provided it meets the planting soil specifications.
- C. Notify Contracting Officer's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Notify Contracting Officer's Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow water to percolate away before positioning trees and shrubs.

### **3.6 TREE, SHRUB, AND VINE PLANTING**

- A. Prior to planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grades.
1. Use planting soil for backfill.
  2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately

one-half full, water thoroughly before placing remainder of backfill.  
Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### **3.7 MECHANIZED TREE SPADE PLANTING**

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

C. Cut exposed roots cleanly during transplanting operations.

D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.

E. Where possible, orient the tree in the same direction as in its original location.

### **3.8 TREE, SHRUB, AND VINE PRUNING**

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Contracting Officer's Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

### **3.9 MULCH INSTALLATION**

A. Mulch backfilled surfaces of planting areas and other areas indicated. Keep mulch out of plant crowns and off buildings, pavements, utility standards/pedestals, and other structures.

1. Trees and Tree-like Shrubs in Turf Areas: Apply mulch ring of 3 inch (75 mm) average thickness, with 36 inch (900 mm) radius around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2 inch (50 mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3. Mineral Mulch in Rain Garden per plan details.

### **3.10 EDGING INSTALLATION**

A. For Natural Cut Edging provide a uniform lazy 'V' cut with one vertical side adjacent to turf areas 5 inches (125 mm) deep and a second side angled 10 inches (250 mm) toward center of plant bed for a clear cut division line between the plant bed and adjacent turf.

### **3.11 PLANT MAINTENANCE**

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### **3.12 TURF AREA PREPARATION AND GRADING**

A. For newly graded subgrades loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1/2 inch (12.5mm) in any

dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening, at rates recommended by the soils analysis.
2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of 4 inches (100 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
  - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.
  - b. Reduce elevation of planting soil to allow for soil thickness of sod.

- B. Finish grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

### **3.13 PREPARATION FOR EROSION-CONTROL MATERIALS.**

- A. Prepare area as specified in "Turf Area Preparation and Grading" Article.
- B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten with biodegradable materials as recommended by material manufacturer.
- C. Fill cells of erosion control mat with planting soil and compact before planting.
- D. For erosion control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten with biodegradable materials as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### **3.14 HYDROSEEDING**

- A. For hydroseeding, mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with nonasphaltic tackifier.
  2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
  3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

### **3.15 TURF RENOVATION**

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
  2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).



- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply seed and protect with straw mulch as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

### **3.16 TURF MAINTENANCE**

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
  - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  - 2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
  - 1. Mow to a height of 2 to 3 inches (50 to 75 mm).

### **3.17 SATISFACTORY TURF**

A. Turf installations shall meet the following criteria as determined by Contracting Officer's Representative:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

### **3.18 PESTICIDE APPLICATION**

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Contracting Officer's Representative before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

### **3.19 CLEANUP AND PROTECTION**

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- E. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- F. Remove nondegradable erosion control measures after grass establishment period.
- G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

--- END ---

**SECTION 33 10 00**  
**WATER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies materials and procedures for construction of underground water distribution for domestic and/or fire supply systems outside the building that are complete and ready for operation. This includes piping, structures, appurtenances and all other incidentals.

**1.2 RELATED WORK**

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete: Section 03 30 00, CAST IN-PLACE CONCRETE.
- C. General plumbing: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

**1.3 DEFINITIONS**

- A. Water distribution system: Pipelines and appurtenances which are part of the distribution system outside the building for potable water and fire supply.
- B. Water service line: Pipeline from main line to 5 feet outside of building.

**1.4 ABBREVIATIONS**

- A. PVC: Polyvinyl chloride plastic.
- B. DI: Ductile iron pipe.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends and flange faces.
- B. Use a sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

- C. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- D. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- E. Store plastic piping protected from direct sunlight and support to prevent sagging and bending.
- F. 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.

#### **1.6 COORDINATION**

- A. Coordinate connection to water main with Public Utility company.
- B. Coordinate water service lines with building contractor.

#### **1.7 QUALITY ASSURANCE:**

- A. Products Criteria:
  - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
  - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least three years. Digital electronic devices, software and systems such as controls, instruments or computer work stations shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years.
- C. Regulatory requirements:
  - 1. Comply with the rules and regulations of the public utility company having jurisdiction over the connection to public water lines and the extension and/or modifications to public utility systems.

2. Comply with the rules and regulations of the City of Richmond Department of Public Utilities having jurisdiction for potable water-service.
- D. Provide certification of factory hydrostatic testing of not less than 500 psi (3.5 MPa) in accordance with AWWA C151. Piping materials shall bear the label, stamp or other markings of the specified testing agency.
- E. 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.
- F. Applicable codes:
  1. Plumbing Systems: IPC, International Plumbing Code.
  2. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

#### **1.8 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):
  - MSS SP-60-2004 .....Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
  - MSS SP-108-2002.....Resilient-Seated Cast Iron, Eccentric Plug Valves
  - MSS SP-123-1998(R2006)..Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
- C. American Society of Mechanical Engineers (ASME):
  - A112.1.2-2004.....Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water-Connected Receptors))
  - A112.6.3-2001.....Floor Drains
  - B31.....Code for Pressure Piping Standards
- D. American Society for Testing and Materials (ASTM):

A536-84(2009).....Ductile Iron Castings

A674-10.....Polyethylene Encasement for Ductile Iron Pipe  
for Water or Other Liquids

C651-05.....Disinfecting Water Mains

D2239-03.....Polyethylene (PE) Plastic Pipe (SIDR-PR) Based  
on Controlled Inside Diameter

D2464-06.....Threaded Poly(Vinyl Chloride) PVC Pipe  
Fittings, Schedule 80

D2609-02(2008).....Plastic Insert Fittings for Polyethylene (PE)  
Plastic Pipe

D3350-10a.....Polyethylene Plastics Pipe and Fittings  
Materials

F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter

E. American Water Works Association (AWWA):

B300-10.....Hypochlorites

B301-10.....Liquid Chlorine

C104-08.....Cement-Mortar Lining for Ductile Iron Pipe and  
Fittings

C105/A21.5-10.....Polyethylene Encasement for Ductile Iron Pipe  
Systems

C110-08.....Ductile Iron and Gray-Iron Fittings

C111/A21.11-07.....Rubber-Gasket Joints for Ductile Iron Pressure  
Pipe and Fittings

C115/A21.11-11.....Flanged Ductile Iron Pipe with Ductile Iron or  
Gray-Iron Threaded Flanges

C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-11.....Ductile Iron Compact Fittings for Water Service

C502-05.....Dry-Barrel Fire Hydrants

C509-09.....Resilient-Seated Gate Valves for Water Supply  
Service

C550-05.....Protective Interior Coatings for Valves and  
Hydrants

C600-10.....Installation of Ductile Iron Mains and Their  
Appurtenances

C605-11.....Underground Installation of Polyvinyl Chloride  
(PVC) Pressure Pipe and Fittings for Water

C651-05.....Disinfecting Water Mains

C800-05.....Underground Service Line Valves and Fittings

C906-07.....Polyethylene (PE) Pressure Pipe and Fittings, 4  
In. (100 mm) Through 64 In. (1,600 mm), for  
Water Distribution and Transmission

M44-2nd Ed.....Distribution Valves: Selection, Installation,  
Field Testing and Maintenance

F. NSF International (NSF):

NSF/ANSI 61-2010.....Drinking Water System Components - Health  
Effects

G. American Society of Safety Engineers (ASSE):

1060-2006.....Performance Requirements for Outdoor Enclosures  
for Fluid Conveying Components

## **1.9 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**



## **2.1 FACTORY-ASSEMBLED PRODUCTS**

- A. Standardization of components shall be maximized to reduce spare part requirements. The 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.

## **2.2 SAFETY GUARDS**

- A. All equipment shall have moving parts protected to prevent personal injury. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gauge sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 1/4 inch (6 mm) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

## **2.3 LIFTING ATTACHMENTS**

- A. Equipment shall be provided 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 DUCTILE IRON PIPE AND FITTINGS**

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated, 350 psi (2400 kPa).
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, round-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances: ASTM A47, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions matching pipe, 350 psi (3400 kPa).
  2. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions, Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
  3. Gaskets: AWWA C111.
- D. Flanged Ductile Iron Pipe: AWWA C115/A21.11, with factory applied screwed long hub flanges.
1. Flanges: ASME B16.1 for 250 psi (1725 kPa) pressure ratings, as necessary.
  2. Wall Sleeve Castings, size and types shown on the drawings, shall be hot dipped galvanized per ASTM A123.
  3. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 09 91 00, PAINTING. Pipe shall be shop primed with one coat of rust inhibitive primer. Final paint color shall match the final wall color.
- E. Exterior Pipe Coating: The exterior of pipe shall have the standard asphaltic coating.

## **2.5 PE PIPE AND FITTINGS**

- A. PE, ASTM Pipe: ASTM D2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psi (1100 kPa).
1. Insert Fittings for PE Pipe: ASTM D2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
  2. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 160 psi (1100 kPa).
1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 160 psi (1100 kPa).

## **2.6 VALVES**

- A. Gate Valves: AWWA C509, Non-rising Stem, Resilient Seat, 200 psi (1380 kPa).

1. Valves 3 inches (75 mm) and larger: Resilient seat valve with gray- or ductile iron body and bonnet; cast iron or bronze double-disc gate; bronze gate rings; non-rising bronze stem and stem nut.
2. Interior and exterior coating: AWWA C550, thermo-setting or fusion epoxy.
3. Underground valve nut: Furnish valves with 2 inch (50 mm) nut for socket wrench operation.
4. Aboveground and pit operation: Furnish valves with hand wheels.
5. End connections shall match main line pipe.

B. Gate Valve Accessories and Specialties

1. Tapping-Sleeve Assembly: ANSI MSS SP-60; sleeve and valve to be compatible with the drilling matching.
  - a. Tapping Sleeve: Ductile Iron, two-piece bolted sleeve. Sleeve to match the size and type of pipe material being tapped.
  - b. Valve shall include one raised face flange mating tapping-sleeve flange.
2. Valve Boxes: AWWA M44 with top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel.
3. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut. (Provide two wrenches for Project.)

C. Corporation Valves and Curb Valves

1. Service-Saddle Assemblies: AWWA C800.
  - a. Service Saddle: Copper alloy with seal and threaded outlet for corporation valve.
  - b. Corporation Valve: Bronze body and ground-key plug, with threaded inlet and outlet matching service piping material.
2. Curb Valves: AWWA C800, bronze body, ground-key plug or ball, wide tee head, with inlet and outlet matching service piping material, minimum pressure of 200 psi (1375 kPa).
3. Service Boxes for Curb Valves: AWWA M44, cast iron telescoping top section; plug shall include lettering "WATER"; bottom section with base that fits over curb valve.

4. Shutoff Rods: Steel, tee-handle with one pointed end. Stem length shall extend 2 feet (600 mm) above top of valve box for operation of deepest buried valve, with slotted end matching curb valve.

## **2.7 FIRE HYDRANTS**

A. All hydrants shall have removable interiors capable of replacement without digging up the hydrant and be packable under pressure. Threaded joints or spindles shall be bronze and upper and lower barrels shall be of equal diameter. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 4 inches (100 mm) above finished grade. All fire hydrants shall have 6 inch (150 mm) bottom connection. Provide 2 hydrant wrenches not less than 14 inches (350 mm) long. Pressure Rating: 150 psi (1035 kPa) minimum. Hydrant valve shall open by turning operating nut to left or counterclockwise. Exterior finish shall be silver base with aqua green tops alkyd-gloss enamel paint, to match existing fire hydrants onsite. Outlet threads shall meet NFPA 1963, with external hose thread used by local fire department. Include cast iron caps with steel chains and Pentagon, 1-1/2 inch (38 mm) point to flat operating and cap nuts.

### **B. Dry-Barrel Fire Hydrants:**

1. AWWA C502, freestanding, one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4 inch (133 mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet; interior coating according to AWWA C550; cast iron body, compression-type valve opening against pressure and closing.
2. UL 246, freestanding, one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4 inch (133 mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet; cast iron body, compression-type valve opening against pressure and closing.

## **2.8 DISINFECTION CHLORINE**

- A. Liquid chlorine: AWWA B301.
- B. Sodium Hypochlorite: AWWA B300 with 5 percent to 15 percent available chlorine.
- C. Calcium hypochlorite: AWWA B300 supplied in granular form of 5 g. tablets, and shall contain 65 percent chlorine by weight.

## **2.9 WARNING TAPE**

- A. Warning tape shall be standard, 4 mil. Polyethylene, 3 inch (76 mm) wide tape, detectable type, blue with black letters and imprinted with "CAUTION BURIED WATER LINE BELOW".

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Use pipe, fittings, and joining methods for piping systems according to the following applications.
1. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
  2. Do not use flanges or unions for underground piping.
  3. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- B. Underground water-service piping NPS 8 to NPS 12 (DN 100 to DN 200) shall be any of the following:
1. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.

### **3.2 VALVE APPLICATIONS**

- A. Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts:  
UL/FMG, cast iron, nonrising-stem gate valves with indicator post.
  2. Use the following for valves in vaults and aboveground:
    - a. Gate Valves, NPS 3 (DN 80) and Larger: // AWWA, cast iron, OS&Y rising stem, metal seated // AWWA, cast iron, OS&Y rising stem, resilient seated // UL/FMG, cast iron, OS&Y rising stem // .

### **3.3 DUCTILE IRON PIPE**

- A. Install Ductile Iron, water-service piping according to AWWA C600 and AWWA M41-3rd Edition.
- B. Pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.
- C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.
- D. Push on joints shall be made in strict accordance with the manufacturer's instruction. Pipe shall be laid with bell ends looking ahead.

### **3.4 VALVE INSTALLATION**

- A. AWWA Valves: Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Valves: Install each underground valve and valves in vaults with stem pointing up and with vertical cast iron indicator post.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- E. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

### **3.5 FIRE HYDRANT INSTALLATION**

- A. Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

### **3.6 FIELD QUALITY CONTROL**

- A. Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- C. Perform hydrostatic tests at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psi (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psi (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare reports of testing activities.

### **3.7 IDENTIFICATION**

- A. Install continuous underground warning tape 12 inches (300 mm) directly over piping.

### **3.8 CLEANING**

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by local utility provider , if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
  1. Fill the water system with a water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
  2. Drain the system of the previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow system to stand for 3 hours.
  3. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
  4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- C. Prepare reports of purging and disinfecting activities.

--- E N D ---

**SECTION 33 30 00  
SANITARY SEWER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies materials and procedures for construction of outside, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

**1.2 RELATED WORK**

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATION.
- D. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

**1.3 ABBREVIATIONS**

- A. PVC: Polyvinyl chloride plastic

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.
- B. Handle manholes according to manufacturer's written rigging instructions.

**1.5 COORDINATION**

- A. Coordinate connection to sanitary sewer main with Public Utility company. (Approval from public utility has been obtained indicating that the downstream sanitary systems have sufficient capacity to handle the sanitary discharge from the facility.)
- B. Contractor to obtain approval from the Public Agency that the existing sanitary sewer systems have the capacity to handle the discharge from the facility.
- C. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.



D. Coordinate connection to public sewer system with Public Utility Company.

**1.6 QUALITY ASSURANCE:**

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

**1.7 SUBMITTALS:**

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.

**1.8 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):

F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe

F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter  
Plastic Gravity Sewer Pipe and Fittings

F1417-11.....Standard Test Method for Installation  
Acceptance of Plastic Gravity Sewer Lines Using  
Low-Pressure Air

F1668-08.....Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and  
Fabricated Fittings, 4 In. Through 12 In. (100  
mm Through 300 mm), for Water Transmission and  
Distribution

D. American Society of Mechanical Engineers:

A112.36.2M-1991.....Cleanouts

## **1.9 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

## **PART 2 - PRODUCTS**

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

A. Standardization of components shall be maximized to reduce spare part requirements.

B. The 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.

### **2.2 PVC, GRAVITY SEWER PIPE AND FITTINGS**

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings shall conform to ASTM D3034 SDR 35.
2. Gaskets: ASTM F477.

### **2.3 CLEANOUTS**

A. Cast-Iron Cleanouts:

1. Cleanouts shall be as per ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Top-Loading Classification(s): Valve loadings shall be designed for Light Duty.
3. Cleanout Riser: Sewer pipe fitting on main line pipe and riser shall be as per ASTM A74, service class.

**B. PVC Cleanouts:**

1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

**2.4 WARNING TAPE**

- A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape // detectable // non-detectable // type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

**PART 3 - EXECUTION**

**3.1 PIPING INSTALLATION**

- A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- E. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.
- H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe

- I. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.
- J. Install gravity-flow, non-pressure, drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
  - 2. Install piping with 48 inch (1220 mm) minimum cover as shown on Drawings.
  - 3. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.
- K. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### **3.2 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, non-pressure, drainage piping according to the following:
  - 1. Join PVC piping according to ASTM D2321.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

### **3.3 BUILDING SERVICE LINES**

- A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

### **3.4 CLEANOUT INSTALLATION**

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches (150 mm) in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and 1/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

- B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.
- D. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

### **3.5 CONNECTIONS**

- A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.
- B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.
- C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
  - 1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
  - 2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.
  - 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### **3.6 REGRADING**

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish

grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

### **3.7 PIPE SEPARATION**

A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:
  - a. Local conditions prevent a lateral separation of 10 feet (3 m); and
  - b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.
3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches (600 mm) of water lines.

3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

### **3.8 IDENTIFICATION**

- A. Install green warning tape directly over piping and at outside edges of underground manholes.

### **3.9 FIELD QUALITY CONTROL**

- A. All systems shall be inspected and obtain the Resident Engineer's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
- B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.
  1. Submit separate report for each system inspection.
  2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Re-inspect and repeat procedure until results are satisfactory.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Test plastic gravity sewer piping according to ASTM F1417.
2. Test concrete gravity sewer piping according to ASTM C924.
3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.
4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).
5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.
6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

### **3.10 CLEANING**

- A. Clean dirt and superfluous material from interior of piping.

--- E N D ---



**SECTION 33 40 00  
STORM SEWER UTILITIES**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

**1.2 RELATED WORK**

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- B. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. General plumbing, protection of Materials and Equipment, and quality assurance: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Materials and Testing Report Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- E. Erosion and Sediment Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

**1.3 DEFINITIONS (NOT USED)**

**1.4 ABBREVIATIONS**

- A. HDPE: High-density polyethylene
- B. RCP: Reinforced Concrete Pipe

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes, catch basins, and stormwater inlets according to manufacturer's written rigging instructions.

**1.6 COORDINATION**

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

**1.7 QUALITY ASSURANCE:**

- A. Products Criteria:
  - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

#### **1.8 SUBMITTALS**

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

#### **1.9 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):

A185/A185M-07.....Steel Welded Wire Reinforcement, Plain, for  
Concrete

A242/A242M-04(2009).....High-Strength Low-Alloy Structural Steel

A615/A615M-09b.....Deformed and Plain Carbon-Steel Bars for  
Concrete Reinforcement

C14-07.....Non-reinforced Concrete Sewer, Storm Drain, and  
Culvert Pipe

C33/C33M-08.....Concrete Aggregates

C76-11.....Reinforced Concrete Culvert, Storm Drain, and  
Sewer Pipe

C139-10.....Concrete Masonry Units for Construction of  
Catch Basins and Manholes

C150/C150M-11.....Portland Cement

C443-10.....Joints for Concrete Pipe and Manholes, Using  
Rubber Gaskets

C478-09.....Precast Reinforced Concrete Manhole Sections

C891-09.....Installation of Underground Precast Concrete  
Utility Structures

C913-08.....Precast Concrete Water and Wastewater  
Structures

C923-08.....Resilient Connectors Between Reinforced  
Concrete Manhole Structures, Pipes, and  
Laterals

C924-02(2009).....Testing Concrete Pipe Sewer Lines by Low-  
Pressure Air Test Method

C990-09.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants

C1103-03(2009).....Joint Acceptance Testing of Installed Precast  
Concrete Pipe Sewer Lines

C1173-08.....Flexible Transition Couplings for Underground  
Piping Systems

C1433-10.....Precast Reinforced Concrete Monolithic Box  
Sections for Culverts, Storm Drains, and Sewers

C1479-10.....Installation of Precast Concrete Sewer, Storm  
Drain, and Culvert Pipe Using Standard  
Installations

D448-08.....Sizes of Aggregate for Road and Bridge  
Construction

D698-07e1.....Laboratory Compaction Characteristics of Soil  
Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600  
kN-m/m<sup>3</sup>))

D1056-07.....Flexible Cellular Materials—Sponge or Expanded  
Rubber

D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,  
Schedules 40, 80, and 120

D3350-10.....Polyethylene Plastics Pipe and Fittings  
Materials

- D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain,  
Waste, and Vent (DWV), Sewer, Sanitary, and  
Storm Plumbing Systems
- F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe
- F679-08.....Poly(Vinyl Chloride) (PVC) Large-Diameter  
Plastic Gravity Sewer Pipe and Fittings
- F714-10.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based  
on Outside Diameter
- F894-07.....Polyethylene (PE) Large Diameter Profile Wall  
Sewer and Drain Pipe
- F1417-11.....Installation Acceptance of Plastic Gravity  
Sewer Lines Using Low-Pressure Air
- F1668-08.....Construction Procedures for Buried Plastic Pipe
- C. American Association of State Highway and Transportation Officials  
(AASHTO):
- M198-10.....Joints for Concrete Pipe, Manholes, and Precast  
Box Sections Using Preformed Flexible Joint  
Sealants
- M252-09.....Corrugated Polyethylene Drainage Pipe
- M294-10.....Corrugated Polyethylene Pipe, 12 to 60 In. (300  
to 1500 mm) Diameter
- M23-2nd ed.....PVC Pipe "Design And Installation"
- D. American Society of Mechanical Engineers (ASME):
- A112.6.3-2001.....Floor and Trench Drains
- A112.14.1-2003.....Backwater Valves
- A112.36.2M-1991.....Cleanouts
- E. American Concrete Institute (ACI):
- 318-05.....Structural Commentary and Commentary

350/350M-06.....Environmental Engineering Concrete Structures  
and Commentary

F. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for  
Erosion and Sediment Control

**1.10 WARRANTY**

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

**PART 2 - PRODUCTS**

**2.1 FACTORY-ASSEMBLED PRODUCTS**

A. Standardization of components shall be maximized to reduce spare part requirements. The 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.

**2.2 PE PIPE AND FITTINGS**

- A. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); ASTM F714, SDR 21 for pipes 3 to 24 inches (300 to 600 mm) with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
1. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

**2.3 CONCRETE PIPE AND FITTINGS**

- A. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.
1. Bell-and-spigot ends and gasketed joints with ASTM C443, rubber gaskets
2. Class III

## **2.4 NONPRESSURE TRANSITION COUPLINGS**

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials
  - 1. For concrete pipes: ASTM C443, rubber.
  - 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  - 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

## **2.5 CLEANOUTS**

- A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
  - 1. Top-Loading Classification(s): Medium Duty
  - 2. Pipe fitting and riser to cleanout shall be same material as main pipe line.
- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

## **2.6 DRAINS**

- A. Cast-Iron Area Drains: ASME A112.6.3, gray-iron round body with anchor flange and round grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
  - 1. Top-Loading Classification(s): Medium and Heavy Duty
- B. Grate openings shall be 1/4 inch (6.4 mm) circular.

## **2.7 MANHOLES AND CATCH BASINS**

- A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). Individual FRP steps or FRP ladder, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
10. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

**B. Manhole Frames and Covers:**

1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

**2.8 CONCRETE FOR MANHOLES AND CATCH BASINS**

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.

4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

## **2.9 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS**

A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

## **2.10 WARNING TAPE**

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

# **PART 3 - EXECUTION**

## **3.1 PIPE BEDDING**

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.



### **3.2 PIPING INSTALLATION**

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with 12 inch minimum cover as shown on the Drawings.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
  - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
  - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
  - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
  - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
  - 6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
  - 7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fittings; or cast in-place concrete supports or anchors.
3. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
4. Install reinforced concrete sewer piping according to ASTM C1479.

### **3.3 REGRADING**

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

### **3.4 CONNECTIONS TO EXISTING VA-OWNED MANHOLES**

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

### **3.5 MANHOLE INSTALLATION**

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere unless otherwise indicated.
- C. Circular Structures:
1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with

mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.

2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
  - a. Forming directly in concrete base of structure.
  - b. Building up with brick and mortar.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade. Install an 8 inch (203 mm) thick, by 12 inch (300 mm) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

### **3.6 CATCH BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### **3.7 CONNECTIONS**

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.
- B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
- C. Make connections to existing piping and underground manholes.
  1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.
  2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.
  3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
  - a. Unshielded flexible couplings for same or minor difference OD pipes.
  - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
  - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
2. Use pressure-type pipe couplings for force-main joints.

### **3.8 CLOSING ABANDONED STORM DRAINAGE SYSTEMS**

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8 inch (203 mm) thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section EARTH MOVING.

### **3.9 IDENTIFICATION**

A. Install green warning tape directly over piping and at outside edge of underground structures.

### **3.10 FIELD QUALITY CONTROL**

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video

record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
  - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
  - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

### **3.11 TESTING OF STORM SEWERS:**

- A. Submit separate report for each test.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
  4. Submit separate report for each test.
  5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
- C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### **3.12 CLEANING**

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

H.H. McGuire VAMC  
Construct New Parking Garage  
Richmond, VA 23249

October 24, 2014  
Bid Documents  
Project No. 246-13-C-0127

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**SECTION 34 71 13**  
**VEHICLE BARRIERS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section includes passive High-Security Vehicle Barricades of walls and fixed bollards of crash resistance rating.

**1.2 RELATED WORK**

- A. Section 32 12 16, ASPHALT PAVING, for asphalt driveway and approach paving.
- B. Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS, for concrete driveway and approach paving.
- C. Section 03 30 00, CAST-IN-PLACE CONCRETE, for concrete islands and curbing.
- D. Section 05 50 00, METAL FABRICATIONS, for pipe bollards to protect parking control equipment.
- E. Section 28 16 00, INTRUSION DETECTION SYSTEM

**1.3 SYSTEM DESCRIPTION**

- A. Barricade system mounted in the ground as detailed on the drawings.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Indicate dimensions, required clearances, method of field assembly, and location and size of each field connection.
- C. Certificate test reports confirming compliance's with specified resistive rating.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain parking control equipment through one source from a single manufacturer.

**1.6 PERFORMANCE**

- A. Performance Evaluation. All passive vehicle barriers shall be certified for their resistance to ramming according to the Department of State,



Diplomatic Security, "Test Method of Vehicle Crash Testing of Perimeter Barriers and Gates" SD-STD-02.01 Revision A March 2003, or latest edition.

#### **1.7 COORDINATION**

Coordinate installation of anchorages for parking control equipment. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### **PART 3-EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, critical dimensions, and other conditions affecting performance.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

Install Gate in concrete foundation pad as outlined in manufactures installation instructions.

#### **3.3 FIELD QUALITY CONTROL**

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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