

DEPARTMENT OF VETERANS AFFAIRS
RENOVATE MEDICAL MEDIA
FOR GERIATRICS/WOUND CARE
CLINIC

At Michael E. DeBakey VA Medical Center
Houston, Texas

Project Number 580-17-100

PROJECT MANUAL

Construction Documents

November 18, 2016

Department of Veterans Affairs Renovate Medical Media for Geriatrics/Wound Care Clinic

At Michael E. DeBakey VA Medical Center, Houston, Texas
Project Number 580-17-100

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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 Department of Veterans Affairs, Renovate Medical Media for Geriatrics/ Wound Care Clinic, Michael E. DeBakey VA Medical Center, Houston, Texas, as required by Drawings and Specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Contracting Officer's Representative (COR).
- C. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than 3 work days unless otherwise designated by the COR.
- D. 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.
- E. 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.
- F. Training:
 - 1. All employees of general contractor or subcontractors shall have the 10-hour or 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.

G. VHA Directive 2011-36, Safety and Health during Construction, dated 9/22/2011 in its entirety is made a part of this Section. Contractor shall submit valid negative tuberculin screening test documentation, for each worker, dated within 90 days prior to assignment to the work site.

1.2 STATEMENT OF BID ITEM(S)

- A. RENOVATION: Work includes general construction, alterations, mechanical and electrical work, utility systems, necessary removal of existing structures and construction and certain other items.
- B. Refer to Solicitation, Offer and Award, VA Document Standard Form 1442, for description of Work, basis of award, Base Bid, and Bid Options.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, the Contractor will be furnished electronic files of the Contract Documents for Contractor's use in executing the Contract.
- B. Additional sets of Drawings may be made by the Contractor, as needed or required, 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 COR 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 COR.
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 COR.

C. 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.

D. Document Control:

1. Before starting any work, the General Contractor/subcontractors 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 COR upon request.

4. These security documents shall not be removed or transmitted from the Project site without the written approval of COR.
5. All paper waste or electronic media such as CDs and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify COR 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.

E. 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 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 20 feet exposing overall length, separate by 10 feet.

E. Temporary Construction Partitions:

1. Install and maintain temporary construction partitions to provide 1 hour separations between construction areas and adjoining

areas. Construct partitions of gypsum board or treated plywood (flame spread rating of 25 or less in accordance with ASTM E84) on both sides of fire-retardant-treated wood or metal steel studs. Extend the partitions through suspended ceilings to floor slab deck or roof. Seal joints and penetrations. At door openings, install Class C, ¾-hour fire-/smoke-rated doors with self-closing devices.

2. 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.
- H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to COR.
- 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. Standpipes: Install and extend standpipes up as required and indicated on the Drawings, in accordance with 29 CFR 1926 and NFPA 241.
- L. Sprinklers: Install, test and activate new automatic sprinklers prior to removing existing sprinklers.
- M. 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. 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.

- N. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with COR.
- O. 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. Designate Contractor's responsible Project-site fire prevention program manager to permit hot work.
- P. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to COR.
- Q. 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.
- R. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
- S. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.
- T. 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 COR. 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 COR 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 COR, the buildings and utilities may be abandoned and need not be removed.
- C. The Contractor shall, under regulations prescribed by the COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the COR. 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.
- D. Working space and space available for storing materials shall be as determined by the COR.
- E. Working space and space available for storing materials shall be as shown on the Drawings.
- F. Workmen are subject to rules of Michael E. DeBakey Medical Center applicable to their conduct.
- G. Execute work so as to interfere as little as possible with normal functioning of Michael E. DeBakey 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 2 work days. Provide unobstructed access to Michael E. DeBakey Medical Center areas required to remain in operation.
 3. Where access by Michael E. DeBakey 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.
- H. 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.
- I. Phasing: To insure such executions, Contractor shall furnish the COR with a schedule of approximate 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 2 weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to COR and Contractor.
- J. Building No. B100 will be occupied during performance of work; but immediate areas of alterations will be vacated.
1. Contractor shall take all measures and provide all material necessary for protecting existing equipment and property in affected areas of construction against dust and debris, so that equipment and affected areas to be used in the Medical Center's operations will not be hindered. Contractor shall permit access to Department of Veterans Affairs personnel and patients through other construction areas which serve as routes of access to such affected areas and equipment. Coordinate alteration work in areas occupied by Department of Veterans Affairs so that Medical Center operations will continue during the construction period.

2. Immediate areas of alterations not mentioned in preceding subparagraph 1 will be temporarily vacated while alterations are performed.

K. When a Project area is turned over to Contractor, Contractor shall accept entire responsibility therefore.

1. Contractor shall maintain a minimum temperature of 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 Department of Veterans Affairs, whichever will be required to respond to an alarm from Contractor's employee or watchman.

L. Utilities Services: Maintain existing utility services for Michael E. DeBakey 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 Michael E. DeBakey 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.

M. 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. 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.

N. 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 1 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.

O. 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 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR and a representative of VA Supply Service, of areas of buildings in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three, to the COR. This report shall list by rooms and spaces:
1. Existing condition and types of resilient flooring, doors, windows, walls and other surfaces not required to be altered throughout affected areas of building.
 2. Existence and conditions of items such as plumbing fixtures and accessories, electrical fixtures, equipment, venetian blinds, shades, etc., required by Drawings to be either reused or relocated, or both.
 3. Shall note any discrepancies between Drawings and existing conditions at site.
 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by Drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR and/or Supply Representative, to be in such condition that their use is impossible or impractical, shall be furnished by the VA or replaced by Contractor with new items in accordance with Specifications which will be furnished by Government. Provided the Contract work is changed by reason of this subparagraph B, the Contract will be modified accordingly, under provisions of clauses entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing, of resilient flooring, doors, windows, walls and other surfaces as compared with conditions of same as noted in first condition survey report:
1. Re-survey report shall also list any damage caused by Contractor to such flooring and other surfaces, despite protection measures; and,

will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

D. Protection: Provide the following protective measures:

1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
3. Protection of interior of existing structures at all times from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

1.8 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 as specified here. 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, 1-hour fire-rated 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. High Efficiency Particulate Accumulator (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 filter vacuum system rated at 95 percent 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 24 by 36 inches, 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 freestanding), partitions, flooring, etc.
3. All new air ducts shall be cleaned prior to final inspection.

1.9 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 identified by attached tags 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 reinstallation 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.

1.10 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 COR.
- 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 COR may have the necessary work performed and charge the cost to the Contractor.

1.11 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 clauses entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 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.

1.13 LAYOUT OF WORK

- A. The Contractor shall lay out the interior renovation work 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 COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the COR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the COR may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

1.14 AS-BUILT DRAWINGS

- A. The Contractor shall maintain 2 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 2 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, and 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.

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.
 - a. 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.

- b. Units shall be properly lubricated, balanced, and aligned. Vibrations must be eliminated.
 - c. Automatic temperature control systems for preheat coils shall function properly and all safety controls shall function to prevent coil freeze-up damage.
 - d. 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.
 - e. 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 TOILETS

- A. Contractor may have for use of Contractor's workmen, such toilet accommodations as may be assigned to Contractor by Medical Center. Contractor shall keep such places clean and be responsible for any damage done thereto by Contractor's workmen. Failure to maintain satisfactory condition in toilets will deprive Contractor of the privilege to use such toilets.

1.18 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 COR, 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 Cemetery 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:
 - 1. Obtain heat by connecting to Medical Center heating distribution system.
 - a. Steam is available at no cost to Contractor.
- 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.

1.19 NEW TELEPHONE EQUIPMENT

- A. 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.

1.20 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 COR. 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.

1.21 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 1 compact disc (4 hard copies and 1 electronic copy each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the jobsite. 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 jobsite. 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 interrelated 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.

1.22 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 COR 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.

1.23 RELOCATED EQUIPMENT AND ITEMS

- A. Contractor shall disconnect, dismantle as necessary, remove and reinstall in new location, all existing equipment and items indicated by symbol "R" 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.
- E. Contractor shall employ services of an installation engineer, who is an authorized representative of the manufacturer of this equipment to supervise assembly and installation of existing eye care equipment required to be relocated.

- 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.

1.24 HISTORIC PRESERVATION

- A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

1.25 VA TRIRIGA CPMS

- A. VA contractors, selected by award to perform work, are required to get access to the VA TRIRIGA CPMS. The TRIRIGA CPMS is the management and collaborative environment that the VA uses for all Major, Minor and Non-Recurring Maintenance (NRM) projects within the Office of Construction & Facilities Management (CFM), Veterans Health Administration (VHA), National Cemetery Administration (NCA), and the Veterans Benefits Administration (VBA).

1. The Contractor is solely responsible for acquiring access to the VA TRIRIGA CPMS.

2. To gain access to the VA TRIRIGA CPMS the Contractor is encouraged to follow the licensing process outline as specified below.

- B. Requirement: TRIRIGA is the management and collaborative environment that VA uses for all construction projects. VA requires its contractors to procure TRIRIGA access as part of the cost of performance for a VA construction related contract.

- C. Access Request and Payment can be made through the following URL

<https://valicensing.oncfi.com/>

Inquiries or to request additional services, contact the following:

Craig Alsheimer, Federal Account Manager

Computerized Facility Integrations, LLC

18000 West Nine Mile Road, Suite 700

Department of Veterans Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC, Houston, TX

Southfield, MI 48075

Email: calsheimer@gocfi.com

Phone: 248-557-4234 Extension 6010; 410-292-7006

D. Process:

1. Once the Contractor has been notified by VA of the award and a unique contract number, the Contractor can enter a request for access to TRIRIGA at URL <https://valicensing.oncfi.com/>
2. CFI will process the request for access and payment. CFI will create the USER ID and a password. Security provisions required to align the contractor to the Contract Number will be entered and an email will be generated and submitted to the requestor.
3. CFI will also provide standard terms and conditions related to the transaction and use agreement.

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SECTION 01 32 16.15
PROJECT SCHEDULES
(SMALL PROJECTS - DESIGN/BID/BUILD)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The Contractor shall develop a critical path method (CPM) plan and schedule demonstrating fulfillment of the Contract requirements (Project Schedule), and shall keep the Project Schedule up-to-date in accordance with the requirements of this Section and shall utilize the plan for scheduling, coordinating and monitoring work under this Contract (including all activities of subcontractors, equipment vendors and suppliers). Conventional critical path method (CPM) technique shall be utilized to satisfy both time and cost applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate an authorized representative responsible for the Project Schedule including preparation, review and progress reporting with and to the Contracting Officer's Representative (COR).
- B. The Contractor's representative shall have direct Project control and complete authority to act on behalf of the Contractor in fulfilling the requirements of this Specification Section.
- C. The Contractor's representative shall have the option of developing the Project Schedule within their organization or to engage the services of an outside consultant. If an outside scheduling consultant is utilized, Section 1.3 of this Specification will apply.

1.3 CONTRACTOR'S CONSULTANT:

- A. The Contractor shall submit a qualification proposal to the COR, within 10 days of bid acceptance. The qualification proposal shall include:
1. The name and address of the proposed consultant.
 2. Information to show that the proposed consultant has the qualifications to meet the requirements specified in the preceding paragraph.
 3. A representative sample of prior construction projects, which the proposed consultant has performed complete project scheduling services. These representative samples shall be of similar size and scope.
- B. The COR has the right to approve or disapprove the proposed consultant, and will notify the Contractor of the VA decision within 7 calendar days from receipt of the qualification proposal. In case of disapproval, the

Contractor shall resubmit another consultant within 10 calendar days for renewed consideration. The Contractor shall have their scheduling consultant approved prior to submitting any schedule for approval.

1.4 COMPUTER-PRODUCED SCHEDULES

- A. The Contractor shall provide monthly, to the Department of Veterans Affairs (VA), all computer-produced time/cost schedules and reports generated from monthly Project updates. This monthly computer service will include: three copies of up to 5 different reports (inclusive of all pages) available within the user-defined reports of the scheduling software approved by the COR; a hard copy listing of all Project Schedule changes, and associated data, made at the update and an electronic file of this data; and the resulting monthly updated schedule in PDM format. These must be submitted with and substantively support the Contractor's monthly payment request and the signed look ahead report. The COR shall identify the 5 different report formats that the Contractor shall provide.
- B. The Contractor shall be responsible for the correctness and timeliness of the computer-produced reports. The Contractor shall also be responsible for the accurate and timely submittal of the updated Project Schedule and all CPM data necessary to produce the computer reports and payment request that is specified.
- C. The VA will report errors in computer-produced reports to the Contractor's representative within 10 calendar days from receipt of reports. The Contractor shall reprocess the computer-produced reports and associated diskette(s), when requested by the COR, to correct errors which affect the payment and schedule for the Project.

1.5 THE COMPLETE PROJECT SCHEDULE SUBMITTAL

- A. Within 30 calendar days after receipt of Notice to Proceed, the Contractor shall submit for the COR's review; 3 blue-line copies of the interim schedule on sheets of paper 30 by 42 inches and an electronic file in the previously approved CPM schedule program. The submittal shall also include 3 copies of a computer-produced activity/event ID schedule showing Project duration; phase completion dates; and other data, including event cost. Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, activity/event description, duration, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start or start-to-start without lead or lag constraints.

Activity/event date constraints, not required by the Contract, will not be accepted unless submitted to and approved by the COR. The Contractor shall make a separate written detailed request to the COR identifying these date constraints and secure the COR's written approval before incorporating them into the network diagram. The COR's separate approval of the Project Schedule shall not excuse the Contractor of this requirement. Logic events (non-work) will be permitted where necessary to reflect proper logic among work events, but must have zero duration. The complete working schedule shall reflect the Contractor's approach to scheduling the complete Project. **The final Project Schedule in its original form shall contain no Contract changes or delays which may have been incurred during the final network diagram development period and shall reflect the entire Contract duration as defined in the Bid Documents.** These changes/delays shall be entered at the first update after the final Project Schedule has been approved. The Contractor should provide their requests for time and supporting time extension analysis for Contract time as a result of Contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.

- B. Within 30 calendar days after receipt of the complete Project interim Project Schedule and the complete final Project Schedule, the COR will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. A meeting with the Contractor at or near the jobsite for joint review, correction or adjustment of the proposed plan will be scheduled if required. Within 14 calendar days after the joint review, the Contractor shall revise and shall submit 3 blue-line copies of the revised Project Schedule, 3 copies of the revised computer-produced activity/event ID schedule and a revised electronic file as specified by the COR. The revised submission will be reviewed by the COR and, if found to be as previously agreed upon, will be approved.
- E. The approved baseline schedule and the computer-produced schedule(s) generated therefrom shall constitute the approved baseline schedule until subsequently revised in accordance with the requirements of this Section.

1.6 WORK ACTIVITY/EVENT COST DATA

- A. The Contractor shall cost load all work activities/events except procurement activities. The cumulative amount of all cost loaded work activities/events (including alternates) shall equal the total Contract price. Prorate overhead, profit and general conditions on all work activities/events for the entire Project length. The Contractor shall generate from this information cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the COR to assist him in determining approval or disapproval of the cost loading. Negative work activity/event cost data will not be acceptable, except on VA-issued Contract changes.
- B. The Contractor shall cost load work activities/events for guarantee period services, test, balance and adjust various systems in accordance with the provisions in Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS).
- C. In accordance with FAR 52.236 - 1 (PERFORMANCE OF WORK BY THE CONTRACTOR) and VAAR 852.236 - 72 (PERFORMANCE OF WORK BY THE CONTRACTOR), the Contractor shall submit, simultaneously with the cost per work activity/event of the construction schedule required by this Section, a responsibility code for all activities/events of the project for which the Contractor's forces will perform the work.
- D. The Contractor shall cost load work activities/events for all BID ITEMS. The sum of each BID ITEM work shall equal the value of the bid item in the Contractors' bid.

1.7 PROJECT SCHEDULE REQUIREMENTS

- A. Show on the Project Schedule the sequence of work activities/events required for complete performance of all items of work. The Contractor shall:
 - 1. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar preconstruction work.
 - b. COR's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA facilities utilities, delivery of Government-furnished equipment, and rough-in drawings, Project phasing and any other Specification requirements.

- d. Test, balance and adjust various systems and pieces of equipment, maintenance and operation manuals, instructions and preventive maintenance tasks.
 - e. VA inspection and acceptance activity/event with a minimum duration of 5 workdays at the end of each phase and immediately preceding any VA move activity/event required by the Contract phasing for that phase.
2. Show not only the activities/events for actual construction work for each trade category of the Project, but also trade relationships to indicate the movement of trades from one area, floor, or building, to another area, floor, or building, for at least 5 trades who are performing major work under this contract.
 3. Break up the work into activities/events of a duration no longer than 20 workdays each or one reporting period, except as to non-construction activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the COR may approve the showing of a longer duration. The duration for VA approval of any required submittal, shop drawing, or other submittals will not be less than 20 workdays.
 4. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
 5. The schedule shall be generally numbered in such a way to reflect discipline, phase or location of the Work.
- B. The Contractor shall submit the following supporting data in addition to the Project Schedule:
1. The appropriate Project calendar including working days and holidays.
 2. The planned number of shifts per day.
 3. The number of hours per shift.
- Failure of the Contractor to include this data shall delay the review of the submittal until the COR is in receipt of the missing data.
- C. To the extent that the Project Schedule or any revised Project Schedule shows anything not jointly agreed upon, it shall not be deemed to have been approved by the COR. Failure to include any element of work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within any applicable completion date of each phase regardless of the COR's approval of the Project Schedule.

D. Compact Disk Requirements and CPM Activity/Event Record Specifications:

Submit to the VA an electronic file(s) containing one file of the data required to produce a schedule, reflecting all the activities/events of the complete Project Schedule being submitted.

1.8 PAYMENT TO THE CONTRACTOR:

A. Monthly, the Contractor shall submit the AIA Application and Certificate for Payment Documents G702 and G703 reflecting updated schedule activities and cost data in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, FAR 52.232 - 5 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS) and VAAR 852.236 - 83 (PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS). The Contractor shall be entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Project Schedule. Monthly payment requests shall include: a listing of all agreed upon Project Schedule changes and associated data; and an electronic file (s) of the resulting monthly updated schedule.

B. Approval of the Contractor's monthly Application for Payment shall be contingent, among other factors, on the submittal of a satisfactory monthly update of the Project Schedule.

1.9 PAYMENT AND PROGRESS REPORTING

A. Monthly schedule update meetings will be held on dates mutually agreed to by the COR and the Contractor. Contractor and their CPM consultant (if applicable) shall attend all monthly schedule update meetings. The Contractor shall accurately update the Project Schedule and all other data required and provide this information to the COR 3 workdays in advance of the schedule update meeting. Job progress will be reviewed to verify:

1. Actual start and/or finish dates for updated/completed activities/events.
2. Remaining duration for each activity/event started, or scheduled to start, but not completed.
3. Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the Project Schedule.
4. Changes in activity/event sequence and/or duration which have been made, pursuant to the provisions of following Article, ADJUSTMENT OF CONTRACT COMPLETION.
5. Completion percentage for all completed and partially completed activities/events.

6. Logic and duration revisions required by this Section of the Specifications.
 7. Activity/event duration and percent complete shall be updated independently.
- B. After completion of the joint review, the Contractor shall generate an updated computer-produced, calendar-dated schedule and supply the COR with reports in accordance with the Article, COMPUTER PRODUCED SCHEDULES, specified.
- C. After completing the monthly schedule update, the Contractor's representative or scheduling consultant shall rerun all current period Contract change(s) against the prior approved monthly Project Schedule. The analysis shall only include original workday durations and schedule logic agreed upon by the Contractor and resident engineer for the Contract change(s). When there is a disagreement on logic and/or durations, the Contractor shall use the schedule logic and/or durations provided and approved by the COR. After each rerun update, the resulting electronic Project Schedule data file shall be appropriately identified and submitted to the VA in accordance to the requirements listed in articles 1.4 and 1.7. This electronic submission is separate from the regular monthly Project Schedule update requirements and shall be submitted to the resident engineer within 14 calendar days of completing the regular schedule update. **Before inserting the Contract changes durations, care must be taken to ensure that only the original durations will be used for the analysis, not the reported durations after progress. In addition, once the final network diagram is approved, the Contractor must recreate all manual progress payment updates on this approved network diagram and associated reruns for Contract changes in each of these update periods as outlined above for regular update periods. This will require detailed record keeping for each of the manual progress payment updates.**
- D. Following approval of the CPM schedule, the VA, the General Contractor, its approved CPM Consultant, COR, and all subcontractors needed, as determined by the COR, shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of Project Schedule and to identify any necessary actions required to maintain Project Schedule during the reporting period. The Government representatives and the Contractor should conclude the meeting with a clear understanding of those work and administrative actions necessary to maintain Project Schedule status during the

reporting period. This schedule coordination meeting will occur after each monthly Project Schedule update meeting utilizing the resulting schedule reports from that schedule update. If the project is behind schedule, discussions should include ways to prevent further slippage as well as ways to improve the Project Schedule status, when appropriate.

1.10 RESPONSIBILITY FOR COMPLETION

- A. If it becomes apparent from the current revised monthly progress schedule that contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:
 - 1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of Work.
 - 2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of Work.
 - 3. Reschedule the Work in conformance with the Specification requirements.
- B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the COR for the proposed schedule changes. If such actions are approved, the representative schedule revisions shall be incorporated by the Contractor into the Project Schedule before the next update, at no additional cost to the Government.

1.11 CHANGES TO THE SCHEDULE

- A. Within 30 calendar days after VA acceptance and approval of any updated Project Schedule, the Contractor shall submit a revised electronic file (s) and a list of any activity/event changes including predecessors and successors for any of the following reasons:
 - 1. Delay in completion of any activity/event or group of activities/events, which may be involved with Contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the CPM as the direct cause for delaying the Project beyond the acceptable limits.
 - 2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the Work necessary.
 - 3. The schedule does not represent the actual prosecution and progress of the Project.
 - 4. When there is, or has been, a substantial revision to the activity/event costs regardless of the cause for these revisions.

- B. CPM revisions made under this paragraph which affect the previously approved computer-produced schedules for Government furnished equipment, vacating of areas by the VA Facility, Contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, shall be furnished in writing to the COR for approval.
- C. COR's approval for the revised Project Schedule and all relevant data is contingent upon compliance with all other paragraphs of this Section and any other previous agreements by the COR.
- D. The cost of revisions to the Project Schedule resulting from Contract changes will be included in the proposal for changes in work as specified in FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental), and will be based on the complexity of the revision or Contract change, man-hours expended in analyzing the change, and the total cost of the change.
- E. The cost of revisions to the Project Schedule not resulting from contract changes is the responsibility of the Contractor.

1.12 ADJUSTMENT OF CONTRACT COMPLETION

- A. The Contract completion time will be adjusted only for causes specified in this Contract. Request for an extension of the Contract completion date by the Contractor shall be supported with a justification, CPM data and supporting evidence as the COR may deem necessary for determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in workdays) and costs is obligatory to any approvals. The schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved in this request. The COR's determination as to the total number of days of Contract extension will be based upon the current computer-produced, calendar-dated schedule for the time period in question and all other relevant information.
- B. Actual delays in activities/events which, according to the computer-produced, calendar-dated schedule, do not affect the extended and predicted Contract completion dates shown by the critical path in the network, will not be the basis for a change to the Contract completion date. The Contracting Officer will within a reasonable time after receipt of such justification and supporting evidence, review the facts and advise the Contractor in writing of the COR's decision.

- C. The Contractor shall submit each request for a change in the Contract completion date to the COR in accordance with the provisions specified under FAR 52.243 - 4 (Changes) and VAAR 852.236 - 88 (Changes - Supplemental). The Contractor shall include, as a part of each change order proposal, a sketch showing all CPM logic revisions, duration (in workdays) changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.
- D. All delays due to non-work activities/events such as REQUESTS FOR INFORMATION, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month-by-month basis.

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

- 1-1 Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (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 (COR), 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 COR, or Architect-Engineer, and action thereon will be taken by COR on behalf of the Contracting Officer.
- 1-6 Upon receipt of submittals, COR, or 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 COR, 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 COR 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. COR assumes no responsibility for checking quantities or exact numbers included in such submittals.
- A. Submit samples required by each Specification Section and the Finish Schedule on the Drawings, 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 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 COR.

1. Laboratory shall furnish COR 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 5 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 COR and to
Architect-Engineer simultaneously with submission of material to a
commercial testing laboratory.
5. 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 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 the COR under one cover.

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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 a.m. - 3:00 p.m.

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

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

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

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

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

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

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

Department of Veterans Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC, Houston, TX

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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Department of Veterans Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC, Houston, TX

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 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.
 1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this Contract.
 2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features by marking, fencing, or using any other approved techniques.
 - a. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
 - b. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
 3. 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.
 4. Store chemical waste away from the work areas in corrosion-resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

5. Handle discarded materials other than those included in the solid waste category as directed by the Contracting Officer's Representative (COR).
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems.
- D. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the jobsite.
 1. 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 COR. 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 the COR. 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 3 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 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
SCRAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80

EARTHMOVING		MATERIALS HANDLING PUMPS	
	75	BLASTING	not permitted
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 5 successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure 50 feet from the noise source. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. Submit the recorded information to the COR noting any problems and the alternatives for mitigating actions.
- 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 Cleanup: 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 COR. 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 58 16
TEMPORARY INTERIOR SIGNAGE

PART 1 GENERAL

DESCRIPTION

This Section specifies temporary interior signs.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNS

- A. Fabricate from 110-pound, matte finish white paper.
- B. Cut to 4-inch-wide by 12-inch-long size tag.
- C. Punch 1/8-inch-diameter hole centered on 4-inch dimension of tag. Edge of hole spaced approximately 1/2-inch from one end on tag.
- D. Reinforce hole on both sides with gummed cloth washer or other suitable material capable of preventing tie pulling through paper edge.
- E. Ties: Steel wire 0.0120-inch thick, attach to tag with twist tie, leaving 6-inch-long free ends.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install temporary signs attached to room door frame or room door knob, lever, or pull for doors on corridor openings.
- B. Mark on signs with felt tip marker having approximately 1/8-inch-wide stroke for clearly legible numbers or letters.
- C. Identify room with numbers as designated on Floor Plans.

3.2 LOCATION

- A. Install on doors that have room, corridor, and space numbers shown.
- B. Doors that do not require signs are as follows:
 - 1. Corridor barrier doors (cross-corridor) in corridor with same number.
 - 2. Folding doors or partitions.
 - 3. Toilet or bathroom doors within and between rooms.
 - 4. Communicating doors in partitions between rooms with corridor entrance doors.
 - 5. Closet doors within rooms.
- C. Replace missing, damaged, or illegible signs.

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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 (e.g., 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 (e.g., steel, wire, beverage containers, copper, etc.).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (e.g., 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, SELECTIVE DEMOLITION.
- B. Section 01 00 00, GENERAL REQUIREMENTS.

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 Contracting Officer's Representative (COR) 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 jobsite waste to be generated.
 - a. List of each material and quantity to be salvaged, reused, or 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, or 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, or invoices. Include the net total costs for each disposal.

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SECTION 02 41 00
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This Section specifies demolition and removal of portions of existing buildings and utilities as required for the installation of new work.

1.2 RELATED WORK:

- A. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- E. Construction Waste Management: Section 017419 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, and other similar items that are required for protection of all personnel during demolition and removal operations.
- C. 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.
- D. 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 Contracting Officer's Representative (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.

- H. The Work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.4 JOB CONDITIONS:

- A. The Owner will be continuously occupying the portions of the building outside Project limits. Coordinate all demolition work with COR in order to minimize disruptions to Owner's normal operations.
- B. Do not interrupt existing utilities serving occupied portions of the building without permission from the COR. Provide temporary services as required by COR during interruptions to existing utilities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove portions of structures, including all appurtenances related or connected thereto, as required and indicated in the Drawings. Notify COR immediately of any unanticipated mechanical, electrical or structural elements which are found in conflict with demolition activities or new work.
- B. Debris, including concrete masonry unit, concrete, 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.

3.2 CLEANUP:

On completion of work of this Section and after removal of all debris, leave site in clean condition satisfactory to COR. Cleanup 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 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

This Section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

1.3 TOLERANCES:

- A. ACI 117.

1.4 REGULATORY REQUIREMENTS:

- A. ACI SP-66 ACI Detailing Manual.
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design.

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 Concrete Institute (ACI):
 - 117-10.....Specification for Tolerances for Concrete Construction, Materials and Commentary
 - 211.1-91(R2009).....Standard Practice for Proportions for Normal, Heavyweight, and Mass Concrete
 - 211.2-98(R2004).....Standard Practice for Selecting Proportions for Structural Lightweight Concrete
 - 301-10.....Specifications for Structural Concrete
 - 305.1-06.....Specification for Hot Weather Concreting
 - 306.1-90(R2002).....Standard Specification for Cold Weather Concreting
 - SP-66-04ACI Detailing Manual
 - 318-11.....Building Code Requirements for Structural Concrete and Commentary
 - 347-04.....Guide to Formwork for Concrete

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

A185/A185M-07.....Standard Specification for Steel Welded Wire
Reinforcement, Plain, for Concrete Reinforcement
A615/A615M-09.....Standard Specification for Deformed and Plain
Carbon Steel Bars for Concrete Reinforcement
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 Material 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
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
D1751-04(R2008)Standard Specification for Preformed Expansion
Joint Fillers for Concrete Paving and Structural
Construction (Non-extruding and Resilient
Bituminous Types)

D4397-10.....Standard Specification for Polyethylene Sheeting
for Construction, Industrial and Agricultural
Applications

E1155-96(2008).....Standard Test Method for Determining F_F Floor
Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

Wood, plywood, metal, or other materials, approved by Resident Engineer,
of grade or type suitable to obtain type of finish specified.

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, Size 67. Size 467 may be used for footings and walls over 12 inches thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Lightweight Aggregate for Structural Concrete: ASTM C330, Table 1.
- F. Mixing Water: Fresh, clean, and potable.
- G. Air-Entraining Admixture: ASTM C260.
- H. Chemical Admixtures: ASTM C494.
- I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See Structural Drawings for grade.
- J. Welded Wire Fabric: ASTM A185.
- K. Expansion Joint Filler: ASTM D1751.
- L. Sheet Materials for Curing Concrete: ASTM C171.
- M. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- N. Liquid Densifier/Sealer: 100 percent active colorless aqueous siliconate solution.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days shall be not less than 4,000 psi for normal weight concrete and 3,000 psi for lightweight concrete.

- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of 3 cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 4 inches tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):
1. Lightweight structural concrete. Pump mixes may require higher cement values.
 2. Determined by laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength	Non-Air-Entrained		Air-Entrained	
Min. 28-Day Comp. Str. psi	Min. Cement lbs/c. yd.	Max. Water Cement Ratio	Min. Cement lbs/c. yd.	Max. Water Cement Ratio
4,000	550	0.55	570	0.50
3,000	500	*	520	*

- F. Air-entrainment is required for all exterior concrete. Air content shall conform to the following tables:

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

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
3/8-inch	6 to 10
½-inch	5 to 9
¾-inch	4 to 8
1 inch	3-1/2 to 6-1/2
1-1/2 inches	3 to 6

**TABLE II - TOTAL AIR CONTENT
AIR CONTENT OF LIGHTWEIGHT STRUCTURAL CONCRETE**

Nominal Maximum Size of Total Air Content	Coarse Aggregate, Inches Percentage by Volume
Great than 3/8-inch 4 to 8	3/8-inch or less 5 to 9

2.4 BATCHING AND MIXING:

A. Store, batch, and mix materials as specified in ASTM C94.

1. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to Project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.
2. Mixing Structural Lightweight Concrete: Charge mixer with 2/3 of total mixing water and all of the aggregate. Mix ingredients for not less than 30 seconds in a stationary mixer or not less than 10 revolutions at mixing speed in a truck mixer. Add remaining mixing water and other ingredients and continue mixing. Above procedure may be modified as recommended by aggregate producer.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation conforms to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- 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. Inserts, Sleeves, and Similar Items: Masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other Sections of Specifications and required to be in their final position at the time concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.
- D. Construction Tolerances:
1. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. 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 are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

- A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.3 VAPOR BARRIER:

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier, to match existing.
- B. Lap joints 6 inches, and seal with a compatible pressure-sensitive tape.
- C. Patch punctures and tears.

3.4 PLACING CONCRETE:

- A. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- B. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water or cement more than 1-1/2 hours. Do not allow concrete to drop freely more than 5 feet in unexposed work or more than 3 feet in exposed work. Place and consolidate concrete in horizontal layers not exceeding 12 inches in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.
- C. Hot Weather Placing of Concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- D. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 12 inches and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from Contracting Officer's Representative (COR).

3.5 PROTECTION AND CURING:

Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COR.

3.6 FORM REMOVAL:

Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.7 SURFACE PREPARATION:

Immediately after forms have been removed and work has been examined and approved by COR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.8 FINISHES:

A. Vertical and Overhead Surface Finishes:

1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by COR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.

B. Slab Finishes:

1. Scratch Finish: Slab surfaces to receive a bonded, applied cementitious application shall all be thoroughly raked or wire broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.
2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or

template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.

4. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.

3.9 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.
- B. Liquid Densifier/Sealer: Use on all exposed concrete floors and concrete floors to receive carpeting, except those specified to receive non-slip finish.

3.10 RESURFACING FLOORS:

- A. Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 1 inch below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, wetting, and grouting. Apply lightweight concrete topping as specified and indicated on the Drawings. Float and steel trowel topping to a hard, smooth finish.

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SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This Section specifies materials and services required for installation of cold-formed steel, including tracks and required accessories as shown and specified. This Section includes the following:

1. Interior load-bearing steel stud walls.
2. Steel joists.

1.2 RELATED WORK:

- A. Non-Load-Bearing Metal Stud Framing Assemblies: Section 09 22 16, NON-STRUCTURAL METAL FRAMING.
- B. Gypsum Board Assemblies: Section 09 29 00, GYPSUM BOARD.

1.3 DESIGN REQUIREMENTS:

- A. Design steel in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members," except as otherwise shown or specified.
- B. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
1. Design Loads: As indicated.
 2. Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Load-Bearing Walls: Lateral deflection of 1/240 of the wall height.
 - b. Ceiling Joists: Vertical deflection of 1/240 of the span.
 3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 degrees F.

4. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
5. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Shop and erection drawings showing steel unit layout, connections to supporting members, and information necessary to complete installation as shown and specified.
- C. Manufacturer's Literature and Data: Showing steel component sections and specifying structural characteristics.
- D. For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

1.5 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 Iron and Steel Institute (AISI):
Specification and Commentary for the Design of Cold-Formed Steel Structural Members (1996)
- C. American Society of Testing and Materials (ASTM):
A36/A36M-08.....Standard Specifications for Carbon Structural Steel
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

- A307-10.....Standard Specifications for Carbon Steel Bolts
and Studs
- A653/A653M-10.....Standard Specifications for Steel Sheet, Zinc-
Coated (Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process
- C1107/C1107M-08.....Standard Specifications for Packaged Dry,
Hydraulic-Cement Grout (Non-shrink)
- E488-96(R2003).....Standard Test Methods for Strength of Anchors
in Concrete and Masonry Elements
- E1190-95(R2007).....Standard Test Methods for Strength of Power-
Actuated Fasteners Installed in Structural
Members
- D. American Welding Society (AWS):
- D1.3/D1.3M-08.....Structural Welding Code-Sheet Steel
- E. Military Specifications (Mil. Spec.):
- MIL-P-21035B.....Paint, High Zinc Dust Content, Galvanizing
Repair

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Sheet steel for joists, studs and accessories 16 gage and heavier:
ASTM A653, structural steel, zinc-coated G60, with a yield of 340 MPa
minimum.
- B. Sheet Steel for joists, studs and accessories 18 gage and lighter:
ASTM A653, structural steel, zinc-coated G60, with a yield of 230 MPa
minimum.
- C. Galvanizing Repair Paint: MIL-P-21035B.

2.2 WALL FRAMING:

- A. Steel Studs: Manufacturer's standard C-shaped steel studs of web depth
indicated, with lipped flanges, and complying with the requirements
shown on the Drawings.
- B. Steel Track: Manufacturer's standard U-shaped steel track, unpunched,
of web depths indicated, with straight flanges, and complying with the
following:

1. Design Uncoated-Steel Thickness: Matching steel studs.
2. Flange Width: Manufacturer's standard deep flange where indicated, standard flange elsewhere.

2.3 JOIST FRAMING:

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, unpunched, of web depths indicated, with lipped flanges, and complying with the requirements indicated on the Drawings.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, unpunched, of web depths indicated, with straight flanges, and complying with the following:
 1. Design Uncoated-Steel Thickness: Matching steel joists.

2.4 FRAMING ACCESSORIES:

- A. Fabricate steel framing accessories of the same material and finish used for framing members, with minimum yield strength of 230 MPa.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Gusset plates.
 5. Deflection track and vertical slide clips.
 6. Stud kickers and girts.
 7. Joist hangers and end closures.
 8. Reinforcement plates.

2.5 ANCHORS, CLIPS, AND FASTENERS:

- A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.
- B. Cast-in-Place Anchor Bolts and Studs: ASTM A307, Grade A, zinc coated by the hot-dip process according to ASTM A153.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the

design load, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times the design load, as determined by testing per ASTM E1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.6 REQUIREMENTS:

- A. Welding in accordance with AWS D1.3
- B. Furnish members and accessories by one manufacturer only.

PART 3 - EXECUTION

3.1 FABRICATION:

- A. Framing components may be preassembled into panels. Panels shall be square with components attached.
- B. Cut framing components squarely or as required for attachment. Cut framing members by sawing or shearing; do not torch cut.
- C. Hold members in place until fastened.
- D. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - 1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - 2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- E. Where required, provide specified insulation in double-header members and double-jamb studs which will not be accessible after erection.

3.2 ERECTION:

- A. Handle and lift prefabricated panels in a manner as to not distort any member.

- B. Securely anchor tracks to supports as shown.
- C. At butt joints, securely anchor 2 pieces of track to same supporting member or butt-weld or splice together.
- D. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.
- E. All axially loaded members shall be aligned vertically to allow for full transfer of the loads down to the foundation. Vertical alignment shall be maintained at floor/wall intersections.
- F. Install jack studs above and below openings and as required to furnish support. Securely attach jack studs to supporting members.
- G. Install headers in all openings that are larger than the stud spacing in that wall.
- H. Attach bridging for studs in a manner to prevent stud rotation. Space bridging rows as shown.
- I. Studs in one piece for their entire length, splices will not be permitted.
- J. Provide a load distribution member at top track where joist is not located directly over bearing stud.
- K. Provide joist bridging and web stiffeners at reaction points where shown.
- L. Provide end blocking where joist ends are not restrained from rotation.
- M. Provide an additional joist under parallel partitions, unless otherwise shown, when partition length exceeds one-half joist span and when floor and roof openings interrupt one or more spanning members.
- N. Provide temporary bracing and leave in place until framing is permanently stabilized.
- O. Do not bridge building expansion joints with cold-formed metal framing. Independently frame both sides of joints.
- P. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.3 TOLERANCES:

- A. Vertical alignment (plumbness) of studs shall be within 1/960th of the span.
- B. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths.
- C. Spacing of studs shall not be more than 1/8-inch +/- from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.
- D. Prefabricated panels shall be not more than 1/8-inch +/- out of square within the length of that panel.

3.4 FIELD REPAIR:

Touch up damaged galvanizing with galvanizing repair paint.

- - - E N D - - -

Department of Veterans Affairs, Renovate Medical Media for
Geriatrics Wound Care Clinic
Project Number 580-17-100

MEDVAMC Houston, TX

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
 - 2. Frames
 - 3. Steel support angles
 - 4. Loose lintels
 - 5. Railings

1.2 RELATED WORK

- A. Colors, finishes, and textures as indicated in the Finish Schedule on the Drawings.
- B. 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. 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.
- C. 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.

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-12.....Structural Steel
 - A47-99(R2009).....Malleable Iron Castings
 - A48-03(R2012).....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
 - A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet and Strip
 - A269-10.....Seamless and Welded Austenitic Stainless-Steel
Tubing for General Service
 - A307-12.....Carbon Steel Bolts and Studs, 60,000 PSI Tensile
Strength
 - A391/A391M-07(R2012)....Grade 80 Alloy Steel Chain
 - 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: 200 pounds in any direction at any point.

2.2 MATERIALS

- A. Structural Steel: ASTM A36.
- B. Primer Paint: As specified in Section 09 91 00, PAINTING.
- C. 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 within 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 0.0125-inch-thick stainless steel.
- D. Grout: ASTM C1107, pourable type.

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 60,000 psi tensile strength bolts.
 - c. ASTM F468 for nonferrous bolts.
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 member's 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. 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: Use appropriate anchors, as applicable to conditions and materials, and as indicated on the Drawings, for related loads, in compliance with applicable standards and regulations.

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 AMP 500 Metal Finishes Manual.
- 2. Steel and Iron: NAAMM AMP 504.
 - a. Zinc Coated (Galvanized): ASTM A123, G90 unless noted otherwise.
 - b. Surfaces Exposed in the Finished Work:
 - 1) Finish smooth rough surfaces and remove projections.

- 2) Fill holes, dents and similar voids and depressions with epoxy type patching compound.

c. 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: 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.

B. For Wall-Mounted Items:

1. For items supported by metal stud partitions.
2. Steel strip or hat channel minimum of 0.0598-inch thick.
3. Steel strip minimum of 6 inches wide, length extending one stud space beyond end of item supported.
4. Steel hat channels where shown. Flange cut and flattened for anchorage to stud.
5. Structural-steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
6. Use steel angles for through-wall counters. Drill angle for fasteners at ends and not over 4 inches on center between ends.

C. For Trapeze Bars:

1. Construct assembly above ceilings as shown and design to support not less than a 750-pound working load at any point.

2. Fabricate trapeze supports as shown, with all exposed members, including screws, nuts, bolts and washers, fabricated of stainless steel.
 3. Fabricate concealed components of structural steel shapes unless shown otherwise.
 4. Stainless-steel ceiling plate drilled for eye bolt.
 5. Continuously weld connections where welds shown.
 6. Use modular channel where shown with manufacturer's bolts and fittings.
 - a. Weld ends of steel angle braces to steel plates and secure to modular channel units as shown. Drill plates for anchor bolts.
 - b. Fabricate eye bolt, special clamp bolt, and plate closure full length of modular channel at ceiling line and secure to modular channel unit with manufacturer's standard fittings.
- D. For Operating Room Light:
1. Fabricate as shown to suit equipment furnished.
 2. Drill leveling plate for light fixture bolts.

2.6 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 6-inch bearing at each end for nonbearing masonry walls, and 8-inch bearing at each end for bearing walls.
- C. Provide one angle lintel for each 4 inches of masonry thickness as follows except as otherwise specified or shown.
 1. Openings 2-1/2 feet to 6 feet - 4 by 3-1/2 by 5/16-inch.
 2. Openings 6 feet to 10 feet - 6 by 3-1/2 by 3/8-inch.
- D. For 6-inch-thick masonry openings 2-1/2 feet to 10 feet, use one angle 6 by 3-1/2 by 3/8-inch.
- E. Provide bearing plates for lintels where shown.
- F. Weld or bolt upstanding legs of double angle lintels together with 3/4-inch bolts spaced at 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.

2.7 SUPPORT ANGLES

- A. Fabricate from steel angles of size shown.

- B. Fabricate angles with horizontal slotted holes for 3/4-inch bolts spaced at not over 3 feet on centers and within 12 inches of ends.

2.8 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. Base plates are not required on pipe sleeves where ornamental railings occur.
 - 6. 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.
- 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 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. Opening Guardrails:
 - 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. Field weld in accordance with AWS.
 1. Design and finish as specified for shop welding.
 2. Use continuous weld unless specified otherwise.
- D. 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.
- E. 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.
- F. Isolate aluminum from dissimilar metals and from contact with concrete and masonry materials as required to prevent electrolysis and corrosion.
- G. 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.
- C. Ceiling Support for Operating Observation Light:
 1. Anchor support to structure above as shown.
 2. Set leveling plate as shown level with ceiling.
 3. Secure light to leveling plate in accordance with light manufacturer's requirements.
- D. Supports for Trapeze Bars:
 1. Secure plates to overhead construction with fasteners as shown.
 2. Secure angle brace assembly to overhead construction with fasteners as shown and bolt plate to braces.
 3. Fit modular channel unit flush with finish ceiling, and secure to plate with modular channel unit manufacturer's standard fittings through steel shims or spreaders as shown.
 - a. Install closure plates in channel between eye bolts.
 - b. Install eyebolts in channel.

3.3 STEEL LINTELS

- A. Use lintel sizes and combinations shown or specified.
- B. Install lintels with longest leg upstanding, except for openings in 6-inch masonry walls, install lintels with longest leg horizontal.
- C. Install lintels to have not less than 6-inch bearing at each end for nonbearing walls, and 8-inch bearing at each end for bearing walls.

3.4 SUPPORT ANGLES

- A. Anchor support angles with 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.

3.5 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 sliding flanged fittings to posts at base with set screws.
5. Secure fixed flanged fittings to concrete with expansion bolts.
6. Secure posts to steel with welds.

B. 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.

C. Handrails:

1. Anchor brackets for metal handrails as detailed.
2. Install brackets within 12 inches of return of walls, and at evenly spaced intermediate points not exceeding 4 feet on centers unless shown otherwise.
3. Expansion bolt to concrete or solid masonry.
4. Toggle bolt to installed supporting frame wall and to hollow masonry unless shown otherwise.

3.19 CLEANING 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 recommended by the metal manufacture and protected from damage until completion of the Project.

- - - E N D - - -

SECTION 06 20 00
FINISH CARPENTRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies interior millwork.
- B. Items Specified:
 - 1. Counter or Work Tops
 - 2. Mounting Strips, Shelves, and Rods

1.2 RELATED WORK

- A. Fabricated Metal Brackets and Countertop Legs: Section 05 50 00, METAL FABRICATIONS.
- B. Wood Doors: Section 08 14 00, WOOD DOORS.
- D. Color and Texture of Finish: As indicated in the Finish Schedule on the Drawings.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
 - 1. Millwork items - Half-full-size scale for sections and details 1:50 (1/4-inch) for elevations and Plans.
 - 2. Show construction and installation.
- C. Samples: Plastic laminate finished plywood, 6 by 12 inches.
- D. Certificates:
 - 1. Indicating fire-retardant treatment of materials, meet the requirements specified.
 - 2. Indicating moisture content of materials, meet the requirements specified.
- E. Manufacturer's Literature and Data:
 - 1. Finish hardware.
 - 2. Sinks with fittings.
 - 3. Electrical components.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect lumber and millwork from dampness, maintaining moisture content specified both during and after delivery at site.
- B. Store finishing lumber and millwork in weathertight, well-ventilated structures or in space in existing buildings designated by Contracting Officer's Representative (COR). Store at a minimum temperature of 70 degrees F for not less than 10 days before installation.

- C. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

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 Testing and Materials (ASTM):
- A36/A36M-08.....Structural Steel
 - A53-12.....Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
 - A167-99 (R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - B26/B26M-09.....Aluminum-Alloy Sand Castings
 - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - E84-10.....Surface Burning Characteristics of Building Materials
- C. American Hardboard Association (AHA):
- A135.4-04.....Basic Hardboard
- D. Builders Hardware Manufacturers Association (BHMA):
- A156.9-03.....Cabinet Hardware
 - A156.11-10.....Cabinet Locks
 - A156.16-08.....Auxiliary Hardware
- E. Hardwood Plywood and Veneer Association (HPVA):
- HP1-09.....Hardwood and Decorative Plywood
- F. American Wood-Preservers' Association (AWPA):
- AWPA C1-03.....All Timber Products - Preservative Treatment by Pressure Processes
- G. Architectural Woodwork Institute (AWI):
- AWI-09.....Architectural Woodwork Quality Standards and Quality Certification Program
- H. National Electrical Manufacturers Association (NEMA):
- LD 3-05.....High-Pressure Decorative Laminates
- I. U.S. Department of Commerce, Product Standard (PS):
- PS20-10.....American Softwood Lumber Standard
- J. Military Specification (Mil. Spec):
- MIL-L-19140E.....Lumber and Plywood, Fire-Retardant Treated
- K. Federal Specifications (Fed. Spec.):
- A-A-1922A.....Shield Expansion

A-A-1936.....Contact Adhesive
FF-N-836D.....Nut, Square, Hexagon Cap, Slotted, Castle
FF-S-111D(1).....Screw, Wood
MM-L-736(C).....Lumber, Hardwood

PART 2 - PRODUCTS

2.1 LUMBER

A. Grading and Marking:

1. Lumber shall bear the grade mark, stamp, or other identifying marks indicating grades of material.
2. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
3. The inspection agency for lumber shall be approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Sizes:

1. Lumber size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which product is produced.
2. Millwork, Standing and Running Trim, and Rails: Actual size as shown or specified.

C. Hardwood: MM-L-736, species as specified for each item.

D. Softwood: PS-20, exposed to view appearance grades:

1. Use C select or D select, vertical grain for transparent finish including stain transparent finish.
2. Use prime for painted or opaque finish.

2.2 PLYWOOD

A. Softwood Plywood:

1. Production standard.
2. Grading and Marking:
 - a. Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood.
 - b. The mark shall identify the plywood by species group or identification index, and shall show glue type, grade, and compliance with PS1.
3. Plywood, 1/2-inch and thicker; not less than 5-ply construction, except 1-1/4-inch-thick plywood not less than 7-ply.

4. Plastic Laminate Plywood Cores:
 - a. Exterior type, and species group.
 - b. Veneer Grade: A-C.
 5. Shelving Plywood:
 - a. Interior type, any species group.
 - b. Veneer Grade: A-B or B-C.
 6. Other: As specified for item.
- B. Hardwood Plywood:
1. HPVA: HP.1
 2. Species of face veneer shall be as shown or as specified in connection with each particular item.
 3. Inside of Building:
 - a. Use Type II (interior), A-grade veneer for transparent finish.
 4. Use wood species and cut, matching existing wood products.

2.3 PARTICLEBOARD

- A. The use of particleboard or plastic laminated particleboard cores is not allowed.

2.4 PLASTIC LAMINATE

- A. NEMA LD-3.
- B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General purpose, Type HGL.
- C. Cabinet Interiors Including Shelving: Both of following options to comply with NEMA, CLS as a minimum.
1. Plastic-laminate-clad plywood or particle board.
 2. Resin-impregnated decorative paper thermally fused to particleboard.
- D. Backing sheet on bottom of plastic-laminate-covered wood tops: Backer, Type HGP.
- E. Post Forming Fabrication, Decorative Surfaces: Post forming, Type HGP.

2.5 ADHESIVE

- A. For Plastic Laminate: Fed. Spec. A-A-1936.
- B. For Interior Millwork: Unextended urea resin, unextended melamine resin, phenol resin, or resorcinol resin.

2.6 STAINLESS STEEL

- A. ASTM A167, Type 302 or 304.

2.7 ALUMINUM CAST

- A. ASTM B26.

2.8 ALUMINUM EXTRUDED

- A. ASTM B221

2.9 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 electric-galvanizing process. Galvanized where specified.
2. Use galvanized coating on ferrous metal for exterior work unless non-ferrous metals or stainless is used.
3. Fasteners:
 - a. Bolts with Nuts: FF-N-836.
 - b. Expansion Bolts: A-A-1922A.
 - c. Screws: Fed. Spec. FF-S-111.

B. Finish Hardware:

1. Cabinet Hardware: ANSI A156.9.
 - a. Door/Drawer Pulls: B02011. Door in seismic zones: B03182.
 - b. Drawer Slides: B05051 for drawers over 6 inches deep, B05052 for drawers 3 to 6 inches deep, and B05053 for drawers less than 3 inches deep.
 - c. Sliding Door Tracks: B07063.
 - d. Adjustable Shelf Standards: B4061 with shelf rest B04083.
 - e. Concealed Hinges: B1601, minimum 110-degree opening.
 - f. Butt Hinges: B01361 for flush doors, B01381 for inset lipped doors, and B01521 for overlay doors.
 - g. Cabinet Door Catch: B0371 or B03172.
 - h. Vertical-Slotted Shelf Standard: B04103 with shelf brackets B04113, sized for shelf depth.
2. Cabinet Locks: ANSI A156.11.
 - a. Drawers and Hinged Door: E07262.
 - b. Sliding Door: E07162.
3. Auxiliary Hardware: ANSI A156.16.
 - a. Shelf Bracket: B04041, japanned or enameled finish.
 - b. Combination Garment rod and Shelf Support: B04051 japanned or enamel finish.
 - c. Closet Bar: L03131 chrome finish of required length.
 - d. Handrail Brackets: L03081 or L03101.
 - 1) Cast aluminum, satin polished finish.
 - 2) Cast malleable iron, japanned or enamel finish.
4. Steel Channel Frame and Leg Supports for Countertop: Fabricated under Section 05 50 00, METAL FABRICATIONS.

5. Pipe Bench Supports:
 - a. Pipe: ASTM A53.
6. Fabricated Wall Bench Supports:
 - a. Steel Angles: ASTM A36 steel with chrome finish, or ASTM A167, stainless steel with countersunk wood screws, holes at 2-1/2 inches on center on horizontal member.
 - b. Use 1-1/2- by 1-1/2- by 3/16-inch angle thick drilled for screw and bolt holes unless shown otherwise. Drill 1/4-inch holes for anchors on vertical member, not more than 8 inches on center between ends or corners.
 - c. Stainless-Steel Bar Brackets: ASTM A167, fabricated to shapes shown, Number 4 finish. Use 2-inch by 3/16-inch bars unless shown otherwise. Drill for anchors and screws. Drill countersunk wood screw holes at 2-1/2 inches on center on horizontal members and not less than two 1/4-inch holes for anchors on vertical member.
7. Through-Wall Counter Brackets:
 - a. Steel angles drilled for fasteners on 4-inch centers.
 - b. Baked enamel prime coat finish.
8. Edge Strips Moldings:
 - a. Driven Type "T" shape with serrated retaining stem; vinyl plastic to match plastic laminate color, stainless steel, or 1/8-inch-thick extruded aluminum.
 - b. Stainless steel or extruded aluminum channels.
 - c. Stainless steel, number 4 finish; aluminum, mechanical applied medium satin finish, clear anodized 0.4 mils thick.
9. Rubber or Vinyl Molding:
 - a. Rubber or vinyl standard stock and in longest lengths practicable.
 - b. Design for closures at joints with walls and adhesive anchorage.
 - c. Adhesive as recommended by molding manufacturer.
10. Primers: Manufacturer's standard primer for steel providing baked enamel finish.

2.10 MOISTURE CONTENT

- A. Moisture content of lumber and millwork at time of delivery to site.
 1. Interior finish lumber, trim, and millwork 1-1/4 inches or less in nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on the remainder.
 2. Exterior treated or untreated finish lumber and trim 4 inches or less in nominal thickness: 15 percent.

3. Moisture content of other materials shall be in accordance with the standards under which the products are produced.

2.11 FIRE-RETARDANT TREATMENT

- A. Where wood members and plywood are specified to be fire-retardant treated, the treatment shall be in accordance with Mil. Spec. MIL-L19140.
- B. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings.
- C. Each piece of treated material shall bear identification of the testing agency and shall indicate performance in accordance with such rating of flame spread and smoke developed.
- D. Treat wood for maximum flame spread of 25 and smoke developed of 25.
- E. Fire-Resistant Softwood Plywood:
 1. Use Grade A, exterior, plywood for treatment.
 2. Meet the following requirements when tested in accordance with ASTM E84:
 - a. Flame Spread: 0 to 25.
 - b. Smoke Developed: 100 maximum

2.12 PRESERVATIVE TREATMENT

- A. Wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including wood members used for rough framing of millwork items except heart-wood Redwood and Western Red Cedar shall be preservative treated in accordance with AWWPA Standards.
- B. Use Grade exterior plywood for treatment.

2.13 FABRICATION

- A. General:
 1. Except as otherwise specified, use AWI Custom Grade for architectural woodwork and interior millwork.
 2. Finish woodwork shall be free from pitch pockets.
 3. Except where special profiles are shown, trim shall be standard stock molding and members of the same species.
 4. Plywood shall be not less than 1/2-inch unless otherwise shown or specified.
 5. Edges of members in contact with concrete or masonry shall have a square corner caulking rebate.
 6. Fabricate members less than 14 feet in length from one piece of lumber, back channeled and molded as shown.
 7. Plastic Laminate Work:
 - a. Factory glued to a plywood core, thickness as shown or specified.

- b. Cover exposed edges with plastic laminate, except where aluminum, stainless steel, or plastic molded edge strips are shown or specified. Use plastic molded edge strips on 3/4-inch molded thick or thinner core material.
 - c. Provide plastic backing sheet on underside of countertops, vanity tops, through-wall counter and sills including backsplashes and endsplashes of countertops.
 - d. Use backing sheet on concealed large panel surface when decorative face does not occur.
- B. Benches:
- 1. Fabricate from 2-inch stock strips of plain-sawed White Oak, or Maple. Use preservative-treated softwood.
 - 2. Solid seats securely glued together of spliced, doweled, or double tongued and grooved wood pieces. Where open joints are indicated, work each wood piece from solid stock.
 - 3. Round top edges and corners where exposed.
- C. Mounting Strips, Shelves and Rods:
- 1. Cut mounting strips from 1- by 4-inch softwood stock, with exposed edge slightly rounded.
 - 2. Cut wood shelf from softwood 1-inch stock, of width shown, exposed edge slightly rounded. Option: Use 3/4-inch-thick plywood with 3/4-inch softwood edge nosing on exposed edge, slightly rounded.
 - 3. Plastic laminate covered, 3/4-inch-thick plywood core with edges and ends having plastic molded edge strips. Size, finish and number as shown.
- D. Countertops or Work Tops:
- 1. Fabrication with plastic laminate over 1-1/4-inch-thick core unless shown otherwise.
 - a. Use decorative laminate for exposed edges of tops 1-1/2-inch-wide and on backsplash and endsplash. Use plastic or metal edges for top edges less than 1-1/2 inches wide.
 - b. Countertops shall have a bullnose front edge as shown on the Drawings.
 - c. Assemble backsplash and endsplash to countertop.
 - d. Use one-piece counters for straight runs.
 - e. Miter corners for field joints with overlapping blocking on underside of joint.
 - 2. Fabricate wood counter for workbenches as shown.

PART 3 - EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

- A. Maintain work areas and storage areas to a minimum temperature of 70 degrees F for not less than 10 days before and during installation of interior millwork.
- B. Do not install finish lumber or millwork in any room or space where wet process systems such as concrete, masonry, or plaster work are not complete and dry.

3.2 INSTALLATION

A. General:

- 1. Millwork receiving transparent finish shall be primed and back-painted on concealed surfaces. Set no millwork until primed and back-painted.
- 2. Secure trim with fine finishing nails, screws, or glue as required.
- 3. Set nails for putty stopping. Use washers under bolt heads where no other bearing plate occurs.
- 4. Seal cut edges of preservative and fire-retardant treated wood materials with a certified acceptable sealer.
- 5. Coordinate with plumbing and electrical work for installation of fixtures and service connections in millwork items.
- 6. Plumb and level items unless shown otherwise.
- 7. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.

B. Benches:

- 1. Use stainless-steel countersunk screws to secure wood seats to brackets, angle, or pipe supports.
- 2. Freestanding Benches: Support within 8 inches of ends and not over 3 feet on centers with pipe bench supports.

C. Shelves:

- 1. Install mounting strip at back wall and end wall for shelves in closets where shown secured with toggle bolts at each end and not over 24-inch centers between ends.
 - a. Nail Shelf to mounting strip at ends and to back wall strip at not over 36 inches on center.
 - b. Install metal bracket, ANSI A156.16, B04041, not over 4-foot centers when shelves exceed 6 feet in length.
 - c. Install metal bracket, ANSI A156.16, B04051, not over 4 feet on centers where shelf length exceeds 6 feet in length with metal

rods, clothes hanger bars ANSI A156.16, L03131, of required
length, full length of shelf.

2. Install vertical slotted shelf standards, ANSI A156.9, B04103 to
studs with toggle bolts through each fastener opening. Double-slotted
shelf standards may be used where adjacent shelves terminate.
 - a. Install brackets ANSI A156.9, B04113, providing supports for shelf
not over 36 inches on center and within 1/2-inch of shelf end
unless shown otherwise.
 - b. Install shelves on brackets so front edge is restrained by
bracket.

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SECTION 06 61 16
SOLID POLYMER (SOLID SURFACING) FABRICATIONS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. ASTM International (ASTM):
 - ASTM D2583..... (2013) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
 - ASTM D5116..... (2010) Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
 - ASTM D570..... (1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
 - ASTM D638..... (2010) Standard Test Method for Tensile Properties of Plastics
 - ASTM D696..... (2008; E 2013) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
 - ASTM E84..... (2013a) Standard Test Method for Surface Burning Characteristics of Building Materials
 - ASTM G21..... (2009) Determining Resistance of Synthetic Polymeric Materials to Fungi
- C. International Association Of Plumbing And Mechanical Officials (IAPMO):
 - IAPMO Z124.3..... (2005) Plastic Lavatories
 - IAPMO Z124.6..... (2007) Plastic Sinks
- D. National Electrical Manufacturers Association (NEMA):
 - ANSI/NEMA LD 3..... (2005) Standard for High-Pressure Decorative Laminates
- E. NSF International (NSF):
 - NSF/ANSI 51..... (2012) Food Equipment Materials
- F. Scientific Certification Systems (SCS):
 - SCS..... Scientific Certification Systems (SCS)Indoor Advantage
- G. Tile Council Of North America (TCNA):
 - TCNA Hdbk..... (2013) Handbook for Ceramic, Glass, and Stone Tile Installation
- H. U.S. Green Building Council (USGBC):
 - LEED NC..... (2009) Leadership in Energy and Environmental Design(tm) New Construction Rating System
- I. UL Environment (ULE):
 - ULE Greenguard..... UL Greenguard Certification Program

1.2 SYSTEM DESCRIPTION

- A. Work under this Section includes counter and transaction top and other items utilizing solid polymer (solid surfacing) fabrication as shown on

the Drawings and as described in this Specification. Do not change source of supply for materials after work has started, if the appearance of finished work would be affected.

- B. In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to ensure that necessary structural wall support, cabinet countertop structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer.

1.3 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
 - 1. Shop Drawings: Show design and installation details.
 - 2. Manufacturer's Literature and Product Data:
 - a. Solid polymer material
 - b. Qualifications
 - c. Certification
 - 3. Samples: Submit a 4- by 4-inch sample of each indicated product.
 - 4. Test Reports: Solid polymer material.
 - 5. Operation and Maintenance Data: Cleanup.

1.4 QUALITY ASSURANCE

- A. Qualifications: To ensure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. Mark all fabrications with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials. Submit solid polymer manufacturer's certification attesting to fabricator qualification approval.
- B. Mock-ups: Submit Detail Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work. Prior to final approval of shop drawings, provide a full-size mock-up of a typical countertop. The mock-up shall include all solid polymer components required to provide a completed unit. The mock-up shall utilize finishes in patterns and colors indicated on the Drawings. Should the mock-up not be approved, rework or remake it until approval is secured. Remove rejected units from the jobsite. Approved mock-up may remain as part of the finished work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver materials to Project site until areas are ready for installation. Deliver components and materials to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Provide protective coverings to

prevent physical damage or staining following installation, for duration of Project.

1.6 WARRANTY

- A. Provide manufacturer's warranty of 10 years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for material and labor for replacement or repair of defective material for a period of 10 years after component installation.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Provide solid polymer material that is a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting IAPMO Z124.3 and IAPMO Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01-inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the Drawings. In no case shall material be less than ¼-inch in thickness. Submit a minimum 4- by 4-inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work. Submit test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.
- B. Cast, 100 Percent Acrylic Polymer Solid Surfacing Material: Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4,000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	0.000023-in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
¼-inch sheet	36 inches, ½-lb ball, no failure	
½-inch sheet	140 inches, ½-lb ball, no failure	
¾-inch sheet	200 inches, ½-lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51

C. Material Patterns and Colors: Patterns and colors for all solid polymer components and fabrications shall be those indicated on the Project Drawings. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

D. Surface Finish: Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be as indicated on the Drawings.

2.2 ACCESSORY PRODUCTS

- A. Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.
- B. Seam Adhesive: Seam adhesive shall be a 2-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.
- C. Panel Adhesive: Panel adhesive shall be neoprene-based panel adhesive meeting TCNA Hdbk, Underwriter's Laboratories (UL) listed. Use this adhesive to bond solid polymer components to adjacent and underlying substrates.
- D. Silicone Sealant: Sealant shall be a mildew-resistant, FDA and OSHA Nationally Recognized Testing Laboratory (NRTL) listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Use sealant to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

2.3 FABRICATIONS

- A. Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practical, in accordance with approved Shop Drawings and manufacturer's requirements. Provide factory cutouts where indicated on the Drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected. Submit product data indicating product description, fabrication information, and compliance with

specified performance requirements for solid polymer, joint adhesive, and sealants.

- B. Joints and Seams: Form joints and seams between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.
- C. Edge Finishing: Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be a bullnose as detailed on the Drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- D. Countertops: Fabricate all solid surfacing, solid polymer countertop components from ½-inch-thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Attach 2-inch-wide reinforcing strip of polymer material under each horizontal countertop seam. Submit a minimum 1-foot-wide by 6-inch-deep, full-size sample for each type of countertop shown on the Project Drawings. The sample shall include the edge profile as detailed on the Project Drawings. Solid polymer material shall be of a pattern and color as indicated on the Drawings. Sample shall include at least 1 seam. Approved sample shall be retained as standard for this work.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Components: Install all components and fabricated units plumb, level, and rigid. Make field joints between solid polymer components using solid polymer manufacturer's approved seam adhesives, to provide a monolithic appearance with joints inconspicuous in the finished work.
- B. Silicone Sealant: Use a clear, silicone sealant or caulk to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors and ceiling. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

3.2 CLEANUP

- A. Components shall be cleaned after installation and covered to protect against damage during completion of the remaining Project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. Submit a minimum of 6 copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided, if available. Maintenance kit for matte finishes shall be submitted.

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SECTION 06 61 60
TRANSLUCENT RESIN PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the plastic fabrication of translucent resin panels as shown and specified in the described system(s) and related accessories.
 - 1. Front of transaction desk.
- B. The extent of solid polymer fabrication is shown on the Drawings.
- C. Related Sections include the following: Section 06 20 00 FINISH CARPENTRY.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Project Pre-installation Meeting:
 - 1. Owner, Architect, Contractor, Installer shall meet at Project site within 1 week of scheduled installation.
 - 2. Review mounting conditions, installation and storage instructions, fabrication requirements, seaming and protection measures.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product List: Minimum of 3 completed installations or 3 installations of similar materials and complexity. Include contact name and email address for each product.
- C. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.
- D. Submit product test reports from a qualified independent third party testing agency indicating each type and class of panel system complies with the Project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this Project.
 - 1. Test reports required are:
 - a. Rate of Burning (ASTM D 635).
 - b. Self-Ignition Temperature (ASTM D 1929).
 - c. Density of Smoke (ASTM D 2843).
- E. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.
- F. Samples for Initial Selection: Submit minimum 2-inch by 2-inch samples. Indicate full color, texture and pattern variation.
- G. Samples for Verification: Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid translucent resin panel plastic fabrication.

H. Mockups:

1. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects.
2. Build mockup of each type of plastic fabrication.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications:

1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least 3 consecutive years and which can show evidence of those materials being satisfactorily used on at least 3 projects of similar size, scope and location. At least 1 of the projects shall have been successful for use 1 year or longer.
2. Manufacturer must offer a documented reclamation process that will take back, at the manufacturer's cost, panels that are at their end of life cycle.
3. Manufacturer must have documented training and qualification program for fabrication and installation of plastic fabrications.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plastic fabrications, systems and specified items in manufacturer's standard protective packaging.
- B. Do not deliver plastic fabrications, system, components and accessories to Project site until areas are ready for installation.
- C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements. Materials are to be protected against damage from moisture and direct sunlight.
- D. Store in area of installation minimum of 24 hours prior to installation.
- E. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of Project.
- F. Before installing plastic fabrications, permit them to reach room temperature.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install solid polymer fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

- A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.
- B. Warranty Period: 1 year after Substantial Completion Date.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: Basis of Design: 3form, Inc., Salt Lake City, Utah, USA, telephone 801-649-2500.

2.2 MATERIALS

- A. 3form Chroma:
 - 1. Engineered acrylic resin
 - 2. Sheet Size: Maximum 4' x 10'.
 - 3. Thickness: Minimum ½-inch.
 - 4. Basis of Design Product: The design of plastic fabrications is based on Chroma as provided by 3form, Inc. Products from other manufacturers must be approved by the Contracting Officer's Representative (COR) prior to bidding in accordance with the Instructions to Bidders.
- B. Sheet Minimum Performance Attributes:
 - 1. Rate of Burning (ASTM D 635). Material must attain CC2 Rating for a nominal thickness of 0.060-inch and greater.
 - 2. Self-Ignition Temperature (ASTM D 1929). Material must have a self-ignition temperature greater than 850 degrees F.
 - 3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 10 percent.
 - 4. Color infusion must use water soluble dyes and penetrate at least 150 microns into material.
 - 5. Applied coatings must be low-VOC, contain non-toxic pigments, not contain any heavy metals and be approved for exterior use.
 - 6. Matte surface should be completely renewable onsite.

2.3 FABRICATION

- A. General: Fabricate plastic fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the Drawings. Panels shall incorporate rounded, polished edges as shown on Drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
 - 1. Sawing: Select equipment and blades suitable for type of cut required.
 - 2. Drilling: Drills specifically designed for use with plastic products.

- 3. Routing.
- 4. Tapping.
- D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
 - 1. Cold bending.
 - 2. Hot bending.
 - 3. Thermoforming: Acceptable only on uncoated material.
 - 4. Drape forming.
 - 5. Matched mold forming.
 - 6. Mechanical forming.
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Standoffs/Spacers: Furnish standoffs for panel installation to keep panels clear off transaction desk surface and allow for installation of lighting as shown on the Drawings. Standoffs shall be brushed stainless steel or brushed chrome.
- D. Fasteners: Use screws designed specifically for plastics. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.
- E. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of plastic fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for the installation of plastic fabrications. Sizes, profiles and other characteristics are indicated on the Drawings.
- B. Panels have a directional pattern to be maintained for the entire installation. Application of panels shall be of a single panel without seams and/or joints. Follow manufacturer's installation instructions and as shown on the Drawings.
- C. Manufacturer's shop shall fabricate items to the greatest degree possible.
- D. Installation should be performed by an authorized installer.

- E. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- F. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- G. Panel edges shall be polished.

3.3 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of Substantial Completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

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SECTION 07 21 13
THERMAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This Section specifies acoustical insulation for buildings.
- B. Acoustical insulation is identified by thickness and words "Acoustical Insulation."

1.2 RELATED WORK

- A. Section 09 22 16, NON-STRUCTURAL FRAMING.
- B. Section 09 29 00, GYPSUM BOARD.

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. Insulation, each type used.
 - 2. Adhesive, each type used.
 - 3. Tape.
- C. Certificates: Stating the type and thickness of the insulation to be installed.

1.4 STORAGE AND HANDLING:

- A. Store insulation materials in weathertight enclosure.
- B. Protect insulation from damage from handling, weather and construction operations before, during, and after installation.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C270-10.....Mortar for Unit Masonry
 - C516-08.....Vermiculite Loose Fill Thermal Insulation
 - C549-06.....Perlite Loose Fill Insulation
 - C552-07.....Cellular Glass Thermal Insulation
 - C553-08.....Mineral Fiber Blanket Thermal Insulation for
Commercial and Industrial Applications
 - C578-10.....Rigid, Cellular Polystyrene Thermal Insulation
 - C591-09.....Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation

C612-10.....Mineral Fiber Block and Board Thermal
Insulation
C665-06.....Mineral Fiber Blanket Thermal Insulation for
Light Frame Construction and Manufactured
Housing
C728-05 (R2010).....Perlite Thermal Insulation Board
C954-10.....Steel Drill Screws for the Application of
Gypsum Panel Products or Metal Plaster Base to
Steel Studs From 0.033-inch to 0.112-inch 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
D312-00(R2006).....Asphalt Used in Roofing
E84-10.....Surface Burning Characteristics of Building
Materials
F1667-11.....Driven Fasteners: Nails, Spikes and Staples

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL:

- A. Where acoustical or sound insulation is specified or shown for insulation, the thickness shown on the Drawings is nominal. Use only insulation with actual thickness that is not less than that required to provide the acoustical resistance specified.
- B. Where more than one type of insulation is specified, the type of insulation for each use is optional, except use only one type of insulation in any particular area.

2.2 ACOUSTICAL INSULATION:

- A. Mineral Fiber Boards: ASTM C553, Type II, flexible, or Type III, semirigid (4.5-pound nominal density).
- B. Mineral Fiber Batt or Blankets: ASTM C665. Maximum flame spread of 25 and smoke development of 450 when tested in accordance with ASTM E84.
- C. Thickness as shown; of widths and lengths to fit tight against framing.

2.3 FASTENERS:

- A. Staples or Nails: ASTM F1667, zinc-coated, size and type best suited for purpose.
- B. Screws: ASTM C954 or C1002, size and length best suited for purpose with washer not less than 2 inches in diameter.

- C. Impaling Pins: Steel pins with head not less than 2 inches in diameter with adhesive for anchorage to substrate. Provide impaling pins of length to extend beyond insulation and retain cap washer when washer is placed on the pin.

2.4 ADHESIVE:

- A. As recommended by the manufacturer of the insulation.
- B. Asphalt: ASTM D312, Type III or IV.
- C. Mortar: ASTM C270, Type 0.

2.5 TAPE:

- A. Pressure-sensitive adhesive on one face.
- B. Perm rating of not more than 0.50.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install batt or blanket insulation with tight joints and filling framing void completely. Seal cuts, tears, and unlapped joints with tape.
- B. Fit insulation tight against adjoining construction and penetrations, unless specified otherwise.

3.2 ACOUSTICAL INSULATION:

- A. Fasten blanket insulation between metal studs and wall furring with continuous pressure-sensitive tape along edges or adhesive.
- B. Pack insulation around door frames and windows and in cracks, expansion joints, control joints, door soffits and other voids. Pack behind outlets, around pipes, ducts, and services encased in wall or partition. Hold insulation in place with pressure-sensitive tape or adhesive.
- C. Do not compress insulation below required thickness except where embedded items prevent required thickness.
- D. Where acoustical insulation is installed above suspended ceilings, install blanket at right angles to the main runners or framing. Extend insulation over wall insulation systems not extending to structure above.
- E. Where semirigid insulation is used which is not full thickness of cavity, adhere to one side of cavity maintaining continuity of insulation and covering penetrations or embedments in insulation.

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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.
- B. Closure of openings in walls against penetration of gases or smoke in smoke partitions.

1.2 RELATED WORK

- 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

- A. Firestopping work subject to the terms of the Article "Warranty of Construction," FAR clause 52.246-21, except extend the warranty period to 5 years.

1.6 QUALITY ASSURANCE

- A. 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 4-inch-nominal pipe or 16 square inches 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 shall be asbestos free.

2.2 SMOKE STOPPING IN SMOKE PARTITIONS

- A. Use silicone sealant in smoke partitions as specified in Section 07 92 00, JOINT SEALANTS.
- B. Use mineral fiber filler and bond breaker behind sealant.
- C. Sealants shall have a maximum flame spread of 25 and smoke developed of 50 when tested in accordance with E84.
- D. When used in exposed areas, capable of being sanded and finished with similar surface treatments as used on the surrounding wall or floor surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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 6 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 CLEANUP AND ACCEPTANCE OF WORK

- A. As work on each floor is completed, remove materials, litter, and debris.
- B. Do not move materials and equipment to the next scheduled work area until completed Work is inspected and accepted by the COR.
- C. Clean up spills of liquid-type materials.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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. Masonry Control and Expansion Joint: Section 04 20 00, UNIT MASONRY.
- B. Firestopping Penetrations: Section 07 84 00, FIRESTOPPING.
- C. Glazing: Section 08 80 00, GLAZING.
- D. Glazed Aluminum Storefront: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- E. Sound-Rated Gypsum Partitions/Sound Sealants: Section 09 29 00, GYPSUM BOARD.
- F. Mechanical Work: Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION; Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING; 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. Volatile Organic Compound (VOC): Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

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. 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 40 degrees F.
 - b. When joint substrates are wet.

B. Joint-Width Conditions: 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: 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 90 degrees F or less than 40 degrees 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 sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction," FAR Clause 52.246-21, except that warranty period shall be extended to 2 years.
- 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 1,200 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.

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, 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 26 degrees 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 - NONPOROUS SURFACES

- A. 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 nonporous 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 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 1/4-inch, sealant depth equal to width.

B. At widths over 1/4-inch, sealant depth 1/2 of width up to 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 40 degrees and 100 degrees 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 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 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.

3.7 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. Sanitary Joints:
 1. Walls to Plumbing Fixtures: Type S-9.
 2. Counter Tops to Walls: Type S-9.
 3. Pipe Penetrations: Type S-9.
- B. High-Temperature Joints over 400 degrees F:
 1. Exhaust Pipes, Flues, Breech Stacks: Type S-7 or S-8.
- C. Interior Caulking:
 1. Typical Narrow Joint 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. Perimeter of Lead-Faced Control Windows and Plaster or Gypsum Wallboard Walls: Types C-1 and C-2.
 5. Exposed Isolation Joints at Top of Full-Height Walls: Types C-1 and C-2.
 6. Exposed Acoustical Joint at Sound-Rated Partitions Type C-2.

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7. Concealed Acoustic Sealant: Types S-4, C-1 and C-2.

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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. Door Hardware: Section 08 71 00, DOOR HARDWARE.
- B. Glazing: Section 08 80 00, GLAZING.

1.3 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.
 - 2. Sound-rated doors, including test report from Testing Laboratory.

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. Door and Hardware Institute (DHI):
 - A115 Series.....Steel Door and Frame Preparation for Hardware, Series A115.1 through A115.17 (Dates Vary)
- C. 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

D. American National Standard Institute:

A250.8-2003 (R2008).....Specifications for Standard Steel Doors and
Frames

E. 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

D1621-10.....Compressive Properties of Rigid Cellular
Plastics

E90-09.....Laboratory Measurement of Airborne Sound
Transmission Loss of Building Partitions

F. The National Association Architectural Metal Manufacturers (NAAMM):
Metal Finishes Manual (AMP 500-06)

G. National Fire Protection Association (NFPA):

80-13.....Fire Doors and Fire Windows

H. Underwriters Laboratories, Inc. (UL):

Fire Resistance Directory

I. Factory Mutual System (FM):

Approval Guide

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Steel: ASTM A1008, cold-rolled for panels (face sheets) of doors.

B. Anchors, Fastenings and Accessories: Fastenings anchors, clips
connecting members and sleeves from zinc coated steel.

C. 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, 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.
- B. Standard-Duty Doors: ANSI A250.8, Level 1, full-flush seamless design of size and design shown. Use for interior locations only. Do not use for stairwell doors, security doors and detention doors.
- C. Heavy-Duty Doors: ANSI A250.8, Level 2, full-flush seamless design of size and design shown. Core Construction Types A, D, or F, for interior doors, and, Types B, C, E, or F, for exterior doors.
- D. Custom Metal Hollow Doors: 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, 0.053-inch-thick sheet steel, types and styles as shown or scheduled.
 2. Frames for exterior doors: Fabricate from 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. 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.
- B. Reinforcement and Covers:
 1. ANSI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
 2. Provide mortar guards securely fastened to back of hardware reinforcements.
- C. Terminated Stops: ANSI A250.8. Stops shall be terminated 6 inches above finished floor, cut at a 45-degree angle, and capped with a steel welded plate of the same gage as the door frame.

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 0.053-inch-thick steel clip angles welded to jamb and drilled to receive two 1/4-inch floor bolts.
- c. Where mullions occur, provide 0.093-inch-thick steel channel anchors, drilled for two 1/4-inch floor bolts and frame anchor screws.

2. Jamb Anchors:

- a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 24 inches apart, except for fire-rated frames space anchors as required by labeling authority.
- b. Form jamb anchors of not less than 0.042-inch-thick steel unless otherwise specified.
- c. 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.
- d. Anchors for Frames Set in Prepared Openings:
 - 1) Steel pipe spacers with 1/4-inch inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 2 inches wide, welded to jamb near stop.
 - 2) Drill jamb stop and strap spacers for 1/4-inch flat head bolts to pass through frame and spacers.
- e. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.4 SHOP PAINTING

- A. 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 1/4-inch-diameter expansion bolts.
2. Power-actuated drive pins may be used to secure frame anchors to concrete floors.

C. Jamb Anchors:

1. Secure anchors to sides of studs with 2 fasteners through anchor tabs. Use steel drill screws to steel studs.
2. Frames set in prepared openings of masonry or concrete: Expansion bolt to wall with 1/4-inch expansion bolts through spacers. Where subframes or rough bucks are used, 1/4-inch expansion bolts on 24-inch centers or power-activated drive pins 24 inches on centers.

- D. Install anchors for labeled fire-rated doors to provide rating as required.

3.2 INSTALLATION OF DOORS AND APPLICATION OF HARDWARE

- A. Install doors and hardware as specified herein and in Section 08 14 00, WOOD DOORS and Section 08 71 00, DOOR HARDWARE.

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SECTION 08 14 00
INTERIOR WOOD DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies interior flush doors with plastic-laminate faces.
- B. Section includes fire-rated doors, sound-retardant doors, and smoke doors.

1.2 RELATED WORK

- A. Metal Door Frames: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Doors and frames of a forced entry/ballistic resistant rated: Section 08 34 53, SECURITY DOORS AND FRAMES.
- C. Door Hardware Including Hardware Location (Height): Section 08 71 00, DOOR HARDWARE.
- D. Installation of Doors and Hardware: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES, Section 08 14 00, WOOD DOORS, or Section 08 71 00, DOOR HARDWARE.
- E. Glazing: Section 08 80 00, GLAZING.
- F. Finish: Section 09 06 00, SCHEDULE FOR FINISHES.
- G. Card Readers and Biometric Devices: Section 28 13 00, ACCESS CONTROL.
- H. Intrusion Alarm: Section 28 16 11, INTRUSION DETECTION SYSTEM.
- I. Security Monitors: Section 28 51 00, SECURITY CONTROL CENTER.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Corner section of flush plastic-laminate face door 12-inches square, showing details of construction, labeled to show grade and type number and conformance to specified standard.
 - 2. Plastic-laminate sample 8 inches by 11 inches by 1/4-inch showing specified color and finish.
- C. Shop Drawings:
 - 1. Show every door in Project and schedule location in building.
 - 2. Indicate type, grade, finish and size; include detail of glazing, sound gasketing, and pertinent details.
 - 3. Provide information concerning specific requirements not included in the manufacturer's literature and data submittal.

D. Manufacturer's Literature and Data:

1. Sound-rated doors, including test report indicating STC rating per ASTM E90 from test laboratory.
2. Labeled fire-rated doors showing conformance with NFPA 80.

E. Laboratory Test Reports:

1. Screw-holding capacity test report in accordance with WDMA T.M.10.
2. Split-resistance test report in accordance with WDMA T.M.5.
3. Cycle/Slam test report in accordance with WDMA T.M.7.
4. Hinge-loading test report in accordance with WDMA T.M.8.

1.4 WARRANTY

A. Doors are subject to terms of Article titled "Warranty of Construction," FAR Clause 52.246-21, except that warranty shall be as follows:

1. For interior doors, manufacturer's warranty for lifetime of original installation.
2. Specified STC RATING for sound-retardant rated door assembly in place.

1.5 DELIVERY AND STORAGE

- A. Factory seal doors and accessories in minimum of 6-mil polyethylene bags or cardboard packages which shall remain unbroken during delivery and storage.
- B. Store in accordance with WDMA I.S.1-A, Jobsite Information.
- C. Label package for door opening where used.

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. Window and Door Manufacturers Association (WDMA):

- I.S.1A-11.....Architectural Wood Flush Doors
- I.S.4-09.....Water-Repellent Preservative Non-Pressure
Treatment for Millwork
- I.S.6A-11.....Architectural Wood Stile and Rail Doors
- T.M.6-08.....Adhesive (Glue Bond) Durability Test Method
- T.M.7-08.....Cycle-Slam Test Method
- T.M.8-08.....Hinge-Loading Test Method
- T.M.10-08.....Screw-Holding Test Method

- C. National Fire Protection Association (NFPA):
 - 80-10.....Protection of Buildings from Exterior Fire
 - 252-08.....Fire Tests of Door Assemblies
- D. ASTM International (ASTM):
 - E90-09.....Laboratory Measurements of Airborne Sound
Transmission Loss

PART 2 - PRODUCTS

2.1 FLUSH DOORS

- A. General:
 - 1. Meet requirements of WDMA I.S.1-A, Extra Heavy Duty.
 - 2. Adhesive: Type II.
 - 3. Thickness: 1-3/4 inches unless otherwise shown or specified.
- B. Plastic-Laminate-Faced Doors:
 - 1. Interior Solid-Core Doors (SC):
 - a. Grade: Custom.
 - b. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD3, Grade HGS.
 - c. Color, Patterns, and Finishes: As indicated on the Drawings.
 - d. Exposed Vertical Edges: Plastic laminate that matches faces, applied before faces.
 - e. Core: Particleboard.
 - f. Construction: Three plies. Stiles and rails are bonded to core, and then entire unit is abrasive planed before faces are applied. Faces are bonded to core using a hot press.
 - 2. Glazing: On non-labeled doors, use applied wood stops nailed tight on room side and attached on opposite side with flathead, countersunk wood screws, spaced approximately 5 inches on centers.
- C. Stiles and Rails:
 - 1. Option for Wood Stiles and Rails: Composite material having screw withdrawal force greater than minimum performance level value when tested in accordance with WDMA T.M.10.
 - 2. Provide adequate blocking for bottom of doors having mechanically operated door bottom seal meeting or exceeding the performance duty level per T.M.10 for horizontal door edge screw holding.

D. Fire-Rated Wood Doors:

1. Fire Performance Rating: Furnish doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated on the Drawings.
2. Labels:
 - a. Doors shall conform to the requirements of ASTM E2074, or NFPA 252, and, carry an identifying label from a qualified testing and inspection agency for class of door or opening shown designating fire performance rating.
 - b. Metal labels with raised or incised markings.
3. Performance Criteria for Stiles of doors utilizing standard mortise leaf hinges:
 - a. Hinge Loading: WDMA T.M.8. Average of 10 test samples for extra-heavy-duty doors.
 - b. Direct Screw Withdrawal: WDMA T.M.10 for extra-heavy-duty doors. Average of 10 test samples using a steel, fully threaded No. 12 wood screw.
 - c. Cycle Slam: 1,000,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with WDMA T.M.7.
4. Additional Hardware Reinforcement:
 - a. Provide fire-rated doors with hardware reinforcement blocking.
 - b. Size of lock blocks as required to secure hardware specified.
 - c. Top, bottom and intermediate rail blocks shall measure not less than 5 inches minimum by full core width.
 - d. Reinforcement blocking in compliance with manufacturer's labeling requirements.
 - e. Mineral material similar to core is not acceptable.
5. Other Core Components: Manufacturer's standard as allowed by the labeling requirements.
6. Provide steel frame approved for use in labeled doors for vision panels.
7. Provide steel astragal on pair of doors.

E. Smoke Barrier Doors:

1. For glazed openings use steel frames approved for use in labeled doors.

2. Provide a steel astragal on one leaf of pairs of doors, including double egress doors.

F. Sound-Rated Doors:

1. Fabricated as specified for flush wood doors with additional construction requirements to meet specified sound transmission class (STC).
2. STC Rating of the door assembly in place when tested in accordance with ASTM E90 by an independent nationally recognized acoustical testing laboratory not less than 36.
3. Accessories:
 - a. Frame Gaskets: Continuous closed-cell sponge neoprene with stop adjusters.
 - b. Automatic Door Bottom Seal:
 - 1) Steel spring operated, closed-cell sponge neoprene metal mounted removable in extruded aluminum housing with a medium matte 4.0 mil thick clear anodized finish.
 - 2) Concealed or surface-mounted.

2.2 PREFINISH, PREFIT OPTION

- A. Flush doors may be factory machined to receive hardware, bevels, undercuts, cutouts, accessories and fitting for frame.
- B. Factory fitting to conform to Specification for shop and field fitting, including factory application of sealer to edge and routings.

2.3 IDENTIFICATION MARK:

- A. On top edge of door.
- B. Either a stamp, brand or other indelible mark, giving manufacturer's name, door's trade name, construction of door, code date of manufacture and quality.
- C. Accompanied by either of the following additional requirements:
 1. An identification mark or a separate certification including name of inspection organization.
 2. Identification of standards for door, including glue type.
 3. Identification of plastic-laminate face and quality certification.

2.4 SEALING

- A. Give top and bottom edge of doors 2 coats of catalyzed polyurethane or water-resistant sealer before sealing in shipping containers.

PART 3 - EXECUTION

3.1 DOOR PREPARATION

- A. Field, shop or factory preparation: Do not violate the qualified testing and inspection agency label requirements for fire-rated doors.
- B. Clearances between Doors and Frames and Floors:
 - 1. Maximum 1/8-inch clearance at the jambs, heads, and meeting stiles, and a 3/4-inch clearance at bottom, except as otherwise specified.
 - 2. Maximum clearance at bottom of sound rated doors, light-proofed doors, doors to operating rooms, and doors designated to be fitted with meal: 3/8-inch.
- C. Provide cutouts for special details required and specified.
- D. Route doors for hardware using templates and location heights specified in Section, 08 71 00 DOOR HARDWARE.
- E. Fit doors to frame, bevel lock edge of doors 1/8-inch for each 2 inches of door thickness undercut where shown.
- F. Immediately after fitting and cutting of doors for hardware, seal cut edges of doors with two coats of water-resistant sealer.
- G. Finish surfaces, including both faces, top and bottom and edges of the doors smooth to touch.
- H. Apply a steel astragal on the opposite side of active door on pairs of fire-rated doors.
- I. Apply a steel astragal to meeting style of active leaf of pair of doors or double egress smoke doors.

3.2 INSTALLATION OF DOORS APPLICATION OF HARDWARE

- A. Install doors and hardware as specified in this Section.

3.3 DOOR PROTECTION

- A. As door installation is completed, place polyethylene bag or cardboard shipping container over door and tape in place.
- B. Provide protective covering over knobs and handles in addition to covering door.
- C. Maintain covering in good condition until removal is approved by COR.

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**SECTION 08 31 13 ACCESS
DOORS AND FRAMES**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section specifies access doors or panels.

1.2 RELATED WORK

- A. Lock Cylinders: Section 08 71 00, DOOR HARDWARE.
B. Access Doors in Acoustical Ceilings: Section 09 51 00, ACOUSTICAL
CEILINGS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT
DATA, AND SAMPLES.
B. Shop Drawings: Access doors, each type, showing construction, location
and installation details.
C. Manufacturer's Literature and Data: Access doors, each type.

1.4 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 Society for Testing and Materials (ASTM):
A167-99(R-2009).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet and Strip
A1008-10.....Steel Sheet, Cold-Rolled, Carbon, Structural,
High-Strength Low-Alloy
C. American Welding Society (AWS):
D1.3-08.....Structural Welding Code Sheet Steel
D. National Fire Protection Association (NFPA):
80-10.....Fire Doors and Windows
E. The National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500 Series.....Metal Finishes Manual
F. Underwriters Laboratories, Inc. (UL):
Fire Resistance Directory

PART 2 - PRODUCTS

2.1 FABRICATION, GENERAL

- A. Fabricate components to be straight, square, flat and in same plane
where required.

1. Slightly round, exposed edges and without burrs, snags and sharp edges.
 2. Exposed welds continuous and ground smooth.
 3. Weld in accordance with AWS D1.3.
- B. Number of locks and non-continuous hinges as required to maintain alignment of panel with frame. For fire-rated doors, use hinges and locks as required by fire test.
- C. Provide anchors or make provisions in frame for anchoring to adjacent construction. Provide size, number and location of anchors on 4 sides to secure access door in opening. Provide anchors as required by fire test.

2.2 ACCESS DOORS, FIRE-RATED

- A. Shall meet requirements for "B" label 1-1/2 hours with maximum temperature rise of 250 degrees F.
- B. Comply with NFPA 80 and have Underwriters Laboratories Inc., or other nationally recognized laboratory label for Class B opening.
- C. Door Panel: Form of 0.0359-inch-thick steel sheet, insulated sandwich-type construction.
- D. Frame: Form of 0.0598-inch-thick steel sheet of depth and configuration to suit material and type of construction where installed. Provide frame flange at perimeter where installed in concrete masonry or gypsum board openings.
1. Weld exposed joints in flange and grind smooth.
 2. Provide frame flange at perimeter where installed in concrete masonry or gypsum board.
- E. Automatic Closing Device: Provide automatic closing device for door.
- F. Hinge: Continuous steel hinge with stainless-steel pin.
- G. Lock:
1. Self-latching, with provision for fitting flush a standard screw-in type lock cylinder. Lock cylinder specified in Section 08 71 00, DOOR HARDWARE.
 2. Provide latch release device operable from inside of door. Mortise case in door.

2.3 ACCESS DOORS, FLUSH PANEL

- A. Door Panel:
1. Form of 0.0747-inch-thick steel sheet.
 2. Reinforce to maintain flat surface.

B. Frame:

1. Form of 0.0598-inch-thick steel sheet of depth and configuration to suit material and type of construction where installed.
2. Provide surface-mounted units having frame flange at perimeter where installed in concrete, masonry, or gypsum board construction.
3. Weld exposed joints in flange and grind smooth.

C. Hinge:

1. Concealed spring hinge to allow panel to open 175 degrees.
2. Provide removable hinge pin to allow removal of panel from frame.

D. Lock:

1. Flush, screwdriver-operated cam lock.
2. Provide tamper-proof screws (spanner head locks).

2.4 FINISH

- A. Provide in accordance with NAAMM AMP 500 Series on exposed surfaces.
- B. Steel Surfaces: Baked-on prime coat over a protective phosphate coating.

2.5 SIZE

- A. Minimum 24-inch-square door unless otherwise shown or required.

PART 3 - EXECUTION

3.1 LOCATION

- A. Provide access panels or doors wherever any valves, traps, dampers, cleanouts, and other control items of mechanical, electrical and conveyor work are concealed in wall or partition, or are above ceiling of gypsum board or plaster.
- B. Use fire-rated doors in fire-rated partitions and ceilings.
- C. Use flush panels in partitions and gypsum board or plaster ceilings.

3.2 INSTALLATION, GENERAL

- A. Install access doors in openings to have sides vertical in wall installations, and parallel to ceiling suspension grid or side walls when installed in ceiling.
- B. Set frames so that edge of frames without flanges will finish flush with surrounding finish surfaces.
- C. Set frames with flanges to overlap opening and so that face will be uniformly spaced from the finish surface.

3.3 ANCHORAGE

- A. Secure frames to adjacent construction using anchors attached to frames or by use of bolts or screws through the frame members.

- B. Type, size and number of anchoring device suitable for the material surrounding the opening, maintain alignment, and resist displacement during normal use of access door.
- C. Anchors for fire-rated access doors shall meet requirements of applicable fire test.

3.4 ADJUSTMENT

- A. Adjust hardware so that door panel will open freely.
- B. Adjust door when closed so door panel is centered in the frame.

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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 14 00, WOOD DOORS; Section 08 11 13, HOLLOW METAL DOORS AND FRAMES; Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- C. Painting: Section 09 91 00, PAINTING.
- D. Card Readers: Section 28 13 11, PHYSICAL ACCESS CONTROL SYSTEMS.
- E. Electrical: Division 26, ELECTRICAL.
- F. Fire Detection: Section 28 31 00, FIRE DETECTION AND ALARM.

1.3 GENERAL

- A. All hardware shall comply with Uniform Federal Accessible Standards (UFAS), 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 and wood doors.
 - 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, except that the warranty period shall be 2 years in lieu of 1 year for all items except as noted below:
1. Locks, Latchsets, and Panic Hardware: 5 years.
 2. Door Closers and Continuous Hinges: 10 years.

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 4 years of submittal of reports for approval.

1.7 DELIVERY AND MARKING

- A. Deliver items of hardware to jobsite in their original containers, complete with necessary appurtenances including screws, keys, and instructions. Tag one of each different item of hardware and deliver to Contracting Officer's Representative (COR) 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:

1. All cylinders shall be keyed into existing Great Grand Master Key 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.
2. Keying will be accomplished by the VA's locksmith. Contractor shall remove construction cores at the end of the Project and furnish new Project removable cores, properly labeled for VA use.

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
 - A156.12-05Interconnected Locks and Latches
 - A156.13-05.....Mortise Locks and Latches Series 1000
 - A156.14-07Sliding and Folding Door Hardware

- A156.15-06.....Release Devices-Closer Holder, Electromagnetic
and Electromechanical
- A156.16-08.....Auxiliary Hardware
- A156.17-04Self-Closing Hinges and Pivots
- A156.18-06.....Materials and Finishes
- A156.20-06Strap 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
- A156.25-07Electrified Locking Devices
- A156.26-06.....Continuous Hinges
- A156.28-07Master Keying Systems
- A156.29-07Exit Locks and Alarms
- A156.30-03High Security Cylinders
- A156.31-07Electric 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 3-knuckle hinges, except 5-knuckle where the required hinge type is not available in a 3-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 3 feet wide or less and Type A2111/A5111 for doors over 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 3 feet wide or less and Type A8111/A5111 for doors over 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 4 Feet High: 2 hinges.
 2. Doors 4 Feet to 7 Feet 5 Inches High: 3 hinges minimum.
 3. Doors Greater than 7 Feet 5 Inches High: 4 hinges.
 4. Doors Up to 3 Feet Wide, Standard Weight: 4-1/2-inch by 4-1/2-inch hinges.
 5. Doors Over 3 Feet to 3 Feet 6 Inches Wide, Standard Weight: 5 inches by 4-1/2 inches.
 6. Doors Over 3 Feet 6 Inches to 4 Feet, Heavy Weight: 5 inches by 4-1/2 inches.
 7. Provide heavy-weight hinges where specified.
 8. At doors weighing 150 lbs. or more, furnish 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 CONTINUOUS HINGES

- A. ANSI/BHMA A156.26, Grade 1-600.
1. Listed under Category N in BHMA's "Certified Product Directory."
- B. General: Minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete
- C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a Teflon-coated 0.25-inch minimum diameter pin that extends entire length of hinge.
1. Base Metal for Exterior Hinges: Stainless steel.
 2. Base Metal for Interior Hinges: Steel.
 3. Base Metal for Hinges for Fire-Rated Assemblies: Steel.
 4. Provide with non-removable pin (hospital tip option) at lockable outswing doors.
 5. Where required to clear adjacent casing, trim, and wall conditions and allow full door swing, provide wide throw hinges of minimum width required.
 6. Where models are specified that provide an integral wrap-around edge guard for the hinge edge of the door, provide manufacturer's adjustable threaded stud and machine screw mechanism to allow the door to be adjusted within the wrap-around edge guard.

2.3 DOOR CLOSING DEVICES

- A. Closing devices shall be products of one manufacturer.

2.4 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 1½-inch minimum piston diameter.

2.5 FLOOR CLOSERS AND FLOOR PIVOT SETS

A. Comply with ANSI A156.4. Provide stainless-steel floor plates for floor closers and floor pivots, except where metal thresholds occur. Provide cement case for all floor closers. Floor closers specified for fire doors shall comply with Underwriters Laboratories, Inc., requirements for concealed type floor closers for classes of fire doors indicated on Drawings. Hold-open mechanism, where required, shall engage when door is opened 105 degrees, except when door swing is limited by building construction or equipment, the hold-open feature shall engage when door is opened approximately 90 degrees. The hold-open mechanism shall be selectable on/off by turning a screw through the floor plate. Floor closers shall have adjustable hydraulic back-check, adjustable close speed, and adjustable latch speed. Provide closers with delayed action where a hold-open mechanism is not required. Floor closers shall be multi-sized. Single-acting floor closers shall also have built-in dead stop. Where required, provide closers with special cement cases appropriate for shallow deck installation or where concrete joint lines run through the floor blockout. At offset-hung doors installed in deep reveals, provide special closer arm and spindle to allow for installation. Where stone or terrazzo is applied over the floor closer case, provide closer without floor plate and with extended spindle (length as required) and special cover pan (depth as required) to allow closer to be accessed without damaging the material applied over the closer. Pivots for non-labeled doors shall be cast, forged or extruded brass or bronze.

B. Where floor closer appears in hardware set provide the following as applicable.

1. Double-Acting Floor Closers: Type C06012.
2. Single-Acting Floor Closer: Type C06021 (center pivoted).
(Intermediate pivot is not required.)
3. Single-Acting Floor Closers: Type C06041 (offset pivoted).

4. Single-Acting Floor Closer for Labeled Fire Doors: Type C06051
(offset pivoted).

5. Single-Acting Floor Closers for Lead-Lined Doors: Type C06071
(offset pivoted).

2.6 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 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 2 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 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.
- K. Where the specified wall or floor stop cannot be used, provide concealed overhead stops (surface-mounted where concealed cannot be used).

2.7 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.

2.8 FLOOR DOOR HOLDERS

- A. Conform to ANSI Standard A156.16. Provide extension strikes for Types L01301 and L01311 holders where necessary.

2.9 LOCKS AND LATCHES

- A. Basis of Design: Provide locks and latches by Yale Locks & Hardware, 225 Episcopal Road, Berlin, CT 06037-4004, telephone 800-438-1951, fax 800-338-0965, www.yalelocks.com.
 - 1. 8800 Series, Grade 1, mortise locks.
 - 2. Cylindrical locksets, Grade 1, of series as applicable to indicated door functions per Door Hardware Schedule.
 - 3. Hardware Trim: Carmel - CRR.
- B. Conform to ANSI A156.2. Locks and latches for doors 1-3/4 inches thick or over shall have beveled fronts. Lock cylinders shall have not less than 7 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 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.
- C. 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 Yale Series 8800, Grade 1. All locksets and latchsets shall have lever handles fabricated from cast stainless

- steel. Provide sectional (lever x rose) lever design matching. No substitute lever material shall be accepted. All locks and latchsets shall be furnished with 4-7/8-inch curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 7/8-inch lip-to-center dimension. Lock function F02 shall be furnished with emergency tools/keys for emergency entrance. 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 Americans with Disabilities Act (ADA) requirements. Cylindrical locksets shall be Series 4000 Grade I. All locks and latchsets shall be furnished with 4-7/8-inch curved lip strike and wrought box. At outswing pairs with overlapping astragals, provide flat lip strip with 7/8-inch lip-to-center dimension. Provide lever design to match design selected by Architect or to match existing lever design. Where 2 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. 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).

2.10 PUSH-BUTTON COMBINATION LOCKS

- A. ANSI/BHMA A156.13, Grade 1. Battery operated pushbutton entry.
- B. Construction: Heavy-duty mortise lock housing conforming to ANSI/BHMA A156.13, Grade 1. Lever handles and operating components in compliance with the UFAS and the ADA Accessibility Guidelines. Match lever handles of locks and latchsets on adjacent doors.

- C. Special Features: Key override to permit a master keyed security system and a pushbutton security code activated passage feature to allow access without using the entry code.

2.11 ELECTROMAGNETIC LOCKS

- A. ANSI/BHMA A156.23; electrically powered, of strength and configuration indicated; with electromagnet attached to frame and armature plate attached to door. Listed under Category E in BHMA's "Certified Product Directory."
1. Type: Full exterior or full interior, as required by application indicated.
 2. Strength Ranking: 1,000 lbf.
 3. Inductive Kickback Peak Voltage: Not more than 53V.
 4. Residual Magnetism: Not more than 4 lbf to separate door from magnet.
- B. Delayed-Egress Locks: BHMA A156.24. Listed under Category G in BHMA's "Certified Product Directory."
1. Means of Egress Doors: Lock releases within 15 seconds after applying a force not more than 15 lbf for not more than 3 seconds, as required by NFPA 101.
 2. Security Grade: Activated from secure side of door by initiating device.
 3. Movement Grade: Activated by door movement as initiating device.
 4. The lock housing shall not project more than 4 inches from the underside of the frame head stop.

2.12 ELECTRIC STRIKES

- A. ANSI/BHMA A156.31 Grade 1.
- B. General: Use fail-secure electric strikes at fire-rated doors.

2.13 KEYS

- A. Stamp all keys with change number and key set symbol. Furnish keys in quantities as follows:

Locks/Keys	Quantity
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
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2.14 KEY CABINET

- A. ANSI Standard A156.5. Provide key cabinet made of cold-rolled, 0.0478-inch-thick furniture steel electro-welded. Doors shall have "no sag" continuous brass-pin piano-type hinge and be equipped with chrome-plated locking door handles, hook cam and mechanical push-button door lock. Key Cabinet and Key Control System shall accommodate all keys for this Project plus 25 percent. Provide minimum number of multiple cabinets where a single cabinet of largest size will not accommodate the required number of keys.
- B. Key tags shall consist of 2 sets: Permanent self-locking and loan key snaphook type with tag colors as follows: Red fiber marker of the permanent self-locking type approximately 1-1/4 inches in diameter engraved with the legend "FILE KEY MUST NOT BE LOANED." Also furnish for each hook a white cloverleaf key marker with snap-hooks engraved with the legend "LOAN KEY."
- C. The manufacturer of the lock cylinders and locks shall attach a key tag to keys of each lock cylinder and shall mark thereon the respective item number and key change number. Provide each group of keys in a key gathering envelope (supplied by Key Cabinet Manufacturer) in which the lock manufacturer shall include the following information: Item number, key change number and door number. The Contractor shall furnish the Key Cabinet Manufacturer the hardware and keying schedules and change keys.
- D. The Key Cabinet Manufacturer shall set up a 3-way cross index system, including master keys, listing the keys alphabetically, the hooks numerically and the key changes numerically on different colored index cards. Index cards shall be typewritten and inserted in a durable binder. Attach the keys to the 2 sets of numbered tags supplied with the cabinet. (The permanent tag and the loan key tag.) Instruct the Owner in proper use of the system. Install cabinet as directed by the COR.

2.15 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 10 inches or 12 inches high. Mop plates shall be 6 inches

- high. Both kick and mop plates shall be minimum 0.050-inch 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 1-1/2 inches less than width of door, except pairs of metal doors which shall have plates 1 inch less than width of each door. Extend all other kick and mop plates to within 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, 35 inches high and 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 1 inch less than width of each door. Where top of intermediate rail of door is less than 35 inches from door bottom, extend armor plates to within 1/2-inch of top of intermediate rail. On doors equipped with panic devices, extend armor plates to within 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 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.

2.16 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.

2.17 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 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 7 feet 2 inches.

2.18 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 1-1/2 by 3-1/2 inches.
- B. At interior doors, provide auto flush bolts less bottom bolt, unless otherwise specified, except at wood pairs with fire rating greater than 20 minutes; provide fire pins as required by auto flush bolt and door fire labels.

2.19 DOOR PULLS WITH PLATES

- A. Conform to ANSI A156.6. Pull Type J401, 6 inches high by 3/4-inch diameter with plate Type J302, 3-1/2 inches by 14 inches, unless otherwise specified. Provide pull with projection of 2-3/4 inches and a clearance of 2 inches. Cut plates of door pull plate for cylinders, or turn pieces where required.

2.20 PUSH PLATES

- A. Conform to ANSI A156.6. Metal, Type J302, 8 inches wide by 14 inches high. Provide metal Type J302 plates 4 inches wide by 14 inches high where push plates are specified for doors with stiles less than 8 inches wide. Cut plates for cylinders, and turn pieces where required.

2.21 COMBINATION PUSH AND PULL PLATES

- A. Conform to ANSI 156.6. Type J303, stainless steel 1/8-inch thick, 3-1/3 inches wide by 16 inches high, top and bottom edges shall be rounded. Secure plates to wood doors with 1-1/2-inch-long No. 12 wood screws. Cut plates for turn pieces, and cylinders where required. Pull shall be mounted down.

2.22 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.

2.23 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 ¼-20 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 elevator 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 0.5inch from fame face.

2.24 AUTOMATIC DOOR BOTTOM SEAL AND RUBBER GASKET FOR LIGHT-PROOF OR SOUND-CONTROL DOORS

- A. Conform to ANSI A156.22. Provide mortise or under-door type, except where not practical. For mortise automatic door bottoms, provide type specific for door construction (wood or metal).

2.25 WEATHERSTRIPS (FOR EXTERIOR DOORS)

- A. Conform to ANSI A156.22. Air leakage shall not to exceed 0.50 cfm per foot of crack length.

2.26 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, except as otherwise specified. Provide cylinders to operate locking devices where specified for following partitions and doors:
 - 1. Folding doors and partitions.
 - 2. Slide-up doors.
 - 3. Swing-up doors.

4. Fire-rated access doors-Engineer's key set.
 5. Doors from corridor to electromagnetic shielded room.
 6. 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.

2.27 PADLOCKS FOR VARIOUS DOORS, GATES AND HATCHES

- A. ASTM E883, size 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. Constant Temperature and Cold Rooms in Research Departments: Research Laboratory Set.
 2. Refrigerators in Canteen Department: Canteen Storage Set.
 3. All Refrigerator Rooms in Main Kitchen Department: Kitchen Storage Set.
 4. Roof Access and Scuttles: Engineer's set.
- C. Omit padlocks on communicating refrigerator doors.

2.28 THERMOSTATIC TEMPERATURE CONTROL VALVE CABINETS

- A. Where lock is shown, equip each cabinet door (metal) with lock Type E06213, conforming to ANSI A156.5. Key locks in Key Sets approved by COR. See Mechanical Drawings and Specifications for location of cabinets.
- B. Cabinet manufacturer shall supply the hinges, bolts and pulls. Ship locks to cabinet manufacturer for installation.

2.29 HINGED WIRE GUARDS (FOR WINDOWS, DOORS AND TRANSOMS) AND WIRE PARTITION DOORS

- A. Butt hinges, Type A8133 (special swaging) 4 inches by 3-1/2 inches, Finish US2C.
1. 3 hinges for guards over 3-1/2 feet high.
 2. 2 hinges for guards less than 3-1/2 feet high.

B. Conform to ANSI A156.5. Lock Type E06081 for guards and Type E06061 for partitions.

1. Keying: Except as noted otherwise, key locks like entrance door or space wherein guards and partitions are located except as otherwise specified.
2. Key locks for partitions enclosing mechanical and electrical equipment in Engineer's Set. (See detailed Drawings for number of locks and butt hinges required for each guard.)

2.30 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 - Exterior Doors: 626 or 630.
 2. Hinges - Interior Doors: 652 or 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: 600.
- D. Hardware Finishes for Existing Buildings: U.S. Standard finishes shall match finishes of hardware in (similar) existing spaces except where otherwise specified.
- 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.
- F. Anti-microbial Coating: All hand-operated hardware (levers, pulls, push bars, push plates, paddles, and panic bars) shall be provided with an anti-microbial/anti-fungal coating that has passed ASTM E2180 tests. Coating to consist of ionic silver (Ag+). Silver ions surround bacterial cells, inhibiting growth of bacteria, mold, and mildew by blockading food and respiration supplies.

2.31 BASE METALS

- A. Apply specified U.S. Standard finishes on different base metals as following:

Finish	Base Metal
652	Steel
626	Brass or bronze
630	Stainless steel

PART 3 - EXECUTION

3.1 HARDWARE HEIGHTS

- A. For existing buildings locate hardware on doors at heights to match existing hardware. The Contractor shall visit the site, verify location of existing hardware, and submit locations to VA COR for approval.
- B. For new buildings, locate hardware on doors at heights specified below, with all hand-operated hardware centered within 34 inches to 48 inches, unless otherwise noted:
- C. Hardware Heights from Finished Floor:
1. Exit devices centerline of strike (where applicable) 40-5/16 inches.
 2. Locksets and latch sets centerline of strike 40-5/16 inches.
 3. Deadlocks centerline of strike 48 inches.
 4. Hospital arm pull 46 inches to centerline of bottom supporting bracket.
 5. Centerline of door pulls to be 40 inches.
 6. Push plates and push-pull shall be 50 inches to top of plate.
 7. Push-pull latch to be 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 except security bedroom, bathroom and anteroom doors which shall have closer installed parallel arm on exterior side of doors. 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:

Door Thickness	Door Width	Hinge Height
1-3/4 inches	3 feet and less	4-1/2 inches
1-3/4 inches	Over 3 feet but not more than 4 feet	5 inches
1-3/8 inches (hollow core wood doors)	Not over 4 feet	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 5 feet or less in height	2 butts
Doors over 5 feet high and not over 7 feet 6 inches high	3 butts
Doors over 7 feet 6 inches high	4 butts
Dutch-type doors	4 butts
Doors with spring hinges 4 feet 6 inches high or less	2 butts
Doors with spring hinges over 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 COR that upon completion, installer has visited the Project and has accomplished the following:
 - 1. Readjust hardware.
 - 2. Evaluate maintenance procedures and recommend changes or additions, and instruct VA 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.

ELECTRIC HARDWARE ABBREVIATIONS LEGEND:

ADO = Automatic Door Operator

EMCH = Electro-Mechanical Closer-Holder

MHO = Magnetic Hold-Open (wall- or floor-mounted)

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INTERIOR SINGLE DOORS

HW-1

Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Door Pull with Plate	J401 x J302
1	Push Plate	J302
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103
1	Closer	C02011/C02021
1	Floor Stop	L02121 x 3 FASTENERS
3	Silencers	L03011

HW-1A

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED	
	X HOSPITAL TIPS AT INSWING DOORS	
1	Latchset	F01
1	Closer	C02011/C02021
	X INSTALL OUTSIDE ROOM	
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103
1	Floor Stop	L02121 x 3 FASTENERS
1	Threshold	J32300 x 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

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HW-1B

Each Door to Have:

NON-RATED/RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 X PADDLES POINTING DOWN
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Seals	R0Y164

NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

HW-1C

THIS SET NOT USED.

HW-1D

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 X PADDLES POINTING DOWN
1	Armor Plate	J101 x 0.050-INCH THICKNESS
1	Mop Plate	J103
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
3	Silencers	L03011

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Each Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X SWING-CLEAR X ADJUSTA-SCREWS
1	Hospital Latch	F01 X PADDLES POINTING DOWN
1	Closer	C02011/C02021
1	Armor Plate	J101 x 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Wall Stop (at Inswing Doors)	L02101 CONVEX
1	Set Self-Adhesive Seals	R0Y154

HW-1F

Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Latchset	F01
1	Kick Plate	J102
1	Wall Stop	L02101 CONVEX
3	Silencers	L03011

HW-1G

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Latchset	F01
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Wall Stop	L02101 CONVEX
3	Silencers	L03011
1	Coat Hook	L03121

Each Dwarf Door to Have:

NON-RATED

1	Gate Spring Pivot Hinge	K13311
1	Door Bolt	L04151
1	Wall Stop	L02101 CONVEX
2	Silencers	L03021

HW-1J

Each [MHO] Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Latchset	F01
1	Closer	C02011/C02021
1	Heavy-Duty Armor Plate	J101 X 0.125-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Magnetic Holder	C00011 TRI-VOLTAGE
1	Set Self-Adhesive Seals	R0Y154

POWER, WIRING, CONDUIT, AND FIRE ALARM CONNECTION BY DIVISION 26.

HW-1K

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Hospital Latch	F01 X PADDLES POINTING DOWN
1	Closer	C02011/C02021
1	Armor Plate	J101 x 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

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Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Latchset	F01
1	Kick Plate	J102
1	Wall Stop	L02101 CONVEX
1	Threshold	J32300 x 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-1M

Each Door to Have:

NON-RATED

1	Floor Closer	C06011
2	Push Plates	J302
2	Kick Plates	J102
2	Edge Guard (at Wood Doors)	J209M/J212 (VERIFY)
1	Overhead Stop	C01541-ADJUSTABLE

HW-1N

Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Door Pull w/ Plate	J401 x J302
1	Push Plate	J302
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103
1	Closer	C02011/C02021
1	Floor Stop	L02121 x 3 FASTENERS
3	Silencers	L03011

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Each Lead-Lined Door to Have:

NON-RATED

1	Floor Closer	C6062
2	Push Plates	J302 8" x 16"
2	Kick Plates	J102
2	Edge Guard (at Wood Doors)	J209M/J212 (VERIFY)
1	Overhead Stop	C01541-ADJUSTABLE

HW-1Q

Each Door to Have:

RATED/NON-RATED

1	Continuous Hinge	
1	Latchset	F01
1	Kick Plate	J102
1	Closer (at rated doors)	C02011/C02021
1	Wall Stop	L02101 CONVEX
1	Threshold	J32300 x 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

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Each Door to Have:

RATED/NON-RATED

1 Continuous Hinge	
1 Latchset	F01
1 Kick Plate	J102
1 Closer (at rated doors)	C02011/C02021
1 Wall Stop	L02101 CONVEX
1 Set Self-Adhesive Seals	R0Y154

HW-2

Each Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Keyed Privacy Indicator Lock	F13 x OCCUPANCY INDICATOR
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

Each [ADO] Door to Have:

RATED/NON-RATED

1 Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS x 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1 Keyed Privacy Indicator Lock	F13 x OCCUPANCY INDICATOR
1 Electric Strike	E09391 (FAIL-SECURE), 24V DC
1 Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 x 3 FASTENERS
1 Threshold	J32300 x 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

STONE THRESHOLD BY OTHER TRADES.

HW-2B

Each Door to Have:

NON-RATED

1 Center Pivot Set	C07042
1 Privacy Lock	F02-MOD x THUMBTURN BOTH SIDES X OCCUPANCY INDICATOR
1 Rescue Stop	A1882
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Wall Stop	L02101 CONVEX

STONE THRESHOLD BY OTHER TRADES.

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Hinges	QUANTITY AND TYPE AS REQUIRED
1 Privacy Lock	F02-MOD X OCCUPANCY INDICATOR
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Wall Stop	L02101 CONVEX
3 Silencers	L03011

STONE THRESHOLD BY OTHER TRADES.

HW-2D

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Privacy Lock	F02-MOD X OCCUPANCY INDICATOR
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Wall Stop	L02101 CONVEX
1 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

HW-2E

Each Door to Have:

RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Hospital Privacy Latch	F02-MOD X TURNPIECE BOTH SIDES
1 Closer	C02011/C02021
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Mop Plate (at Inswing Doors)	J103
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Overhead Stop	C01541-ADJUSTABLE
1 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

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Hinges	QUANTITY AND TYPE AS REQUIRED
1 Privacy Lock	F02-MOD X OCCUPANCY INDICATOR
1 Wall Stop	L02101 CONVEX
3 Silencers	L03011
1 Coat Hook	L03121

HW-2G

Each Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Keyed Privacy Indicator Lock	F13 X OCCUPANCY INDICATOR
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 X 3 FASTENERS
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

HW-2H

Each Door to Have:

NON-RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Hospital Privacy Latch	F02-MOD X TURNPIECE BOTH SIDES X OCCUPANCY INDICATOR
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Overhead Stop	C01541-ADJUSTABLE
3 Silencers	L03011

STONE THRESHOLD BY OTHER TRADES.

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Hinges	QUANTITY AND TYPE AS REQUIRED
1 Privacy Lock	F02-MOD X OCCUPANCY INDICATOR
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Wall Stop	L02101 CONVEX
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

HW-2K

Each Door to Have:

NON-RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Hospital Privacy Latch	F02-MOD X TURNPIECE BOTH SIDES X OCCUPANCY INDICATOR
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Overhead Stop	C01541-ADJUSTABLE
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154

STONE THRESHOLD BY OTHER TRADES.

HW-3

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Office Lock	F04
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

THIS SET NOT USED.

HW-3B

Each Door to Have:

NON-RATED/RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Office Lock	F04
1 Closer	C02011/C02021
1 Floor Stop	L02121 x 3 FASTENERS
1 Door Viewer	L03221 - 190° (VIEW INTO CORRIDOR)
1 Set Self-Adhesive Seals	R0Y154

OMIT VIEWER IF DOOR PROVIDED WITH VISION LITE.

HW-3C

THIS SET NOT USED.

HW-3D

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Office Lock	F04
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Floor Stop	L02121 x 3 FASTENERS
1 Threshold	J32300 x 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

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Hinges	QUANTITY AND TYPE AS REQUIRED
1 Office Lock	F04
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154
1 Coat Hook	L03121

OMIT COAT HOOK WHERE GLASS LITE PREVENTS INSTALLATION.

<u>Each Door to Have:</u>	<u>HW-3F</u>	<u>RATED/NON-RATED</u>
1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS	
1 Office Lock	F04	
1 Closer	CO2011/CO2021 AT RATED DOOR	
1 Kick Plate	J102	
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE	
1 Floor Stop	L02121 X 3 FASTENERS	
1 Threshold	J32300 X 2-1/4-INCH WIDTH	
1 Auto Door Bottom	R0Y346 - HEAVY DUTY	
2 Sets Self-Adhesive Seals	R0Y154	

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Hinges	QUANTITY AND TYPE AS REQUIRED
1 Office Lock	F04
1 Floor Stop	L02121 x 3 FASTENERS
1 Coat Hook	L03121
1 Door Viewer (Mental Health Only)	L03221 - 190° (VIEW INTO CORRIDOR)
1 Threshold	J32300 x 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

OMIT VIEWER IF DOOR PROVIDED WITH VISION LITE.
OMIT COAT HOOK WHERE GLASS LITE PREVENTS INSTALLATION.

HW-3H

Each Door to Have:

RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Office Lock	F04
1 Closer	CO2011/CO2021
1 Kick Plate	J102
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 X 3 FASTENERS
1 Sets Self-Adhesive Seals	R0Y154

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1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Office Lock	F04
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Sound/Light Seals	R0Y264/R0Y255

HW-4

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Classroom Lock	F08
1 Overhead Stop	C04541
3 Silencers	L03011

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Classroom Lock	F08
1	Electric Strike	E09311 (FAIL-SECURE), 24V DC
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103 at TOILET ROOMS ONLY
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFER FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

HW-4B

Each Door to Have:

NON-RATED/RATED

1	Continuous Hinge	
1	Public Restroom Lock	F09
1	Closer	C02011/C02021
1	Closer	CO2051/CO2061
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103
1	Floor Stop (at Outswing Doors)	L02121 X 3 FASTENERS
1	Wall Stop (at Inswing Doors)	L02101 CONVEX
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

PROVIDE NON-HOLD-OPEN CLOSER AT TOILET ROOMS.

STONE THRESHOLD BY OTHER TRADES.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Hospital Utility Lock	F09 X PADDLES POINTING DOWN
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

HW-4D

Each Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Classroom Lock	F08
1	Closer	C02011/C02021
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Mop Plate (at Inswing Doors)	J103
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop (at Outswing Doors)	L02121 X 3 FASTENERS
1	Wall Stop (at Inswing Doors)	L02101 CONVEX
1	Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Utility Lock	F09
1 Closer (at rated doors)	C02011/C02021
1 Closer (at non-rated doors)	C02051/C02061
1 Kick Plate	J102
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-4F

Each Door to Have:

RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Utility Lock	F09
1 Closer	C02011/C02021
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop (at Outswing Doors)	L02121 X 3 FASTENERS
1 Wall Stop (at Inswing Doors)	L02101 CONVEX
1 Set Self-Adhesive Seals	R0Y154

HW-4G

Each Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Utility Lock	F09
1 Closer (at Rated Doors)	C02011/C02021
1 Kick Plate	J102
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Classroom Lock	F08
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Magnetic Holder	C00011 TRI-VOLTAGE
1 Set Self-Adhesive Seals	R0Y154

POWER, WIRING, CONDUIT, AND FIRE ALARM CONNECTION BY DIVISION 26.

HW-4J

Each Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Utility Lock	F09
1 Closer (at Rated Doors)	C02011/C02021
1 Kick Plate	J102
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-4K

Each Door to Have:

NON-RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Utility Lock	F09
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Classroom Lock	F08
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Sound/Light Seals	R0Y264/R0Y255

HW-4M

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Heavy-Duty Armor Plate	J101 X 0.125-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-4N

Each Door to Have:

RATED/NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Utility Lock	F09
1	Closer (at rated doors)	C02011/C02021
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-4Q

Each Door to Have:

NON-RATED

1	Pivot Set	C07162 X 1,000 LBS WEIGHT CAPACITY
1	Intermediate Pivot	C07311
1	Utility Hospital Lock	F09 X LEAD-LINED X PADDLES POINTING DOWN
1	Armor Plate	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seal	R0Y154

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Classroom Lock	F08
1	Electric Strike	E09311 (FAIL-SECURE), 24V DC
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103 AT TOILET ROOMS ONLY
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0Y154

AT TOILET ROOMS, OMIT METAL THRESHOLD; STONE THRESHOLD BY OTHER TRADES.
AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

POWER TRANSFER FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS
PROVIDED BY SECTION 08 71 13).

HW-4S

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Classroom Lock	F08
1	Heavy-Duty Armor Plate	J101 X 0.125-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seals	R0Y154

HW-4U

Each Door to Have:

NON-RATED/RATED

1	Continuous Hinge	
1	Public Restroom Lock	F09
1	Closer	C02011/C02021
1	Closer	C02051/C02061
1	Kick Plate	J102
1	Mop Plate (at Inswing Doors)	J103
1	Floor Stop (at Outswing Doors)	L02121 X 3 FASTENERS
1	Wall Stop (at Inswing Doors)	L02101 CONVEX
1	Set Self-Adhesive Seals	R0Y154

PROVIDE NON-HOLD-OPEN CLOSER AT TOILET ROOMS.

STONE THRESHOLD BY OTHER TRADES.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

1	Pivot Set	C07162 X 1,000 LBS WEIGHT CAPACITY
1	Intermediate Pivot	C07311
1	Utility Hospital Lock	F09 X LEAD-LINED X PADDLES POINTING DOWN
1	Closer	CO2011/CO2021 X METAL LEAD-LINED COVER
1	Armor Plate	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Holder-Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seal	R0Y154

HW-4X

Each [ADO] Lead-Lined Door to Have:

NON-RATED

1	Pivot Set	C07162 X 1,000 LBS WEIGHT CAPACITY
1	Intermediate Transfer Pivot	C07311 X 4 WIRE TRANSFER
1	Utility Hospital Lock	F09 X LEAD-LINED X PADDLES POINTING DOWN
1	Electric Unlatch Strike	E09321
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Armor Plate	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seal	R0Y154

POWER TRANSFER PIVOT IS FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

AUTO DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Utility Hospital Lock	F09 X PADDLES POINTING DOWN
1	Electric Unlatch Strike	E09321
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Overhead Stop	C01541-ADJUSTABLE
1	Set Self-Adhesive Seals	R0Y154

POWER TRANSFER PIVOT IS FOR REACTIVATION SENSOR WIRING (REACTIVATION
SENSORS PROVIDED BY SECTION 08 71 13).

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

HW-5

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Storeroom Lock	F07
1 Closer	C02011/C02021
1 Kick Plate	J102 (AT STORAGE, EVM, AND HAC ROOMS ONLY)
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-5A

THIS SET NOT USED.

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Storeroom Lock	F07
1	Closer	C02011/C02021
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-5C

THIS SET NOT USED.

HW-5D

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Storeroom Lock	F07
1 Kick Plate	J102 (AT STORAGE, EVM, & HAC ROOMS ONLY)
1 Floor Stop (at Inswing Doors)	L02121 X 3 FASTENERS
1 Wall Stop (at Outswing Doors)	L02101 CONVEX
3 Silencers	L03011

HW-5E

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Storeroom Lock	F13-MOD X RIGID OUTSIDE LEVER X KEY RETRACTS DEADBOLT AND LATCHBOLT
1	Armor Plate	J101 X 0.125-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

HW-5F

Each Door to Have:

RATED/NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Storeroom Lock	F07
1	Closer (at Rated Doors)	C02011/C02021
1	Heavy-Duty Armor Plate	J101 X 0.125-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-5G

Each Door to Have:

NON-RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Storeroom Lock	F07
1	Kick Plate	J102
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-5H

Each Dutch Door to Have:

NON-RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Dutch Door Bolt	L04161-4" AT TOP LEAF
1	Storeroom Lock	F07 AT BOTTOM LEAF
1	Kick Plate	J102
1	Floor Stop	L02121 X 3 FASTENERS AT BOTTOM LEAF
1	Wall Stop	L02101 AT BOTTOM LEAF
1	Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

HW-5J

Each Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Storeroom Lock	F07
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-5K

Each Door to Have:

RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Storeroom Lock	F07
1 Closer	C02011/C02021
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

HW-5L

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Security Storeroom Lock	F13-MOD X RIGID OUTSIDE LEVER X KEY RETRACTS DEADBOLT AND LATCHBOLT
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-6

Each Door to Have:

RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Exit Device	TYPE 1 F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-6A

Each Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
1	Exit Device	TYPE 1 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154/R0Y155

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MEDVAMC Houston, TX

Each [MHO] Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Exit Device	TYPE 1 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011/C02021
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Magnetic Holder	C00011 TRI-VOLTAGE
1	Set Self-Adhesive Seals	R0Y154

POWER, WIRING, CONDUIT, AND FIRE ALARM CONNECTION BY DIVISION 26.

HW-6C

Each Door to Have:

NON-RATED/RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Exit Device	TYPE 1 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02021
1	Kick Plate	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-6D

Each [ADO] Integrated Door to Have:

RATED

1	Key Cylinder	TYPE AS REQUIRED
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ALL HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

AUTO DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

Department of Veterans Affairs, Renovate Medical Media for
Geriatrics Wound Care Clinic
Project Number 580-17-100

MEDVAMC Houston, TX

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
	X ADJUSTA-SCREWS
1 Exit Device	TYPE 1 F08 LEVER
1 Key Cylinder	TYPE AS REQUIRED
1 Kick Plate	J102
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-6F

Each [ADO] Door to Have:

NON-RATED/RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
	X ADJUSTA-SCREWS X 8-THRUWIRE
	TRANSFER X IN-HINGE ACCESS PANELS
1 Elec. Exit Device	TYPE 1 F08 LEVER (E04)
1 Key Cylinder	TYPE AS REQUIRED
1 Power Supply	BY EXIT DEVICE MFR. FOR E04 FUNCTION
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

POWER TRANSFER **SHARED BY ELECTRIC PANIC AND** REACTIVATION SENSOR WIRING
(REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).
AUTO DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Exit Device	TYPE 1 F13 LEVER
1 Key Cylinder	TYPE AS REQUIRED
1 Closer	C02011/C02021
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-7

Each Motorized Roll-up Door to Have: NON-RATED

1 Key Cylinder (for keyswitch) TYPE AS REQUIRED
BALANCE OF HARDWARE BY SECTION 08 33 00, COILING DOORS AND GRILLES

HW-7A

Each Special Door to Have: NON-RATED

1 Padlock TYPE AS REQUIRED PER 08 71 00 2.29.
BALANCE OF HARDWARE BY DOOR MANUFACTURER.

HW-7B

Each RF Shielded Door to Have: NON-RATED

1 Key Cylinder TYPE AS REQUIRED
BALANCE OF HARDWARE BY SECTION 13 49 00.

INTERIOR PAIRS OF DOORS

HW-8

Each [MHO] Pair Integrated Doors to Have: RATED

ALL HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

2	Floor Closers	C06041
2	Intermediate Pivots	C07321
2	Push/Pull Bar Sets	J505 - 12-INCH CENTER-TO-CENTER PULL
2	Overhead Stops	C01541-ADJUSTABLE

HW-8B

Each Pair to Have:

NON-RATED

2	Continuous Hinge	
2	Push Plate	J304 8" X 16"
2	Hospital Grip	J401
2	Kick Plate	J102
2	Mop Plate (at Inswing Doors)	J103
2	Closer	C02011/C02021
2	Floor Stop	L02121 X 3 FASTENERS
2	Silencers	L03011

HW-8C

Each Double-Acting Pair to Have:

NON-RATED

2	Double-Acting Floor Closers	C06011
4	Push Plates	J304 8" X 16"
4	Heavy-Duty Armor Plates	J101 X 0.125-INCH THICKNESS
4	Edge Guard (at Wood Doors)	J209P/J212 (VERIFY)
2	Overhead Holders	C01511-ADJUSTABLE

2	Pivot Sets	C07162
2	Intermediate Transfer Pivots	C07321 X 4-WIRES
2	Intermediate Pivots	C07321
2	Push/Pull Bar Sets	J505 - 12-INCH CENTER-TO-CENTER PULL
2	Overhead Stops	C01541-ADJUSTABLE

AUTO DOOR OPERATORS, CONTROLS, AND REACTIVATION SENSORS BY SECTION

08 71 13.11.

POWER TRANSFERS FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

HW-8E

Each [ADO] Pair to Have:

NON-RATED

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFERS X IN-HINGE ACCESS PANEL
2	Push Plate	J304 8" X 16"
2	Hospital Grip	J401
2	Kick Plate	J102
2	Mop Plate (at Inswing Doors)	J103
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stop	L02121 X 3 FASTENERS
2	Silencers	L03011

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFERS FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFERS
		X IN-HINGE ACCESS PANEL
2	Push Plate	J304 8" X 16"
2	Hospital Grip	J401
2	Kick Plate	J102
2	Mop Plate (at Inswing Doors)	J103
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFERS FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

HW-9

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Department of Veterans Affairs, Renovate Medical Media for
Geriatrics Wound Care Clinic
Project Number 580-17-100

MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Lock	F08
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Closers	C02011/C02021
2	Heavy-Duty Armor Plates	J101 X 0.125-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0Y154

INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT
LEVER TRIM.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 8-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THRUWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Lock	F08
1	Electric Unlatch Strike	E09321 (FAIL SECURE)
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Armor Plates	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

POWER TRANSFER **SHARED BY ELECTRIC STRIKE AND** REACTIVATION SENSOR WIRING
(REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
1	Closers (at rated doors)	C02011/C02021
2	Heavy-Duty Armor Plates	J101 X 0.125-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS

INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT
LEVER TRIM.

HW-10C

Each Pair to Have:

NON-RATED

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Utility Lock	F09
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Kick Plates	J102
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Classroom Lock	F08
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Kick Plates	J102
2 Floor Stops	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-10E

Each Lead Lined Pair to Have:

NON-RATED

2 Pivot Sets	C07162 X 1,000 LBS. WEIGHT CAPACITY
2 Intermediate Pivots	C07311
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT x LEAD-LINED
1 Classroom Lock	F08 X LEAD-LINED X PADDLES POINTING DOWN
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS X LEAD-LINED
2 Armor Plates	J101 X 0.050-INCH THICKNESS
4 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2 Floor Stops	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Heavy-Duty Armor Plates	J101 X 0.125-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT
LEVER TRIM.

HW-10G

Each Pair to Have:

NON-RATED

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL
		X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Lock	F08
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Heavy-Duty Armor Plates	J101 X 0.125-INCH THICKNESS
1	Lock Trim Protector Bar	R111LPB-630 (ROCKWOOD), OR EQUAL
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

INSTALL LOCK TRIM PROTECTOR BAR ON PUSH SIDE OF ACTIVE LEAF TO PROTECT
LEVER TRIM.

2	Bottom Pivots	C07162 LESS TOP PIVOT X 1,000 LBS. WEIGHT CAPACITY
1	Intermediate Pivot	C07311 (MIDDLE OF ACTIVE LEAF)
1	Intermediate Transfer Pivot	C07311 X 4-WIRE TRANSFER (MIDDLE OF INACTIVE LEAF)
2	Intermediate Transfer Pivot	C07311 X 4-WIRE TRANSFER (NEAR TOP OF EACH LEAF)
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT X LEAD-LINED
1	Hospital Utility Lock	F09 X PADDLES POINTING DOWN X LEAD-LINED
1	Electric Unlatch Strike	E09321 (FAIL SECURE) (LEAD-LINED)
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with	R0Y634 X R0Y154 X THROUGH-BOLTS X LEAD-LINED
	Self-Adhesive Seal	
2	Armor Plates	J101 X 0.050-INCH THICKNESS
4	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Overhead Stops	C01541-ADJUSTABLE
1	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFER PIVOTS NEAR TOP OF EACH DOOR FOR REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 8-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Hospital Lock	F08 X PADDLES POINTING DOWN
1	Electric Unlatch Strike	E09321 (FAIL-SECURE)
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Armor Plates	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Overhead Stops	C01541-ADJUSTABLE
1	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR OPERATORS.

POWER TRANSFERS **SHARED BY ELECTRIC STRIKE AND** REACTIVATION SENSOR WIRING (REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

*AT WOOD PAIRS RATED 45 MINUTES OR MORE, PROVIDE ELECTRIC STRIKE 310-2-3/4 (FOLGER ADAM OR EQUAL) IN LIEU OF SPECIFIC UNLATCH STRIKE.

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 8-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Classroom Lock	F08
1	Electric Unlatch Strike	E09321 (FAIL-SECURE)
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Armor Plates	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

POWER TRANSFER **SHARED BY ELECTRIC STRIKE AND** REACTIVATION SENSOR WIRING
(REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

*AT WOOD PAIRS RATED 45 MINUTES OR MORE, PROVIDE ELECTRIC STRIKE 310-2-3/4
(FOLGER ADAM OR EQUAL) IN LIEU OF SPECIFIC UNLATCH STRIKE.

Department of Veterans Affairs, Renovate Medical Media for
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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Classroom Lock	F08
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Kick Plates	J102
2 Floor Stops	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
2 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-10M

Each Pair to Have:

NON-RATED

2 Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Utility Lock	F09
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Kick Plates	J102
2 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2 Floor Stops	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
2 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Storeroom Lock	F07
1 Coordinator	TYPE 21A
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Closers	C02011/C02021
2 Kick Plates	J102 (AT STORAGE ROOMS ONLY)
2 Floor Stops	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-11A

Each Pair to Have:

NON-RATED

2 Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1 Set Auto Flush Bolts	TYPE 25
1 Security Storeroom Lock	F13-MOD X RIGID OUTSIDE LEVER X KEY RETRACTS DEADBOLT AND LATCHBOLT
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Armor Plates	J101 X 0.050-INCH THICKNESS
2 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2 Floor Stops	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Set Auto Flush Bolts	TYPE 25
1	Storeroom Lock	F07
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Closers	C02011/C02021
2	Armor Plates	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-11C

Each Pair to Have:

RATED/NR

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1	Storeroom Lock	F07
1	Coordinator	TYPE 21A
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Closers	C02011/C02021
2	Kick Plates	J102 (AT STORAGE ROOMS ONLY)
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Set Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Exit Device	TYPE 7 OR 8 F01
1 Exit Device	TYPE 7 OR 8 F08 LEVER
1 Key Cylinder	TYPE AS REQUIRED
1 Set Meeting Stile Astragals	R0Y834
2 Closers	C02011/C02021
2 Floor Stops	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-12A

Each [MHO] Pair Integrated Doors to Have: RATED

ALL HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

HW-12B

Each [ADO] Pair Integrated Doors to Have: RATED

1 Key Cylinder TYPE AS REQUIRED
BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

HW-12C

Each [MHO] Pair Integrated Double Egress Doors to Have: RATED

ALL HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

HW-12D

Each [ADO] Pair Integrated Double Egress Doors to Have: RATED

ALL HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
1	Exit Device	TYPE 7 OR 8 F01
1	Exit Device	TYPE 7 OR 8 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Set Meeting Stile Astragals	R0Y834
2	Closers	C02011/C02021
2	Kick Plates	J102
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
2	Door Bottom	R0Y434 X NYLON BRUSH INSERT
2	Set Self-Adhesive Seals	R0Y154

HW-12F

Each Pair to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Exit Device	TYPE 7 OR 8 F01
1 Exit Device	TYPE 7 OR 8 F08 LEVER
1 Key Cylinder	TYPE AS REQUIRED
1 Set Meeting Stile Astragals	R0Y834
2 Closers	C02021
2 Floor Stops	L02121 X 3 FASTENERS
2 Door Bottom	R0Y434 X NYLON BRUSH INSERT
2 Sets Self-Adhesive Seals	R0Y154

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MEDVAMC Houston, TX

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Exit Device	TYPE 7 OR 8 F01
1	Exit Device	TYPE 7 OR 8 F08 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Set Meeting Stile Astragals	R0Y834
2	Closers	C02051/C02071
2	Kick Plates	J102
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-12H

Each [ADO] Pair to Have:

NON-RATED

2	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 8-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Elec. Exit Device	TYPE 7 OR 8 F01 (E04)
1	Elec. Exit Device	TYPE 7 OR 8 F08 LEVER (E04)
1	Key Cylinder	TYPE AS REQUIRED
1	Power Supply	BY EXIT DEVICE MFR. FOR E04 FUNCTION
1	Set Meeting Stile Astragals	R0Y834
2	Kick Plates	J102
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

POWER TRANSFERS **SHARED BY ELECTRIC PANIC AND** REACTIVATION SENSOR WIRING
(REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).
AUTO DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13.

Department of Veterans Affairs, Renovate Medical Media for
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	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Exit Device	TYPE 7 OR 8 F01
1	Exit Device	TYPE 7 RO 8 F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Set Meeting Stile Astragals	R0Y834
2	Closers	C02011/C02021
2	Floor Stops	L02121 X 3 FASTENERS
2	Auto Door Bottoms	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

HW-13

Each [ADO] Bi-Parting Automatic Pair to Have:

NON-RATED

ALL HARDWARE BY SECTION 08 42 29.

EXTERIOR SINGLE DOORS

HW-E1

Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Entry Lock	F11
1	Latch Protector (outswing dr)	
1	Closer	C02011/C02021
1	Kick Plate	J102
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold (outswing door)	J32120 X SILICONE GASKET
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL
1	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

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1	Continuous Hinge	
1	Classroom Lock	F05
1	Closer	C02011/C02021
1	Kick Plate	J102
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold (outswing door)	J32120 X SILICONE GASKET
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL
1	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

HW-E3

Each Door to Have:

NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS
1	Storeroom Lock	F13-MOD X RIGID OUTSIDE LEVER X KEY RETRACTS DEADBOLT AND LATCHBOLT
1	Latch Protector (outswing dr)	
1	Closer	C02011/C02021
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Armor Plate	J101 X 0.125-INCH THICKNESS
1	Overhead Holder	C01511-ADJUSTABLE
1	Threshold (outswing door)	J32120 X SILICONE GASKET
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL
1	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

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HW-E4

Each Door to Have:

NON-RATED

1	Continuous Hinge	
1	Anti-Vandal Pull	
1	Exit Device	TYPE 1 F03 LESS TRIM
1	Latch Protector (outswing door)	
1	Key Cylinder	TYPE AS REQUIRED
1	Closer	C02011
1	Kick Plate	J102
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32120 X SILICONE GASKET
1	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

HW-E5

Each Roll-up Door to Have:

NON-RATED

1	Padlock or 2 Cylinders	TYPE AS REQUIRED
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BALANCE OF HARDWARE BY SECTION 08 33 00, COILING DOORS AND GRILLES

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MEDVAMC Houston, TX

EXTERIOR PAIRS OF DOORS

<u>Each Pair to Have:</u>		<u>HW-E6</u>	<u>NON-RATED</u>
2	Continuous Hinge		
1	Set Auto Flush Bolts	TYPE 25	
1	Dust Proof Strike	L04021	
1	Entry Lock	F11	
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS	
1	Coordinator	TYPE 21A	
2	Closer	C02011/C02021	
2	Kick Plate	J102	
2	Floor Stop	L02121 X 3 FASTENERS	
1	Threshold (outswing door)	J32120 X SILICONE GASKET	
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL	
2	Door Sweep	R0Y416	
1	Set Frame Seals	R0Y164	
1	Drip	R0Y976	

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2	Continuous Hinge	
1	Set Auto Flush Bolts	TYPE 25
1	Dust Proof Strike	L04021
1	Classroom Lock	F05
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
1	Coordinator	TYPE 21A
2	Closer	C02011/C02021
2	Kick Plate	J102
2	Floor Stop	L02121 X 3 FASTENERS
1	Threshold (outswing door)	J32120 X SILICONE GASKET
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL
2	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

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2	Continuous Hinge	
1	Set Auto Flush Bolts	TYPE 25
1	Dust Proof Strike	L04021
1	Storeroom Lock	F13-MOD X RIGID OUTSIDE LEVER X KEY RETRACTS DEADBOLT AND LATCHBOLT
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
1	Coordinator	TYPE 21A
2	Closer	C02011/C02021
2	Armor Plate	J101 X 0.125-INCH THICKNESS
2	Floor Stop	L02121 X 3 FASTENERS
1	Threshold (outswing door)	J32120 X SILICONE GASKET
1	Threshold (inswing door)	ALUMINUM, PER ARCHITECTURAL DETAIL
2	Door Sweep	R0Y416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

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2	Continuous Hinge	
1	Exit Device	TYPE 8 F01
1	Exit Device	TYPE 8 F12 LESS PULL
1	Key Cylinder	TYPE AS REQUIRED
2	Latch Protectors (outswing door)	
1	Set Meeting Stile Astragals	R0Y834
2	Closer	C02011
2	Kick Plate	J102
2	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32120 X SILICONE GASKET
2	Door Sweep	R0416
1	Set Frame Seals	R0Y164
1	Drip	R0Y976

HW-E10

Each Sliding Door to Have:

NON-RATED

1	Set Track Hardware	TYPE REQUIRED FOR DOOR MATERIAL, WEIGHT, AND MOUNTING DETAILS (COMPLETE WITH TRACK, TRACK BRACKETS, HANGERS, GUIDES, BUMPERS, AND INTERNAL TRACK STOPS)
2	Pulls	TYPE AS REQUIRED
1	Sliding Door Lock	E8281/E8291 (SLIDING DOOR LOCK)
2	Cylinder (for sliding door lock)	TYPE AS REQUIRED

EXTERIOR SINGLE GATES

HW-G1

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

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HW-G2

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G3

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G4

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G5

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

EXTERIOR PAIRS OF GATES

HW-G6

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G7

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G8

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G9

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-G10

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

RESIDENTIAL UNIT SINGLE DOORS

<u>Each Door to Have:</u>		<u>HW-R1</u>	<u>NON-RATED/RATED</u>
Hinges		QUANTITY AND TYPE AS REQUIRED	
1 Guestroom Card Lock		BY OTHER SECTION.	
1 Closer (at Rated Doors)		C02011	
1 Floor Stop		L02121 X 3 FASTENERS	
2 Door Viewers		L03221 - 190°	
1 Threshold		J32300 X 2-1/4-INCH WIDTH	
1 Auto Door Bottom		R0Y346 - HEAVY DUTY	
2 Sets Self-Adhesive Seals		R0Y154	

<u>Each Door to Have:</u>		<u>HW-R1A</u>	<u>NON-RATED</u>
1 Continuous Hinge			
1 Guestroom Card Lock		BY OTHER SECTION.	
1 Latch Protector (at O/S Drs)			
1 Closer		C02011/C02021	
1 Kick Plate		J102	
1 Floor Stop (at I/S Doors)		L02121 X 3 FASTENERS	
1 Overhead Stop (at O/S Doors)		C01541-ADJUSTABLE	
1 Threshold (outswing door)		J32120 X SILICONE GASKET	
1 Threshold (inswing door)		ALUMINUM, PER ARCHITECTURAL DETAIL	
1 Door Sweep		R0Y416	
1 Set Frame Seals		R0Y164	
1 Drip		R0Y976	

<u>Each Door to Have:</u>		<u>HW-R2</u>	<u>NON-RATED</u>
Hinges		QUANTITY AND TYPE AS REQUIRED	
1 Latchset		F75	
1 Base Stop		L02031 x 3 FASTENERS	
3 Silencers		L03011	

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HW-R2A

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Door Pull with Plate	J401 X J302
1 Push Plate	J302
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Closer	C02011/C02021
1 Floor Stop	L02121 X 3 FASTENERS
3 Silencers	L03011

HW-R2B

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Latchset	F75
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

HW-R2C

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Door Pull w/Plate	J401 X J302
1 Push Plate	J302
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Closer	C02011/C02021
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

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HW-R3

Each Door to Have:

NON-RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Privacy	F76B
1	Base Stop	L02031 X 3 FASTENERS
1	Coat Hook	L03121
3	Silencers	L03011

HW-R3A

Each Door to Have:

NON-RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Privacy	F76B
1	Base Stop	L02031 X 3 FASTENERS
1	Coat Hook	L03121
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
2	Sets Self-Adhesive Seals	R0Y154

AT TOILET ROOMS, OMIT METAL THRESHOLD; STONE THRESHOLD BY OTHER TRADES.

HW-R4

Each Door to Have:

RATED

	Hinges	QUANTITY AND TYPE AS REQUIRED
1	Classroom Lock	F84
1	Closer	C02011/C02021
1	Base Stop	L02031 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

HW-R5

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

RESIDENTIAL UNIT PAIRS OF DOORS

HW-R6

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-R7

Each Pair to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
2 Dummy Sets	
2 Roller Latches	E09091 X MORTISE STRIKE
2 Base Stops	L02031 X 3 FASTENERS
2 Silencers	L03011

HW-R7A

Each Door to Have:

NON-RATED/RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Set Auto Flush Bolts	TYPE 25 LESS BOTTOM BOLT
1 Guestroom Card Lock	BY OTHER SECTION.
1 Coordinator	TYPE 21A
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS
2 Closer (at Rated Doors)	C02011
2 Floor Stop	L02121 X 3 FASTENERS
2 Door Viewers	L03221 - 190°
1 Threshold	J32300 X 2-1/4-INCH WIDTH
2 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

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

INTERIOR SINGLE SECURITY DOORS

HW-SH-1

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-SH-2

Each Door to Have:

NON RATED

1	Continuous Hinge	
1	Door Pull with Plate	J401 X J302
1	Lock	DETENTION TYPE LOCK
1	Strike/Keeper	AS REQUIRED
1	Overhead Stop	C01541-ADJUSTABLE X SEC. TORX
1	Door Position Switch	

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HW-SH-3

Each [AC, EL, REX, DPS] Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Transfer Hinge	4-WIRE TYPE AS REQUIRED
1 Electrified Lock	F07 (E01-REX, E06) 24V DC
1 Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1 Closer	C02011/C02021
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154
1 Alarm Contact	

120-VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.
CARD READER BY DIVISION 28.

HW-SH-3A

THIS SET NOT USED.

HW-SH-3B

Each [PB] Door to Have:

RATED

1 Continuous Hinge	
1 Push-button Combination Lock	N3 - A156.13 F07 G1 E 06
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

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HW-SH-3C

Each [PB] Door to Have:

NON-RATED/RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
	X ADJUSTA-SCREWS
1 Push-button Combination Lock	N3 - A156.13 F07 G1 E06
1 Closer	C02011/C02021
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Floor Stop	L02121 x 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

HW-SH-3D

Each [AC, EL, REX, DPS] Door to Have:

RATED

1 Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
	X ADJUSTA-SCREWS X 4-THROUGHWIRE
	TRANSFER X IN-HINGE ACCESS PANEL
1 Electrified Lock	F07 (E01-REX, E06) 24V DC
1 Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE
	AS REQUIRED
1 Closer	C02011/C02021
1 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154
1 Alarm Contact	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.
 CARD READER BY DIVISION 28.

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HW-SH-3E

Each [AC, EL, REX, DPS] Door to Have:

RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
1 Transfer Hinge	4-WIRE TYPE AS REQUIRED
1 Electrified Occupancy Indicator Lock	F13-MODIFIED (E01-REX, E06) 24V DC X OCCUPANCY INDICATOR X KEY RETRACTS LATCHBOLT AND DEADBOLT X INTERNAL DEADBOLT MONITOR SWITCH
1 Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1 Closer	C02011/C02021
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154
1 Alarm Contact	

INTERNAL DEADBOLT MONITOR SWITCH SHUNTS ACCESS CONTROL DEVICE WHEN
DEADBOLT IS THROWN.

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

CARD READER BY DIVISION 28.

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HW-SH-3F

Each [AC, RR, EL, REX, DPS] Door to Have:

RATED

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Electrified Lock	F13-MOD X RIGID OUTSIDE LEVER X NO INSIDE TURN X KEY RETRACTS LATCHBOLT AND DEADBOLT (E01-REX, E06) 24V DC
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154
1	Alarm Contact	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

CARD READER BY DIVISION 28.

RATED

HW-SH-3G

Each [AC, RR, EL, REX, DPS] Door to Have:

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 4-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Electrified Lock	F13-MOD X RIGID OUTSIDE LEVER X NO INSIDE TURN X KEY RETRACTS LATCHBOLT AND DEADBOLT (E01-REX, E06) 24V DC
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Self-Adhesive Seals	R0Y154
1	Alarm Contact	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.
CARD READER BY DIVISION 28.

RATED

1	Continuous Transfer Hinge	x 4-THRUWIRE TRANSFER x IN-HINGE ACCESS PANEL
1	Electrified Lock	F13-MOD x RIGID OUTSIDE LEVER X KEY RETRACTS LATCHBOLT AND DEADBOLT (E01- REX, E06) 24V DC
1	Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED
1	Closer	C02011/C02021
1	Kick Plate	J102
1	Floor Stop	L02121 x 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154
1	Door Viewer	L03221 - 190°
1	Alarm Contact	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.
CARD READER BY DIVISION 28.

HW-SH-4

Each [AC, EL, REX, DPS] Integrated Door to Have:

RATED

1	Key Cylinder	TYPE AS REQUIRED
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BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

HW-SH-4A

Each [ADO, AC, ELR, REX, DPS] Integrated Door to Have:

RATED

1	Key Cylinder	TYPE AS REQUIRED
---	--------------	------------------

BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

RATED

1	Continuous Transfer Hinge	X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 12-THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
1	Electrified Exit Device	TYPE 1 (E01-REX, E06) F13 LEVER
1	Key Cylinder	TYPE AS REQUIRED
1	Power Supply	TYPE REQUIRED BY PANIC MANUFACTURER X ADO BOARD
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Set Self-Adhesive Seals	R0Y154

POWER TRANSFER **SHARED BY ELECTRIC PANIC AND** REACTIVATION SENSOR WIRING
(REACTIVATION SENSORS PROVIDED BY SECTION 08 71 13).

AUTOMATIC DOOR OPERATOR AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

	<u>RATED</u>
2 Continuous Transfer Hinge	HW-SH-5 X INTEGRAL HINGE GUARD CHANNEL X ADJUSTA-SCREWS X 12 THROUGHWIRE TRANSFER X IN-HINGE ACCESS PANEL
2 Electrified Exit Device	TYPE 1 (E01-REX, E06) F13 LEVER
2 Key Cylinder	TYPE AS REQUIRED
1 Power Supply	TYPE REQUIRED BY PANIC MANUFACTURER X ADO BOARD
2 Closers	C02011/C02021
1 Removable Mullion	
2 Armor Plate	J101 X 0.050-INCH THICKNESS
1 Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2 Floor Stop	L02121 X 3 FASTENERS
2 Threshold	J32300 X 2-1/4-INCH WIDTH
2 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Set Self-Adhesive Seals	R0Y154
2 Alarm Contacts	

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.
CARD READER BY DIVISION 28.

HW-SH-6

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

INTERIOR PAIRS OF SECURITY DOORS

HW-SH-7

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

HW-SH-8

THIS HARDWARE SET LEFT INTENTIONALLY BLANK AT THIS TIME.

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<u>HW-SH-9</u>		<u>RATED</u>
<u>Each [AC, EL, REX, DPS] Pair to Have:</u>		<u>RATED</u>
Hinges	QUANTITY AND TYPE AS REQUIRED	
1 Transfer Hinge	4-WIRE TYPE AS REQUIRED	
1 Set Auto Flush Bolts	TYPE 25	
1 Dust Proof Strike	L04021	
1 Electrified Lock	F07 (E01-REX, E06) 24V DC	
1 Power Supply	REGULATED, FILTERED, 24V DC, AMPERAGE AS REQUIRED	
1 Coordinator	TYPE 21A	
1 Overlapping Astragal with Self-Adhesive Seal	R0Y634 x R0Y154 X THROUGH-BOLTS	
2 Closers	C02011/C02021	
2 Kick Plates	J102 (AT STORAGE ROOMS ONLY)	
2 Floor Stops	L02121 X 3 FASTENERS	
1 Set Self-Adhesive Seals	R0Y154	
2 Alarm Contacts		
120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.		
CARD READER BY DIVISION 28.		

HW-SH-9A

Each [PB] Pair to Have:

RATED

RATED

2	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL	
		X ADJUSTA-SCREWS	
1	Set Auto Flush Bolts	TYPE 25	
1	Dust Proof Strike	L04021	
1	Push-button Combination Lock	N3 - A156.13 F07 G1 E06	
1	Coordinator	TYPE 21A	
1	Overlapping Astragal with Self-Adhesive Seal	R0Y634 X R0Y154 X THROUGH-BOLTS	
2	Closers	C02011/C02021	
2	Armor Plates	J101 X 0.050-INCH THICKNESS	
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE	
2	Floor Stops	L02121 X 3 FASTENERS	
1	Set Self-Adhesive Seals	R0Y154	

HW-SH-10

Each [AC, EL, REX, DPS] Pair Integrated Doors to Have:

RATED

1	Key Cylinder	TYPE AS REQUIRED
---	--------------	------------------

BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

HW-SH-10A

Each [AC, ADO, EL, REX, DPS] Pair Integrated Doors to Have:

RATED

1	Key Cylinder	TYPE AS REQUIRED
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BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES.
AUTOMATIC DOOR OPERATORS AND CONTROLS BY SECTION 08 71 13, AUTOMATIC DOOR
OPERATORS.

EXTERIOR SINGLE SECURITY DOORS

RATED

HW-SH-12

Each [AC, ELR, REX, DPS] Integrated Door to Have:

NON-RATED

1 Key Cylinder

TYPE AS REQUIRED

BALANCE OF HARDWARE BY SECTION 08 17 10, INTEGRATED DOOR ASSEMBLIES

MENTAL HEALTH AREAS

HW-MH1

Each Door to Have:

NON-RATED/RATED

1 Continuous Hinge

X INTEGRAL HINGE GUARD CHANNEL

X HOSPITAL TIP X ADJUSTA-SCREWS

1 Passage Latch

F01 X LESS TRIM

1 Set Anti-Ligature Trim

1 Armor Plate

J101 X 0.050-INCH THICKNESS

1 Edge Guard (at Wood Doors)

J208M/J211 (VERIFY), CUT: HARDWARE

1 Floor Stop

L02121 X 3 FASTENERS

1 Set Seals

R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

HW-MH1A

Each Door to Have:

RATED RATED

Hinges	QUANTITY AND TYPE AS REQUIRED
	X HOSPITAL TIPS
1 Passage Latch	F01 X LESS TRIM
1 Set Anti-Ligature Trim	
1 Closer	C02011/C02021
	X INSTALL OUTSIDE ROOM
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 X 3 FASTENERS
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
1 Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

HW-MH1B

Each Door to Have:

RATED/NON-RATED

1 Continuous Hinge	X HOSPITAL TIP
1 Passage Latch	F01 X LESS TRIM
1 Set Anti-Ligature Trim	
1 Kick Plate	J102
1 Closer (at rated doors)	C02011/C02021
1 Wall Stop	L02101 CONVEX
1 Threshold	J32300 X 2-1/4-INCH WIDTH
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
2 Sets Self-Adhesive Seals	R0Y154

INSTALL CLOSER OUTSIDE ROOM.

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

HW-MH-2

RATED

Each Door to Have:

NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED X HOSPITAL TIP
1 Keyed Privacy Lock	F12-MOD X TURNPIECE BOTH SIDES X LESS TRIM
1 Set Anti-Ligature Trim	
2 Anti-Ligature Thumbturns	
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 X 3 FASTENERS
1 Auto Door Bottom	R0Y346 - HEAVY DUTY
1 Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.
STONE THRESHOLD BY OTHER TRADES.

HW-MH2A

Each Door to Have:

RATED/NON-RATED

Hinges	QUANTITY AND TYPE AS REQUIRED X HOSPITAL TIP
1 Keyed Privacy Indicator Lock	F13 X OCCUPANCY INDICATOR X LESS TRIM
1 Set Anti-Ligature Trim	
1 Anti-Ligature Thumbturn	
1 Closer	C02011/C02021
1 Kick Plate	J102
1 Mop Plate (at Inswing Doors)	J103
1 Floor Stop	L02121 X 3 FASTENERS
1 Set Self-Adhesive Seals	R0Y154

INSTALL CLOSER OUTSIDE ROOM
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.
STONE THRESHOLD BY OTHER TRADES.

<u>Each Door to Have:</u>		<u>HW-MH-3</u>	<u>RATED</u>
			<u>NON-RATED</u>
1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS	
1	Classroom Lock	F05 X LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), or equal	
1	Armor Plate	J101 X 0.050-INCH THICKNESS	
1	Mop Plate	J103	
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 X 3 FASTENERS	
3	Silencers	L03011	
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			

<u>Each Door to Have:</u>		<u>HW-MH3A</u>	<u>RATED</u>
1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS	
1	Classroom Lock	F05 X LESS TRIM	
1	Set Anti-Ligature Trim	CH (Accurate Lock), OR EQUAL	
1	Closer	C02011/C02021	
1	Armor Plate	J101 X 0.050-INCH THICKNESS	
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE	
1	Floor Stop	L02121 X 3 FASTENERS	
1	Set Self-Adhesive Seals	R0Y154	
INSTALL CLOSER OUTSIDE ROOM.			
PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.			

HW-MH4

Each [AC, RR, EL, REX, DPS] Door to Have:

RATED

- | | | |
|---|----------------------------|--|
| 1 | Continuous Transfer Hinge | X INTEGRAL HINGE GUARD CHANNEL
X ADJUSTA-SCREWS X 4-THROUGHWIRE
TRANSFER X IN-HINGE ACCESS PANEL |
| 1 | Electrified Lock | F07 (E01-REX, E06) 24V DC X
LESS TRIM |
| 1 | Set Anti-Ligature Trim | |
| 1 | Power Supply | REGULATED, FILTERED, 24V DC, AMPERAGE
AS REQUIRED |
| 1 | Closer | C02011/C02021 |
| 1 | Kick Plate | J102 |
| 1 | Stretcher Plate | J101 |
| 1 | Edge Guard (at Wood Doors) | J208M/J211 (VERIFY), CUT: HARDWARE |
| 1 | Floor Stop | L02121 X 3 FASTENERS |
| 1 | Door Viewer | L03221 - 190° (VIEW INTO WAITING ROOM) |
| 1 | Door Viewer | L03221 - 190° (VIEW INTO TREATMENT AREA) |
| 1 | Set Self-Adhesive Seals | R0Y154 |
| 1 | Alarm Contact | 1078-G (G.E. SECURITY), OR EQUAL |

OMIT DOOR VIEWERS AT DOORS WITH VISION LITES.

INSTALL DOOR CLOSER ON WAITING ROOM SIDE.

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

120VAC POWER, CONDUIT, AND WIRING BY DIVISION 26.

CARD READER BY DIVISION 28.

HW-MH4A

Each Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
1	Lock	F08 X LESS TRIM
1	Set Anti-Ligature Trim	
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

HW-MH5

Each Door to Have:

RATED/NON-RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls	
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Floor Stop	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
1	Auto Door Bottom	R0Y346 - HEAVY DUTY
1	Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

NO CLOSER REQUIRED AT RATED DOORS DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

HW-MH5A

Each Door to Have:

RATED

1	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls	
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
1	Armor Plate	J101 X 0.050-INCH THICKNESS
1	Floor Stop	L02121 X 3 FASTENERS
3	Silencers	L03011

STONE THRESHOLD BY OTHER TRADES.

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

HW-MH6

Each Pair to Have:

RATED/NON-RATED

2	Continuous Hinges	X INTEGRAL HINGE GUARD CHANNEL X HOSPITAL TIP X ADJUSTA-SCREWS
2	Anti-Ligature Pulls (act. 1f)	
2	Manual Flush Bolts	L04251/L04261 (VERIFY)
1	Dust Proof Strike	L04021
1	Deadlatch	F30 LESS TRIM BOTH SIDES
1	Overlapping Astragal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Armor Plates	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stops	L02121 X 3 FASTENERS
1	Threshold	J32300 X 2-1/4-INCH WIDTH
2	Auto Door Bottom	R0Y336 - HEAVY DUTY
1	Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

Department of Veterans Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic
Project Number 580-17-100

MEDVAMC Houston, TX

HW-MH6A

Each Pair to Have:

NON-RATED/RATED

2	Continuous Hinge	X INTEGRAL HINGE GUARD CHANNEL
		X HOSPITAL TIP X ADJUSTA-SCREWS
2	Manual Flush Bolts	L04251/L04261 (VERIFY)
1	Dust Proof Strike	L04021
1	Passage Latch	F01 X LESS TRIM
1	Set Anti-Ligature Trim	
1	Overlapping Astragal	R0Y634 X R0Y154 X THROUGH-BOLTS
2	Armor Plate	J101 X 0.050-INCH THICKNESS
2	Edge Guard (at Wood Doors)	J208M/J211 (VERIFY), CUT: HARDWARE
2	Floor Stop	L02121 X 3 FASTENERS
1	Set Seals	R0Y164

PROVIDE SECURITY FASTENERS FOR ALL HARDWARE ITEMS.

NO CLOSER REQUIRED DUE TO EXEMPTION FOR PATIENT ROOM DOORS.

- - - E N D - - -

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies glass-related glazing materials and accessories.
Glazing products specified apply to field-glazed items.

1.2 RELATED WORK

- A. Glazing in Hollow Metal Doors: Section 08 11 13, HOLLOW METAL DOORS AND FRAMES.
- B. Glazing in Wood Doors: Section 08 14 00, INTERIOR WOOD DOORS.
- C. Glazing in Aluminum Doors and Storefront Applications: Section 08 41 13, ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- D. Glazing for Mirrors: Section 10 28 00, TOILET, BATH, AND LAUNDRY ACCESSORIES.

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 Contracting Officer's Representative (COR).
- 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Glass Thickness: Thicknesses listed are minimums. Coordinate thicknesses with framing system manufacturers.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

- B. Warranty: Submit written guaranty, conforming to General Condition requirements, and to "Warranty of Construction" Article in this Section.
- C. Manufacturer's Literature and Data:
 - 1. Glass, each kind required.
 - 3. Elastic compound for metal sash glazing.
 - 4. Glazing cushion.
 - 5. Sealing compound.
- D. Samples:
 - 1. Size: 6 inches by 6 inches.
- E. 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 safety glazing units against face and edge damage during entire sequence of fabrication, handling, and delivery to installation location.
 - 1. Treat security glazing as fragile merchandise, and packaged and shipped in export wood cases with width end in upright position and blocked together in a mass. Storage and handling shall comply with manufacturer's directions and as required to prevent edge damage or other damage to glazing resulting from effects of moisture, condensation, temperature changes, direct exposure to sun, other environmental conditions, and contact with chemical solvents.
 - 2. Temporary Protections: The glass front and 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.

3. Edge Protection: To cushion and protect glass clad 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.

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:
 2. Laminated glass units are to remain laminated for 5 years.

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 q3.

2. Thickness, 1/4-inch.
3. Coordinate color/tint/coating to accommodate required security monitoring.

2.2 HEAT-TREATED GLASS

A. Clear Tempered Glass:

1. ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality q3.
2. Thickness, 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. Use 0.060-inch-thick interlayer for: Fully tempered glass assemblies.
- C. Use minimum 0.030-inch-thick interlayer for vertical glazing where 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, 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 3/16-inch thick.

2.5 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 1/4-inch internal depth.
 2. Shore A hardness of 80 to 90 Durometer.
 3. Block Lengths: 2 inches except 4 to 6 inches for insulating glass.
 4. Block Width: Approximately 1/6-inch less than the full width of the rabbet.
 5. Block Thickness: Minimum 3/16-inch. Thickness sized for rabbet depth as required.
- C. Spacers: ASTM C864:
 1. Channel shape having a 1/4-inch internal depth.
 2. Flanges not less 3/32-inch-thick and web 1/8-inch thick.

3. Lengths: 1 to 3 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. Spring Steel Spacer: Galvanized steel wire or strip designed to position glazing in channel or rabbeted sash with stops.
- F. Glazing Clips: Galvanized steel spring wire designed to hold glass in position in rabbeted sash without stops.
- G. Glazing Points (Sprigs): Pure zinc stock, thin, flat, triangular- or diamond-shaped pieces, 1/4-inch minimum size.
- H. 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.
- I. Lock-Strip Glazing Gaskets: ASTM C542, shape, size, and mounting as indicated.
- J. 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.
- K. 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.
- L. Neoprene, EPDM, or Vinyl Glazing Gasket: ASTM C864.
1. Channel shape; flanges may terminate above the glazing channel or flush with the top of the channel.
 2. Designed for dry glazing.

M. 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.

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 to 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. Tempered Glass: Install with roller distortions in horizontal position unless otherwise directed.
- F. Laminated Glass:
 - 1. Tape edges to seal interlayer and protect from glazing sealants.
 - 2. Do not use putty or glazing compounds.

3.4 REPLACEMENT AND CLEANING

- A. Clean new glass surfaces removing temporary labels, paint spots, and defacement after approval by Contracting Officer's Representative (COR).
- 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.

3.5 PROTECTION

- A. Protect finished surfaces from damage during erection, and after completion of Work. Strippable plastic coatings on colored anodized finish are not acceptable.

3.6 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 clear tempered glass on interior sidelights and doors, and interior windows unless otherwise indicated or specified.

- - - E N D - - -

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies steel stud 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. Load-Bearing Framing: Section 05 40 00, COLD-FORMED METAL FRAMING.
- B. Support for Wall-Mounted Items: Section 05 50 00, METAL FABRICATIONS.
- C. Installation of Gypsum Board: Section 09 29 00, GYPSUM BOARD.
- D. Ceiling Suspension Systems for Acoustical Tile or Panels and Lay-In Gypsum Board Panels: Section 09 29 00, GYPSUM BOARD and Section 09 51 00, ACOUSTICAL CEILINGS.

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

- A. 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

- A. 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, 0.0359-inch-thick bare metal (20-gage), 4-inch studs.

2. Runners same thickness and size as studs.
- B. Provide not less than 2 cutouts in web of each stud, approximately 12 inches from each end, and intermediate cutouts on approximately 24-inch centers.
- C. Doubled studs for openings and studs for supporting concrete backer-board.
- D. Studs 12 feet or less in length shall be in one piece.
- E. Shaft Wall Framing:
 1. Conform to rated wall construction.
 2. C-H Studs.
 3. E Studs.
 4. J Runners.
 5. Steel jamb-strut.

2.3 FURRING CHANNELS

- A. Rigid Furring Channels (Hat Shape): ASTM C645.
- B. Resilient Furring Channels:
 1. Not less than 0.0179-inch-thick bare metal.
 2. Semi-hat shape, only 1 flange for anchorage with channel web leg slotted on anchorage side, channel web leg on other side stiffens fastener surface but shall not contact anchorage surface other channel leg is attached to.
- 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. For Fire-Rated Construction: Type and size same as used in fire rating test.
- C. Fasteners for Steel Studs Thicker Than 0.033-Inch Thick: Use ASTM C954 steel drill screws of size and type recommended by the manufacturer of the material being fastened.
- D. 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), manufacturer's 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. Manufacturer's 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 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 wall studs in accordance with ASTM C754 Use 20-gage, 4-inch studs unless otherwise shown on Drawings.
- B. Space studs as shown on Drawings, but not more than 24 inches on center.
- C. Cut studs 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. Extend studs to underside of structure overhead for fire, rated partitions, smoke partitions, shafts, and sound-rated partitions.
- F. Openings:
 - 1. Frame jambs of openings in stud partitions and furring with 2 studs placed back to back or as shown.
 - 2. Fasten back-to-back studs together with 3/8-inch-long Type S pan head screws at not less than 2 feet on center, staggered along webs.
 - 3. Studs fastened flange to flange shall have splice plates on both sides approximately 2 by 3 inches screwed to each stud with 2 screws in each stud. Locate splice plates at 24 inches on center between runner tracks.

G. Fastening Studs:

1. Fasten studs located adjacent to partition intersections, corners and studs at jambs of openings to flange of runner tracks with 2 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.

H. Chase Wall Partitions:

1. Locate cross braces for chase wall partitions to permit the installation of pipes, conduits, carriers and similar items.
2. Use studs or runners as cross bracing not less than 2-1/2 inches wide.

I. Form control joint with double studs spaced 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 2-1/2-inch or narrower studs, 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 3-foot vertical intervals on side without finish.
3. Securely fasten braces to each stud with 2 Type S pan head screws at each bearing.

C. Direct Attachment to Masonry or Concrete; Rigid Channels:

1. Install rigid (hat section) furring channels at 24 inches on center, horizontally or vertically.
2. At corners where rigid furring channels are positioned horizontally, provide mitered joints in furring channels.
3. Ends of spliced furring channels shall be nested not less than 8 inches.
4. Fasten furring channels to walls with power-actuated drive pins or hardened steel concrete nails. Where channels are spliced, provide 2 fasteners in each flange.
5. Locate furring channels at interior and exterior corners in accordance with wall finish material manufacturers printed erection instructions. Locate "Z" channels within 4 inches of corner.

D. Installing Wall Furring-Bracket System: Space furring channels not more than 16 inches on center.

3.4 INSTALLING SUPPORTS REQUIRED BY OTHER TRADES

- A. Provide for attachment and support of electrical outlets, plumbing, laboratory or heating fixtures, recessed-type plumbing fixture accessories, access panel frames, wall bumpers, toilet stall partitions, dressing booth partitions, urinal screens, chalkboards, tackboards, wall-hung casework, 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.

3.5 INSTALLING SHAFT WALL SYSTEM

- A. Conform to UL Design U438 for 2-hour fire rating. Provide 2-hour fire-rated shaft walls where shown on Drawings.
- B. Position J runners at floor and ceiling with the short leg toward finish side of wall. Securely attach runners to structural supports with power driven fasteners at both ends and 24 inches on center.
- C. After liner panels have been erected, cut C-H studs and E studs, from 3/8-inch to not more than 1/2-inch less than floor-to-ceiling height. Install C-H studs between liner panels with liner panels inserted in the groove.
- D. Install full-length steel E studs over shaft wall line at intersections, corners, hinged door jambs, columns, and both sides of closure panels.
- E. Suitably frame all openings to maintain structural support for wall.
 - 1. Provide necessary liner fillers and shims to conform to label frame requirements.
 - 2. Frame openings cut within a liner panel with E studs around perimeter.
 - 3. Frame openings with vertical E studs at jambs, horizontal J runner at head and sill.

3.6 INSTALLING FURRED AND SUSPENDED CEILINGS OR SOFFITS

- A. Install furred and suspended ceilings or soffits in accordance with ASTM C754 or ASTM C841 except as otherwise specified or shown for screw attached gypsum board ceilings and for plaster ceilings or soffits.
 - 1. Space framing at 16-inch centers for metal lath anchorage.
 - 2. Space framing at 24-inch centers for gypsum board anchorage.
- B. Where bar joists or beams are more than 48 inches apart, provide intermediate hangers so that spacing between supports does not exceed 48 inches. Use clips, bolts, or wire ties for direct attachment to steel framing.

C. Steel Decking Without Concrete Topping:

1. Do not fasten to steel decking 0.0299-inch or thinner.
2. Toggle bolt to decking 0.0359-inch or thicker only where anchorage to steel framing is not possible.

3.7 TOLERANCES

- A. Fastening surface for application of subsequent materials shall not vary more than 1/8-inch from the layout line.
- B. Plumb and align vertical members within 1/8-inch.
- C. Level or align ceilings within 1/8-inch.

- - - E N D - - -

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 DESCRIPTION

A. 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 05 40 00, COLD-FORMED METAL FRAMING, and Section 09 22 16, NON-STRUCTURAL METAL FRAMING.

B. Acoustical Sealants: Section 07 92 00, JOINT SEALANTS.

C. Gypsum Base for Veneer Plaster: Section 09 26 00, VENEER PLASTERING.

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.

1.5 DELIVERY, IDENTIFICATION, HANDLING AND STORAGE

A. In accordance with the requirements of ASTM C840.

1.6 ENVIRONMENTAL CONDITIONS

A. 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, 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, Type X.
 - 3. Coreboard for shaft walls 12, 16, or 24 inches wide by required
lengths 1 inch thick with paper faces treated to resist moisture.
- C. Water Resistant Gypsum Backing Board: ASTM C620, Type X, 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 GYPSUM SHEATHING BOARD

- A. ASTM C1396, Type X, water-resistant core, 5/8-inch thick.
- B. ASTM C1177, Type X.

2.3 ACCESSORIES

- A. ASTM C1047, except form of 0.015-inch-thick zinc-coated steel sheet or rigid PVC plastic.
- B. Flanges not less than 7/8-inch wide with punchouts or deformations as required to provide compound bond.

2.4 FASTENERS

- A. ASTM C1002 and ASTM C840, except as otherwise specified.
- B. ASTM C954, for steel studs thicker than 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

- A. 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 GYPSUM BOARD HEIGHTS

- A. Extend all layers of gypsum board from floor to underside of structure overhead on following partitions and furring:
 - 1. Two sides of partitions:
 - a. Fire-rated partitions.
 - b. Smoke partitions.
 - c. Sound-rated partitions.
 - d. Full height partitions (FHP) shown.
 - e. Corridor partitions.
 - 2. One side of partitions or furring:
 - a. Inside of exterior wall furring or stud construction.
 - b. Room side of room without suspended ceilings.
 - c. Furring for pipes and duct shafts, except where fire-rated shaft wall construction is shown.
 - 3. Extend all layers of gypsum board construction used for fireproofing of columns from floor to underside of structure overhead, unless shown otherwise.
- B. In locations other than those specified, extend gypsum board from floor to heights as follows:
 - 1. Not less than 4 inches above suspended acoustical ceilings.

2. At ceiling of suspended gypsum board ceilings.
3. At existing ceilings.

3.2 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. Walls (Except Shaft Walls):
 1. When gypsum board is installed parallel to framing members, space fasteners 12 inches on center in field of the board, and 8 inches on center along edges.
 2. When gypsum board is installed perpendicular to framing members, space fasteners 12 inches on center in field and along edges.
 3. Stagger screws on abutting edges or ends.
 4. For single-ply construction, apply gypsum board with long dimension either parallel or perpendicular to framing members as required to minimize number of joints.
 5. For 2-ply gypsum board assemblies, apply base ply of gypsum board to assure minimum number of joints in face layer. Apply face ply of wallboard to base ply so that joints of face ply do not occur at joints of base ply with joints over framing members.
 6. For 3-ply gypsum board assemblies, apply plies in same manner as for 2-ply assemblies, except that heads of fasteners need only be driven flush with surface for first and second plies. Apply third ply of wallboard in same manner as second ply of 2-ply assembly, except use

- fasteners of sufficient length enough to have the same penetration into framing members as required for 2-ply assemblies.
7. No offset in exposed face of walls and partitions will be permitted because of single-ply and 2-ply or 3-ply application requirements.
 8. Control Joints ASTM C840 and As Follows:
 - a. Locate at both side jambs of openings if gypsum board is not "yoked." Use one system throughout.
 - b. Not required for wall lengths less than 30 feet.
 - c. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
 - H. Acoustical or Sound-Rated Partitions, Fire and Smoke Partitions:
 1. Cut gypsum board for a space approximately 1/8- to 1/4-inch wide around partition perimeter.
 2. Coordinate for application of caulking or sealants to space prior to taping and finishing.
 3. For sound-rated partitions, use sealing compound (ASTM C919) to fill the annular spaces between all receptacle boxes and the partition finish material through which the boxes protrude to seal all holes and/or openings on the back and sides of the boxes. STC minimum values as shown.
 - I. Electrical and Telecommunications Boxes: Seal annular spaces between electrical and telecommunications receptacle boxes and gypsum board partitions.
 - J. 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 1 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.

3.3 INSTALLING GYPSUM SHEATHING

- A. Install in accordance with ASTM C840, except as otherwise specified or shown.
- B. Use screws of sufficient length to secure sheathing to framing.
- C. Space screws 3/8-inch from ends and edges of sheathing and 8 inches on center. Space screws a maximum of 8 inches on center on intermediate framing members.
- D. Apply 2-foot by 8-foot sheathing boards horizontally with tongue edge up.
- E. Apply 4-foot by 8- or 9-foot gypsum sheathing boards vertically with edges over framing.

3.4 CAVITY SHAFT WALL

- A. Coordinate assembly with Section 09 22 16, NON-STRUCTURAL METAL FRAMING, for erection of framing and gypsum board.
- B. Conform to UL Design No. U438 or FM WALL CONSTRUCTION 12-2/HR (Non-bearing for 2-hour fire rating. Conform to FM WALL CONSTRUCTION 25-1/HR (Non-load-bearing) for 1-hour fire rating where shown.
- C. Cut coreboard (liner) panels 1 inch less than floor-to-ceiling height, and erect vertically between J-runners on shaft side.
 - 1. Where shaft walls exceed 14 feet in height, position panel end joints within upper and lower third points of wall.
 - 2. Stagger joints top and bottom in adjacent panels.
 - 3. After erection of J-struts of opening frames, fasten panels to J-struts with screws of sufficient length to secure to framing staggered from those in base, spaced 12 inches on center.
- D. Gypsum Board:
 - 1. Two-Hour Wall:
 - a. Erect base layer (backing board) vertically on finish side of wall with end joints staggered. Fasten base layer panels to studs with 1-inch-long screws, spaced 24 inches on center.
 - b. Use laminating adhesive between plies in accordance with UL or FM if required by fire test.
 - c. Apply face layer of gypsum board required by fire test vertically over base layer with joints staggered and attach with screws of sufficient length to secure to framing staggered from those in base, spaced 12 inches on center.

2. One-Hour Wall With 1 Layer on Finish Side of Wall: Apply face layer of gypsum board vertically. Attach to studs with screws of sufficient length to secure to framing, spaced 12 inches on center in field and along edges.
 3. Where coreboard is covered with face layer of gypsum board, stagger joints of face layer from those in the coreboard base.
- E. Treat joints, corners, and fasteners in face layer as specified for finishing of gypsum board.

3.5 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, except use Level 5 behind reception desk for mural application as shown on Drawings.
- 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 smoke barrier, fire-rated and sound-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 smoke barrier, fire-rated and sound-rated construction. Sanding is not required of non-decorated surfaces.

3.6 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 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 1/2-inch diameter, or equivalent size, with 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 smoke-tight construction, fire protection equivalent to the fire-rated construction, and STC equivalent to the sound-rated construction.

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SECTION 09 30 13
CERAMIC/PORCELAIN TILING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies ceramic, porcelain tile, waterproofing membranes for thin-set applications, crack isolation membranes, and tile backer board.

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, trim shapes, and color of grout as indicated in the Finish Schedule on the Drawings.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Samples:
1. Base tile, each type, each color, each size.
2. Mosaic floor tile panels, 9 inches by 9 inches, each type, color, size and pattern.
3. Paver tile, each size, type, color and pattern.
4. Porcelain tile, each type, color, pattern and size.
5. Wall (or wainscot) tile, each color, size and pattern.
6. Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, color, and size.
C. Product Data:
1. Porcelain tile, marked to show each type, size, and shape required.
2. Cementitious backer unit.
3. Dry-set Portland cement mortar and grout.
4. Elastomeric membrane and bond coat.
5. Reinforcing tape.
6. Leveling compound.
7. Latex-Portland cement mortar and grout.
8. Commercial Portland cement grout.
9. Slip resistant tile.
10. Waterproofing isolation membrane.
11. Fasteners.
D. Certification:
1. Master grade, ANSI A137.1.

2. Manufacturer's certificates indicating that the following materials comply with Specification requirements:
 - a. Chemical-resistant mortar and grout (epoxy and furan).
 - b. Modified epoxy emulsion.
 - c. Commercial Portland cement grout.
 - d. Cementitious backer unit.
 - e. Dry-set Portland cement mortar and grout.
 - f. Elastomeric membrane and bond coat.
 - g. Reinforcing tape.
 - h. Latex-Portland cement mortar and grout.
 - i. Leveling compound.
 - j. Waterproof isolation membrane.
 - k. Factory-mounted tile suitability for application in wet area specified under 2.1, A., 3. with list of successful in-service performance locations.

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):
 - A185-07.....Steel Welded Wire Fabric, Plain, for Concrete Reinforcing

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
C954-11.....Steel Drill Screws for the Application of Gypsum
Board on Metal Plaster Base to Steel Studs from
0.033 in (0.84 mm) to 0.112 in (2.84 mm) in
thickness
C979-10.....Pigments for Integrally Colored Concrete
C1002-07.....Steel Self-Piercing Tapping Screws for the
Application of Panel Products
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. 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 C1027.
 - b. Class V, 12,000 revolutions for floors in corridors, kitchens, storage including refrigerated rooms
 - c. Class IV, 6,000 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 0.7 (wet condition) for bathing areas.
 - 2) Not less than 0.8 on ramps for wet and dry conditions.
 - 3) 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: Matte surface finish with raised ridges spaced uniformly over tile surface.
4. Mosaic tile may be mounted or joined together by a resinous bonding material along tile edges.
5. Do not use back-mounted tiles in showers unless certified by manufacturer as noted in paragraph 1.3,D.
6. Factory Blending: For tile with color variations, within the ranges selected during sample submittals blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
7. Factory-Applied Temporary Protective Coating:
 - a. Protect exposed face surfaces (top surface) of tile against adherence of mortar and grout by pre-coating with a continuous film of petroleum paraffin wax, applied hot.
 - b. Do not coat unexposed tile surfaces.
 - c. Pre-wax tiles set or grouted with latex modified mortars.
- B. Unglazed Ceramic Mosaic Tile: Nominal ¼-inch thick with cushion edges.
- C. Glazed Wall Tile: Cushion edges, glazing, as indicated in the Finish Schedule on the Drawings.
- D. Porcelain Paver Tile: Nominal 5/16-inch thick, with cushion edges.

Porcelain tile produced by the dust pressed method shall be made of approximately 50 percent feldspar; the remaining 50 percent shall be made up of various high-quality light-firing ball clays yielding a tile with a water absorption rate of 0.5 percent or less and a breaking strength of between 390 to 400 pounds.
- E. Trim Shapes:
 1. Conform to applicable requirements of adjoining floor and wall tile.

2. Use slip-resistant trim shapes for horizontal surfaces of showers, overflow ledges, recessed steps, shower curbs, drying area curbs, and seats.
3. Use trim shapes sizes conforming to size of adjoining field wall tile including existing spaces unless detailed or indicated otherwise in the Finish Schedule on the Drawings.
4. Internal and External Corners:
 - a. Square internal and external corner joints are not acceptable.
 - b. External Corners Including Edges: Use bullnose shapes.
 - c. Internal Corners: Use cove shapes.
 - d. Base to Floor Internal Corners: Use special shapes providing integral cove vertical and horizontal joint.
 - e. Base to Floor External Corners: Use special shapes providing bullnose vertical edge with integral cove horizontal joint. Use stop at bottom of openings having bullnose return to wall.
 - f. Wall Top Edge Internal Corners: Use special shapes providing integral cove vertical joint with bullnose top edge.
 - g. Wall Top Edge External Corners: Use special shapes providing bullnose vertical and horizontal joint edge.
 - h. For glazed wall tile installed in Portland cement mortar setting bed, use cove and bullnose shapes as applicable.
 - i. For glazed wall tile installed in dry-set Portland cement mortar, latex-Portland cement mortar (thin set methods), use cove and surface bullnose shapes as applicable.

2.2 CEMENTITIOUS BACKER UNITS

- A. Use in showers or wet areas.
- 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, 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 7/16-inch-diameter head, corrosion-resistant coated, with washers.

3. ASTM C954 for steel 0.033-inch thick.

4. ASTM C1002 for steel framing less than 0.0329-inch thick.

B. Washers: Galvanized steel, 1/2-inch minimum diameter.

2.5 GLASS MAT WATER RESISTANT GYPSUM BACKER BOARD

A. Conform to ASTM C1178/C1178M, Optional System for Cementitious Backer Units where shown on Drawings.

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. Elastomeric Waterproofing Membrane and Bond Coat:

1. TCA F122-02.

2. ANSI A108.1.

3. One-component polyurethane, liquid-applied material having the following additional physical properties:

a. Hardness: Shore "A" between 40 and 60.

b. Elongation: Between 300 and 600 percent.

c. Tensile strength: Between 40 and 60 psig.

d. No volatile compounds.

4. Coal tar modified urethanes are not acceptable.

F. Waterproofing Isolation Membrane:

1. Sheet System TCA F122-02.

2. Optional system to elastomeric waterproof membrane.

3. Composite sheet consisting of ASTM D5109, Type II, Grade I Chlorinated Polyethylene (CM) sheet reinforced on both sides with a non-woven polyester fiber.

4. Designed for use in wet areas as an isolation and positive waterproofing membranes for thin-set bonding of sheet to substrate

and thin-set bonding of ceramic and porcelain tile or marble to sheet. Suited for both horizontal and vertical applications.

5. Conform to the following additional physical properties:

Property	Units	Results	Test Method
Hardness Shore A	Points	70-80	ASTM D2240 (10 Second Reading)
Shrinkage	Percent	5 maximum	ASTM D1204
Brittleness		No crack remains flexible at temperature -25 degrees F	ASTM D2497 1/2- inch Mandrel Bend
Retention of Properties after Heat Aging	Percent of original	80 Tensile 80 Breaking 80 Elongation	ASTM D3045, 194 degrees F for 168 hours

6. Manufacturer's standard sheet size with prefabricated or preformed inside and outside corners.
7. Sheet manufacturer's solvent welding liquid or xylene and edge sealant.

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. White Portland Cement Grout:

1. ANSI A108.1.
2. Use 1 part white Portland cement to 1 part white sand passing a Number 30 screen.
3. Color additive not permitted.

C. Commercial Portland Cement Grout: ANSI A108.1 color as specified.

D. Dry-Set Grout: ANSI A108.1 color as specified.

E. Latex-Portland Cement Grout: ANSI A108.1 color as specified.

1. Unsanded grout mixture for joints 1/8-inch and narrower.
2. Sanded grout mixture for joints 1/8-inch and wider.

F. Chemical-Resistant Grout: Epoxy grout, ANSI A108.1.

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: 3,500 psig per ASTM C109/C109M.
 - 2. Flexural Strength: 1,000 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 1-1/2 inches thick without fillers and up to 4 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

- A. 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

- A. 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: 6 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 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 100 degrees F.

- D. Do not install materials when the temperature of the substrate is below 60 degrees F.
- E. Do not allow temperature to fall below 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 1/4-inch in 10 feet from required elevation where Portland cement mortar setting bed is used.
 - 2. Not more than 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.
- B. Variation in Plane of Wall Surfaces:
 - 1. Not more than 1/4-inch in 8 feet from required plane where Portland cement mortar setting bed is used.
 - 2. Not more than 1/8-inch in 8 feet where dry-set or latex-Portland cement mortar or organic adhesive setting materials is used.

3.3 SURFACE PREPARATION

- A. Cleaning New Concrete or Masonry:
 - 1. Chip out loose material, clean off all oil, grease, dirt, adhesives, curing compounds, and other deterrents to bonding by mechanical method, or by using products specifically designed for cleaning concrete and masonry.
 - 2. Use self-contained power blast cleaning systems to remove curing compounds and steel trowel finish from concrete slabs where ceramic tile will be installed directly on concrete surface with thin-set materials.
 - 3. Steam cleaning or the use of acids and solvents for cleaning will not be permitted.
- B. 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 except finish smooth for elastomeric waterproofing.
 - c. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

3. Apply patching and leveling compound to concrete and masonry wall surfaces that are out of required plane.
4. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

C. Mortar Bed for Slopes to Drains:

1. Slope compound to drain where drains are shown.
2. Install mortar bed in depressed slab sloped to drains not less than 1/16-inch per foot.
3. Allow not less than 2-inch depression at edge of depressed slab.
4. Screed for slope to drain and float finish.
5. Cure mortar bed for not less than 7 days. Do not use curing compounds or coatings.

D. Cleavage Membrane:

1. Install polythene sheet as cleavage membrane in depressed slab when waterproof membrane is not scheduled or indicated.
2. Turn up at edge of depressed floor slab to top of floor.

E. Walls:

1. In showers or other wet areas cover studs with polyethylene sheet.
2. Apply patching and leveling compound to concrete and masonry surfaces that are out of required plane.
3. Apply leveling coats of material compatible with wall surface and tile setting material to wall surfaces, other than concrete and masonry that are out of required plane.

F. Existing Floors and Walls:

1. Remove existing composition floor finishes and adhesive. Prepare surface by grinding, chipping, self-contained power blast cleaning or other suitable mechanical methods to completely expose uncontaminated concrete or masonry surfaces. Follow safety requirements of ANSI A10.20.
2. Remove existing concrete fill or topping to structural slab. Clean and level the substrate for new setting bed and waterproof membrane or cleavage membrane.
3. Where new tile bases are required to finish flush with plaster above or where they are extensions of similar bases in conjunction with existing floor tiles, cut channel in floor slab and expose rough wall construction sufficiently to accommodate new tile base and setting material.

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 8 inches on center and not closer than 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 1 inch of turned up waterproof systems.
- F. Do not install joint treatment for 7 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 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; 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 7 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. Set floor tile in elastomeric bond coat over elastomeric membrane ANSI 108. 13, TCA System F122 where scheduled and where shown.
3. Set wall tile installed over concrete or masonry in dry-set Portland cement mortar, or latex-Portland cement mortar, ANSI 108.1B. and TCA System W211-02, W221-02 or W222-02.
4. Set wall tile installed over concrete backer board in latex-Portland cement mortar, ANSI A108.1B.
5. Set trim shapes in same material specified for setting adjoining tile.

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. Align new tile work scheduled for existing spaces to the existing tile work unless specified otherwise.
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 8 inches square to achieve full support of bond coat.

9. Walls:

- a. Cover walls and partitions, including pilasters, furred areas, and freestanding columns from floor to ceiling, or from floor to nominal wainscot heights shown with tile.
- b. Finish wall surfaces behind and at sides of casework and equipment, except those units mounted in wall recesses, with same tile as scheduled for room proper.

10. Joints:

- a. Keep all joints in line, straight, level, perpendicular and of even width unless shown otherwise.
- b. Make joints 1/16-inch wide for glazed wall tile and mosaic tile work.
- c. Make joints in paver tile, porcelain type, maximum 1/8-inch wide.

11. Back Buttering: For installations indicated below, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:

- a. Tile wall installations in wet areas, including showers.
- b. Tile wall installations composed of tiles 8 by 8 inches or larger.
- c. Exterior tile wall installations.

3.7 CERAMIC TILE INSTALLED WITH PORTLAND CEMENT MORTAR

- A. Mortar Mixes for Floor, Wall and Base Tile (including Showers): ANSI A108.1 except specified otherwise.
- B. Installing Wall and Base Tile: ANSI A108.1, except specified otherwise.
- C. Installing Floor Tile: ANSI A108.1, except as specified otherwise. Slope mortar beds to floor drains a minimum of 1/8-inch per foot.

3.8 PORCELAIN TILE INSTALLED WITH LATEX PORTLAND CEMENT BONDING MORTAR

- A. 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.

3.9 THIN-SET CERAMIC AND PORCELAIN TILE INSTALLED WITH DRY-SET PORTLAND CEMENT AND LATEX-PORTLAND CEMENT MORTAR

- A. Installation of Tile: ANSI A108.1, except as specified otherwise.
- B. Slope tile work to drains not less than 1/8-inch per foot.

3.10 CERAMIC AND PORCELAIN TILE INSTALLED WITH ELASTOMERIC BOND COAT

- A. Surface Preparation: Prepare surfaces as specified in paragraph 3.3,G.
- B. Installation of Elastomeric Membrane: ANSI A108.1 and TCA F122-02.
 - 1. Prime surfaces, where required, in accordance with manufacturer's instructions.
 - 2. Install first coat of membrane material in accordance with manufacturer's instructions, in thickness of 30 to 50 mils.
 - 3. Extend material over flashing rings of drains and turn up vertical surfaces not less than 4 inches above finish floor surface.
 - 4. When material has set, recoat areas with a second coat of elastomeric membrane material for a total thickness of 50 to 75 mils.
 - 5. After curing test for leaks with 1 inch of water for 24 hours.
- C. Installation of Tile in Elastomeric Membrane:
 - 1. Spread no more material than can be covered with tile before material starts to set.
 - 2. Apply tile in second coat of elastomeric membrane material in accordance with the coating manufacturer's instructions in lieu at aggregate surfacing specified in ASTM C1127. Do not install top coat over tile.

3.11 GROUTING

- A. Grout Type and Location:
 - 1. Grout for Glazed Wall: Portland cement grout, latex-Portland cement grout, dry-set grout, or commercial Portland cement grout.
 - 2. Grout for Base Tile, Floor Tile, and Paver Tile: Epoxy grout.
- B. Workmanship:
 - 1. Install and cure grout in accordance with the applicable standard.
 - 2. Portland Cement Grout: ANSI A108.1.
 - 3. Dry-Set Grout: ANSI A108.1.

3.12 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, where shown, not less than 1/4-inch deep.

3.13 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 commercial Portland cement grout and tile set in elastomeric bond coat as recommended by the manufacturer of the grout and bond coat.

3.14 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 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.

3.15 TESTING FINISH FLOOR

- A. Test floors in accordance with ASTM C627 to show compliance with Codes 1 through 10.

- - - E N D - - -

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Metal ceiling suspension system for acoustical ceilings.
- B. Acoustical units.

1.2 RELATED WORK

- A. Color, Pattern, and Location of Each Type of Acoustical Unit: Refer to the Finish Schedule on the Drawings.
- B. HVAC: Section 23 37 00, AIR OUTLETS AND INLETS.
- C. Lighting: Section 26 51 00, INTERIOR LIGHTING.

1.3 SUBMITTAL

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
 - 1. Acoustical units, each type, with label indicating conformance to Specification requirements, including units specified to match existing.
 - 2. Colored markers for units providing access.
- C. Manufacturer's Literature and Data:
 - 1. Ceiling suspension system, each type, showing complete details of installation, including suspension system specified to match existing and upward access system details for concealed grid systems.
 - 2. Acoustical units, each type
- D. Manufacturer's Certificates: Acoustical units, each type, in accordance with Specification requirements.

1.4 DEFINITIONS

- A. Standard definitions as defined in ASTM C634.
- B. Terminology as defined in ASTM E1264.

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 Society for Testing and Materials (ASTM):
 - A641/A641M-03.....Zinc-coated (Galvanized) Carbon Steel Wire
 - A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process
 - C423-07.....Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

C634-02 (E2007).....	Standard Terminology Relating to Environmental Acoustics
C635-04.....	Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
C636-06.....	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
E84-07.....	Surface Burning Characteristics of Building Materials
E119-07.....	Fire Tests of Building Construction and Materials
E413-04.....	Classification for Rating Sound Insulation
E580-06.....	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
E1264-(R2005).....	Classification for Acoustical Ceiling Products

PART 2 - PRODUCTS

2.1 METAL SUSPENSION SYSTEM

- A. ASTM C635, heavy-duty system, except as otherwise specified.
 - 1. Ceiling suspension system members may be fabricated from either of the following unless specified otherwise.
 - a. Galvanized cold-rolled steel, bonderized.
 - 2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.
 - 3. Use aluminum face covers in toilets adjacent to shower areas.
- B. Exposed Grid Suspension System for Support of Lay-In Panels:
 - 1. Exposed grid width not less than 7/8-inch with not less than 5/16-inch panel bearing surface.
 - 2. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
 - 3. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units unless indicated otherwise in the Finish Schedule on the Drawings.

2.2 PERIMETER SEAL

- A. Vinyl, polyethylene or polyurethane open-cell sponge material having density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure-sensitive adhesive coating on one side.
- B. Thickness as required to fill voids between back of wall molding and finish wall.
- C. Not less than 3/8-inch-wide strip.

2.3 WIRE

- A. ASTM A641.
- B. For Wire Hangers: Minimum diameter 0.1055-inch.
- C. For Bracing Wires: Minimum diameter 0.1350-inch.

2.4 ANCHORS AND INSERTS

- A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.
- B. Hanger Inserts: Fabricate inserts from steel, zinc-coated (galvanized after fabrication).
- C. Clips:
 - 1. Galvanized steel.
 - 2. Designed to clamp to steel beam or bar joists, or secure framing member together.
 - 3. Designed to rigidly secure framing members together.
 - 4. Designed to sustain twice the loads imposed by hangers or items supported.

2.5 CARRYING CHANNELS FOR SECONDARY FRAMING

- A. Fabricate from cold-rolled or hot-rolled steel, black asphaltic paint finish, free of rust.
- B. Weighing not less than the following, per 1,000 linear feet:

Size Inches	Cold-rolled Pounds	Hot-rolled Pounds
1-1/2	475	1,120
2	590	1,260

2.6 ACOUSTICAL UNITS

- A. General:
 - 1. Ceiling tile shall meet minimum 37 percent bio-based content in accordance with USDA Bio-Preferred Product requirements.
 - 2. ASTM E1264, weighing 3/4-psf minimum for mineral fiber panels or tile.
 - 3. Class A Flame Spread: ASTM 84.
 - 4. Minimum NRC (Noise Reduction Coefficient): 0.55 unless specified otherwise: ASTM C423.
 - 5. Minimum CAC (Ceiling Attenuation Class): 40 to 44 range unless specified otherwise: ASTM E413.
 - 6. Manufacturer's standard finish, minimum light reflectance (LR) coefficient of 0.75 on the exposed surfaces, except as indicated in the Finish Schedule on the Drawings.

7. Lay-in Panels: Sizes as shown, with square edges or reveal edges, as applicable per the Finish Schedule on the Drawings.
- B. Type III Units: Mineral base with water-based painted finish less than 10 g/l VOC, Form 2 - Water felted, minimum 5/8-inch thick. Mineral base to contain minimum 65 percent recycled content.
- C. Type IV Units - Mineral base with membrane-faced overlay, Form 2 - Water felted, minimum 5/8-inch thick. Apply over the paint coat on the face of the unit a poly (vinyl) chloride overspray having a flame spread index of 25 or less when tested in accordance with ASTM E84.
- D. Type XII Units: Fiberglass with acoustically transparent membrane, Form Z, Pattern E, Fire Class A, 1-1/2 inches thick with NRC equal to 1.0 and light reflectance of 0.90. Surface finish shall be factory-applied latex paint, color white.

2.7 ACCESS IDENTIFICATION

- A. Markers:
1. Use colored markers with pressure-sensitive adhesive on one side.
 2. Make colored markers of paper or plastic, 1/4- to 3/8-inch in diameter.
- B. Use markers of the same diameter throughout building.
- C. Color Code: Use following color markers for service identification:
- | | |
|-------------|--|
| Color..... | Service |
| Red..... | Sprinkler System: Valves and Controls |
| Green..... | Domestic Water: Valves and Controls |
| Yellow..... | Chilled Water and Heating Water |
| Orange..... | Ductwork: Fire Dampers |
| Blue..... | Ductwork: Dampers and Controls |
| Black..... | Gas: Laboratory, Medical, Air and Vacuum |

PART 3 - EXECUTION

3.1 CEILING TREATMENT

- A. Treatment of ceilings shall include sides and soffits of ceiling beams, furred work 24 inches wide and over, and vertical surfaces at changes in ceiling heights unless otherwise shown. Install acoustic tiles after wet finishes have been installed and solvents have cured.
- B. Lay out acoustical units symmetrically about center lines of each room or space unless shown otherwise on reflected ceiling plan.
- C. Moldings:
1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.

2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.

D. Perimeter Seal:

1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.
2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.

E. Existing Ceiling:

1. Where extension of existing ceilings occur, match existing.
2. Where acoustical units are salvaged and reinstalled or joined, use salvaged units within a space. Do not mix new and salvaged units within a space which results in contrast between old and new acoustic units.
3. Comply with Specifications for new acoustical units for new units required to match appearance of existing units.

3.2 CEILING SUSPENSION SYSTEM INSTALLATION

A. General:

1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
3. Support a maximum area of 16 square feet of ceiling per hanger.
4. Prevent deflection in excess of 1/360 of span of cross runner and main runner.
5. Provide extra hangers, minimum of 1 hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.
6. Provide not less than 4-inch clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown,
7. Use main runners not less than 48 inches in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Anchorage to Structure:

1. Steel:
 - a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels for attachment of hanger wires.

- (1) Size and space carrying channels to insure that the maximum deflection specified will not be exceeded.
 - (2) Attach hangers to steel carrying channels, spaced 4 feet on center, unless area supported or deflection exceeds the amount specified.
 - b. Attach carrying channels to the bottom flange of steel beams spaced not 4 feet on center before fireproofing is installed. Weld or use steel clips to attach to beam to develop full strength of carrying channel.
 - c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.
- C. Direct-Hung Suspension System:
1. As illustrated in ASTM C635.
 2. Support main runners by hanger wires attached directly to the structure overhead.
 3. Maximum spacing of hangers 4 feet on centers unless interference occurs by mechanical systems. Use indirect-hung suspension system where not possible to maintain hanger spacing.
- D. Indirect-Hung Suspension System:
1. As illustrated in ASTM C635.
 2. Space carrying channels for indirect hung suspension system not more than 4 feet on center. Space hangers for carrying channels not more than 8 feet on center or for carrying channels less than 4 feet on center so as to insure that specified requirements are not exceeded.
 3. Support main runners by specially designed clips attached to carrying channels.

3.3 ACOUSTICAL UNIT INSTALLATION

- A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.
- B. Install lay-in acoustic panels in exposed grid with not less than 1/4-inch bearing at edges on supports.
1. Install tile to lay level and in full contact with exposed grid.
 2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.
- C. Markers:
1. Install markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.

2. Attach colored markers to exposed grid on opposite sides of the units providing access.

3.4 CLEANUP AND COMPLETION

- A. Replace damaged, discolored, dirty, cracked and broken acoustical units.
- B. Leave finished work free from defects.
- C. Vacuum tiles prior to final inspection.

- - - E N D - - -

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the installation of vinyl or rubber base and resilient stair treads with sheet rubber flooring on landings.

1.2 RELATED WORK

- A. Color and Texture: See the Finish Schedule on the Drawings.
B. Sheet Flooring: Section 09 65 16, RESILIENT SHEET FLOORING.

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. Description of each product.
2. Base material manufacturer's recommendations for adhesives.
3. Application and installation instructions.
C. Samples:
1. Base: 6 inches long, each type and color.
2. Adhesive: Literature indicating each type.

1.4 DELIVERY

- A. Deliver materials to the site in original sealed packages or containers, clearly marked with the manufacturer's name or brand, type and color, production run number and date of manufacture.
B. Materials from containers which have been distorted, damaged or opened prior to installation will be rejected.

1.5 STORAGE

- A. Store materials in weather tight and dry storage facility.
B. Protect material from damage by handling 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):
F1861-08.....Resilient Wall Base

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use only products by the same manufacturer and from the same production run.

2.2 RESILIENT BASE

- A. ASTM F1861, 1/8-inch thick, 4 inches high, Thermoplastics, Group 2-layered. Style B-cove.
- B. Use only one type of base throughout.

2.3 PRIMER (FOR CONCRETE FLOORS)

- A. As recommended by the adhesive and tile manufacturer.

2.4 LEVELING COMPOUND (FOR CONCRETE FLOORS)

- A. Provide products with latex or polyvinyl acetate resins in the mix.

2.5 ADHESIVES

- A. Use products recommended by the material manufacturer for the conditions of use.
- B. Use low-VOC adhesive during installation. Water-based adhesive with low VOC is preferred over solvent based adhesive.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Maintain temperature of materials above 70 degrees F for 48 hours before installation.
- B. Maintain temperature of rooms where work occurs, between 70 and 80 degrees F) for at least 48 hours, before, during, and after installation.
- C. Do not install materials until building is permanently enclosed and wet construction is complete, dry, and cured.

3.2 INSTALLATION REQUIREMENTS

- A. The respective manufacturer's instructions for application and installation will be considered for use when approved by the Contracting Officer's Representative (COR).
- B. Submit proposed installation deviation from this Specification to the COR indicating the differences in the method of installation.
- C. The COR reserves the right to have test portions of material installation removed to check for non-uniform adhesion and spotty adhesive coverage.

3.3 PREPARATION

- A. Examine surfaces on which material is to be installed.
- B. Fill cracks, pits, and dents with leveling compound.
- C. Level to 1/8-inch maximum variations.
- D. Do not use adhesive for leveling or filling.
- E. Grind, sand, or cut away protrusions; grind high spots.
- F. Clean substrate area of oil, grease, dust, paint, and deleterious substances.

- G. Substrate area dry and cured. Perform manufacturer's recommended bond and moisture test.
- H. Preparation of existing installation:
 - 1. Remove existing base including adhesive.
 - 2. Do not use solvents to remove adhesives.
 - 3. Prepare substrate as specified.

3.4 BASE INSTALLATION

- A. Location:
 - 1. Unless otherwise specified or shown, where base is scheduled, install base over toe space of base of casework, lockers, laboratory, pharmacy furniture island cabinets and where other equipment occurs.
 - 2. Extend base scheduled for room into adjacent closet, alcoves, and around columns.
- B. Application:
 - 1. Apply adhesive uniformly with no bare spots.
 - 2. Set base with joints aligned and butted to touch for entire height.
 - 3. Before starting installation, layout base material to provide the minimum number of joints with no strip less than 24 inches in length.
 - a. Short pieces to save material will not be permitted.
 - b. Locate joints as remote from corners as the material lengths or the wall configuration will permit.
- C. Form corners and end stops as follows:
 - 1. Score back of outside corner.
 - 2. Score face of inside corner and notch cove.
- D. Roll base for complete adhesion.

3.5 CLEANING AND PROTECTION

- A. Clean all exposed surfaces of base and adjoining areas of adhesive spatter before it sets.
- B. Keep traffic off resilient material for at least 72 hours after installation.
- C. Clean and polish materials in the following order:
 - 1. After 2 weeks, scrub resilient base material with a minimum amount of water and a mild detergent. Leave surfaces clean and free of detergent residue. Polish resilient base to a gloss finish.
- D. Where protective materials are removed and immediately prior to acceptance, replace damaged materials and re-clean resilient materials. Damaged materials are defined as having cuts, gouges, scrapes or tears and not fully adhered.

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SECTION 09 65 16
RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies the installation of sheet flooring.
- B. Grades of resilient sheet vinyl floor covering without backing having vinyl plastic wearlayer with backing.
- C. Installation of sheet flooring including the following:
 - 1. Heat welded seams.

1.2 RELATED WORK

- A. Concrete Floors: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- B. Color, Pattern and Texture: As shown on the Finish Schedule on the Drawings.
- C. Resilient Base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

1.3 QUALITY CONTROL QUALIFICATIONS

- A. The Contracting Officer shall approve products or service of proposed manufacturer, suppliers, and installers, and the Contractor shall submit certification that:
 - 1. Heat-welded seaming is manufacturer's prescribed method of installation.
 - 2. Installer is approved by manufacturer of materials and has technical qualifications, experience, trained personnel, and facilities to install specified items.
 - 3. Manufacturer's product submitted has been in satisfactory operation on 3 installations similar and equivalent in size to this Project for 3 years. Submit list of installations.
- B. The sheet vinyl floor coverings shall meet fire performance characteristics as determined by testing products, per ASTM test method, indicated below by Underwriters Laboratories, Inc. (UL) or another recognized testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45-watts per sq. cm or more, Class I, per ASTM E648.
 - 2. Smoke Density: Less than 450 per ASTM E662.
- C. The floor covering manufacturer shall certify that products supplied for installation comply with local regulations controlling use of volatile organic compounds (VOCs).

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, submit following:
- B. Manufacturer's Literature and Data:
 - 1. Description of resilient material and accessories to be provided.
 - 2. Resilient material manufacturer's recommendations for adhesives, weld rods, sealants, and underlayment.
 - 3. Application and installation instructions.
- C. Samples:
 - 1. Sheet material, 1-1/2 by 12 inches, of each color and pattern with a welded seam using proposed welding rod 12 inches square for each type, pattern and color.
 - 2. Shop Drawings and Certificates: Layout of joints showing patterns where joints are expressed, and type and location of obscure type joints. Indicate orientation of directional patterns.
 - 3. Certificates: Quality Control Certificate Submittals and lists specified in paragraph, QUALIFICATIONS.
 - 4. Edge Strips: 6 inches long each type.
 - 5. Adhesive, Underlayment and Primer: Pint container, each type.

1.5 PROJECT CONDITIONS

- A. Maintain temperature of floor materials and room, where work occurs, above 65 °F and below 100 °F for 48 hours before, during and for 48 hours after installation. After above period, room temperature shall not fall below 55 °F.
- B. Construction in or near areas to receive flooring work shall be complete, dry and cured. Do not install resilient flooring over slabs until they have been cured and are sufficiently dry to achieve a bond with adhesive. Follow flooring manufacturer's recommendations for bond and moisture testing.
- C. Building shall be permanently enclosed. Schedule construction so that floor receives no construction traffic when completed.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in original sealed packages or containers; labeled for identification with manufacturer's name and brand.
- B. Deliver sheet flooring full-width roll, completely enclosed in factory wrap, clearly marked with the manufacturer's number, type and color, production run number and manufacture date.
- C. Store materials in weathertight and dry storage facility. Protect from damage due to handling, weather, and construction operations before,

during and after installation. Store sheet flooring on end with ambient temperatures maintained as recommended by manufacturer.

- D. Store sheet flooring on end.
- E. Move sheet vinyl floor coverings and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.7 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 Society for Testing Materials (ASTM):
 - E648-10.....Critical Radiant Flux of Floor-Covering Systems
Using a Radiant Energy Source
 - E662-12.....Specific Optical Density of Smoke Generated by
Solid Materials
 - F710-08.....Practice for Preparing Concrete Floors and Other
Monolithic Floors to Receive Resilient Flooring
 - F1303-04(2009).....Sheet Vinyl Floor Covering with Backing
 - F1869-10.....Moisture Vapor Emission Rate of Concrete
Subfloor using Anhydrous Calcium Chloride
 - F1913-04(2010).....Sheet Vinyl Flooring without Backing
 - F2170-09.....Determining Relative Humidity in Concrete Floor
Slabs using In-situ Probes
- C. Resilient Floor Covering Institute (RFCI):
 - Recommended Work Practices for Removal of Resilient Floor Coverings.

1.8 SCHEDULING

- A. Interior finish work such as plastering, drywall finishing, concrete, terrazzo, ceiling work, and painting work shall be complete and dry before installation. Mechanical, electrical, and other work above ceiling line shall be completed. Heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.9 WARRANTY

- A. Submit written warranty, in accordance with FAR Clause 52.246-21, Warranty of Construction requirements except that warranty period shall be extended to include 2 years.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERINGS

- A. Sheet Vinyl Floor Coverings: Embossed face, minimum thickness nominal

2.3 mm. Sheet flooring shall conform to ASTM F1913 and material requirements specified in ASTM F1303, Type II, Grade 1, backing classification not applicable. Foam-backed sheet flooring is not acceptable.

- B. Size: Provide maximum size sheet vinyl material produced by manufacturer to provide minimum number of joints. Minimum size width acceptable is 72 inches.
- C. Each color and pattern of sheet flooring shall be of same production run.

2.2 WELDING ROD

- A. Product of floor covering manufacturer in color shall match field color of sheet vinyl covering.

2.3 APPLICATION MATERIALS AND ACCESSORIES

- A. Floor and Base Adhesive: Type recommended by sheet flooring material manufacturer for conditions of use.
- B. Mastic Underlayment (for Concrete Floors): Provide products with latex or polyvinyl acetate resins in mix. Condition to be corrected shall determine type of underlayment selected for use.

2.4 SHEET FLOORING

- A. ASTM F1303, Type II, Grade 1, except for backing requirements. Foam backed sheet flooring is not acceptable.
- B. Minimum nominal thickness 2.3 mm; 6 feet minimum width.
- C. Critical Radiant Flux: 0.45-watts per sq.cm or more, Class I, per ASTM E648.
- D. Smoke Density: Less than 450 per ASTM E662.
- E. Color and pattern of sheet flooring of the same production run.

2.5 ADHESIVES

- A. Water-resistant type recommended by the sheet flooring manufacturer for the conditions of use. VOC not to exceed 50g/L

2.6 LEVELING COMPOUND (FOR CONCRETE FLOORS)

- A. Provide cementitious products with latex or polyvinyl acetate resins in the mix.

2.7 PRIMER (FOR CONCRETE SUBFLOORS)

- A. As recommended by the adhesive or sheet flooring manufacturer.

2.8 EDGE STRIPS

- A. As specified in Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

2.9 SEALANT

- A. As specified in Section 07 92 00, JOINT SEALANTS.
- B. Compatible with sheet flooring.

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Maintain temperature of sheet flooring above 65 °F for 48 hours before installation.
- B. Maintain temperature of rooms where sheet flooring work occurs above 65 °F for 48 hours, before installation and during installation.
- C. After installation, maintain temperature at or above 65 °F.
- D. Building is permanently enclosed.
- E. Wet construction in or near areas to receive sheet flooring is complete, dry and cured.

3.2 SUBFLOOR PREPARATION

- A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710.
 - 1. Installer shall examine surfaces on which resilient sheet flooring is to be installed, and shall advise Contractor, in writing, of areas which are unacceptable for installation of flooring material. Installer shall advise Contractor which methods are to be used to correct conditions that will impair proper installation. Installation shall not proceed until unsatisfactory conditions have been corrected.
 - 2. Slab substrates dry, free of curing compounds, sealers, hardeners, and other materials which would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by Resilient Floor Covering Institute recommendations in manual RFCI-MRP.
- B. Broom or vacuum clean substrates to be covered by sheet vinyl floor coverings immediately before installation. Following cleaning, examine substrates to determine if there is visually any evidence of moisture, alkaline salts, carbonation, or dust.
- C. Primer: If recommended by flooring manufacturer, prior to application of adhesive, apply concrete slab primer in accordance with manufacturer's directions.
- D. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.
- E. Fill cracks, joints, depressions, and other irregularities in concrete with leveling compound.
 - 1. Do not use adhesive for filling or leveling purposes.
 - 2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.

3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joint lines.
- F. Clean floor of oil, paint, dust and deleterious substances. Leave floor dry and cured free of residue from existing curing or cleaning agents.
- G. Moisture Testing: Perform moisture and pH test as recommended by the flooring and adhesive manufacturers. Perform test locations starting on the deepest part of the concrete structure. Proceed with installation only after concrete substrates meet or exceed the manufacturer's requirements. In the absence of specific guidance from the flooring or adhesive manufacturer, the following requirements are to be met:
 1. Perform moisture vapor emission tests in accordance with ASTM F1869. Proceed with installation only after substrates have a maximum moisture-vapor-emission rate of 3 lbs of water per 1,000 sq. ft. in 24 hours.
 2. Perform concrete internal relative humidity testing using situ probes in accordance with ASTM F2170. Proceed with installation only after concrete reaches maximum 75 percent relative humidity level measurement.
- H. Preparation shall include the removal of existing resilient floor and existing adhesive. Do not use solvents to remove adhesives. Coordinate with Asbestos Abatement Section if asbestos abatement procedures will be involved.
- I. Remove existing resilient flooring and adhesive completely in accordance with Resilient Floor Covering Institute recommendations in manual RFCI-WP. Solvents shall not be used.

3.3 INSTALLATION OF FLOORING

- A. Install work in strict compliance with manufacturer's instructions and approved layout drawings.
- B. Maintain uniformity of sheet vinyl floor covering direction and avoid cross seams.
- C. Arrange for a minimum number of seams and place them in inconspicuous and low traffic areas, but in no case less than 6 inches away from parallel joints in flooring substrates.
- D. Match edges of resilient floor coverings for color shading and pattern at seams.
- E. Where resilient sheet flooring abuts other flooring material, floors shall finish level.
- F. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.

- G. Inform the Contracting Officer's Representative (COR) of conflicts between this Section and the manufacturer's instructions or recommendations for auxiliary materials, or installation methods, before proceeding.
- H. Install sheet in full coverage adhesives.
 - 1. Air pockets or loose edges will not be accepted.
 - 2. Trim sheet materials to touch in the length of intersection at pipes and vertical projections; seal joints at pipe with waterproof cement or sealant.
- I. Keep joints to a minimum; avoid small filler pieces or strips.
- J. Follow manufacturer's recommendations for seams at butt joints. Do not leave any open joints that would be readily visible from a standing position.
- K. Follow manufacturer's recommendations regarding pattern match, if applicable.
- L. Installation of Edge Strips:
 - 1. Locate edge strips under center lines of doors unless otherwise indicated.
 - 2. Set resilient strips in adhesive per manufacturer's installation instructions.
- M. Base Installation: As specified in Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

3.4 WELDING

- A. Heat weld all joints of flooring and base using equipment and procedures recommended by flooring manufacturer.
- B. Welding shall consist of routing joint, inserting a welding rod into routed space, and terminally fusing into a homogeneous joint.
- C. Upon completion of welding, surface across joint shall finish flush, free from voids, and recessed or raised areas.
- D. Fusion of Material: Joint shall be fused a minimum of 65 percent through thickness of material, and after welding shall meet specified characteristics for flooring.

3.5 CLEANING

- A. Clean small adhesive marks during application of sheet flooring and base before adhesive sets, excessive adhesive smearing will not be accepted.
- B. Remove visible adhesive and other surface blemishes using methods and cleaner recommended by floor covering manufacturers.
- C. Clean sheet flooring materials per flooring manufacturer's written recommendations.
- D. Vacuum floor thoroughly.

- E. Do not wash floor until after period recommended by floor covering manufacturer and then prepare in accordance with manufacturer's recommendations.
- F. Upon completion, COR shall inspect floor and base to ascertain that work was done in accordance with manufacturer's printed instructions.
- G. Perform initial maintenance according to flooring manufacturer's written recommendations.

3.6 PROTECTION

- A. Protect installed flooring as recommended by flooring manufacturer against damage from rolling loads, other trades, or placement of fixtures and furnishings.
- B. Keep traffic off sheet flooring for 24 hours after installation.
- C. Where construction traffic is anticipated, cover sheet flooring with reinforced kraft paper properly secured and maintained until removal is authorized by the Resident Engineer.
- D. Where protective materials are removed and immediately prior to acceptance, repair any damage, and re-clean sheet flooring.

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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.

1.2 RELATED WORK

- A. Type of Finish, Color, and Gloss Level of Finish Coat: As indicated in the Finish Schedule on the Drawings.

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. Panels to Show Color: Composition board, 4 inches by 10 inches by 1/8-inch.
 - 3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 4-inch by 10-inch face by 1/4-inch-thick minimum, and where both flat and edge grain will be exposed, 10 inches long by sufficient size, 2 by 2 inches minimum or actual wood member to show complete finish.
 - 4. Attach Labels to Panel Stating the Following:
 - a. Federal Specification Number or manufacturer's name and product number of paints used.
 - b. Product type and color.

- c. Name of Project.
- 5. Strips showing not less than 2-inch-wide strips of undercoats and 4-inch-wide strip of finish coat.
- D. Sample of identity markers if used.
- E. Manufacturers' Certificates indicating compliance with specified requirements:
 - 1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.
 - 2. Epoxy 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 65 and 85 degrees F.

1.5 MOCK-UP PANEL

- A. Before starting application of water paint mixtures, apply paint as specified to an area, not to exceed 100 square feet, selected by Contracting Officer's Representative (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. 22-12.....Aluminum Paint, High Heat (up to 590° - 1,100 F)
(HR)
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. 43-12.....Interior Satin Latex, MPI Gloss Level 4
No. 44-12.....Interior Low Sheen Latex, MPI Gloss Level 2
No. 45-12.....Interior Primer Sealer
No. 46-12.....Interior Enamel Undercoat
No. 47-12.....Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
(AK)
No. 48-12.....Interior Alkyd, Gloss, MPI Gloss Level 6 (AK)
No. 49-12.....Interior Alkyd, Flat, MPI Gloss Level 1 (AK)
No. 50-12.....Interior Latex Primer Sealer
No. 51-12.....Interior Alkyd, Eggshell, MPI Gloss Level 3
No. 52-12.....Interior Latex, MPI Gloss Level 3 (LE)
No. 53-12.....Interior Latex, Flat, MPI Gloss Level 1 (LE)

- No. 54-12.....Interior Latex, Semi-Gloss, MPI Gloss Level 5
(LE)
- No. 59-12.....Interior/Exterior Alkyd Porch & Floor Enamel,
Low Gloss (FE)
- No. 60-12.....Interior/Exterior Latex Porch & Floor Paint, Low
Gloss
- No. 66-12.....Interior Alkyd Fire Retardant, Clear Top Coat
(ULC Approved) (FC)
- No. 67-12.....Interior Latex Fire Retardant, Top Coat (ULC
Approved) (FR)
- 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. 90-12.....Interior Wood Stain, Semi-Transparent (WS)
- No. 91-12.....Wood Filler Paste
- No. 94-12.....Exterior Alkyd, Semi-Gloss (EO)
- No. 95-12.....Fast Drying Metal Primer
- No. 98-12.....High Build Epoxy Coating
- 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
- No. 138-12.....Interior High Performance Latex, MPI Gloss Level
2 (LF)
- No. 139-12.....Interior High Performance Latex, MPI Gloss Level
3 (LL)
- No. 140-12.....Interior High Performance Latex, MPI Gloss Level
4
- No. 141-12.....Interior High Performance Latex (SG) MPI Gloss
Level 5
- 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 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Sherwin-Williams: Paint Stores Group, or approved equal.

2.2 MATERIALS

- A. Interior/Exterior Latex Block Filler: MPI 4.
- B. Exterior Latex, Semi-Gloss (AE): MPI 11.
- C. Knot Sealer: MPI 36.
- D. Interior Satin Latex: MPI 43.
- E. Interior Primer Sealer: MPI 45.
- F. Interior Enamel Undercoat: MPI 47.
- G. Interior Alkyd, Semi-Gloss (AK): MPI 47.
- H. Interior Latex Primer Sealer: MPI 50.
- I. Interior Alkyd, Eggshell: MPI 51
- J. Interior Latex, MPI Gloss Level 3 (LE): MPI 52.
- K. Interior Latex, Flat, MPI Gloss Level 1 (LE): MPI 53.
- L. Interior Latex, Semi-Gloss, MPI Gloss Level 5 (LE): MPI 54.
- M. Epoxy Cold-Cured, Gloss (EC): MPI 77.
- N. Interior Wood Stain, Semi-Transparent (WS): MPI 90.
- O. Wood Filler Paste: MPI 91.
- P. High-Build Epoxy Coating: MPI 98.

2.3 PAINT PROPERTIES

- A. Use ready-mixed (including colors), except 2-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.

2.4 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 10 g/l for interior latex paints/primers and 50 g/l for exterior latex paints and primers.
 - 2. Lead-Based 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.

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 250 g/l and shall not be formulated with more than 1 percent aromatic hydrocarbons 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 5 degrees F above dew point.
 - b. Below 50 degrees F or over 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. 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.

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. Wood:

1. Sand to a smooth even surface and then dust off.
2. Sand surfaces showing raised grain smooth between each coat.
3. Wipe surface with a tack rag prior to applying finish.
4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with MPI 36 (Knot Sealer) before applying paint.
 - b. Apply two coats of MPI 36 (Knot Sealer) over large knots.
5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
7. Fill open grained wood such as oak, walnut, ash and mahogany with MPI 91 (Wood Filler Paste), colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.

D. 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.
- E. Zinc-Coated (Galvanized) Metal, Aluminum Surfaces Specified Painted:
1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion in accordance with SSPC-SP 1 (Solvent Cleaning).
 2. Spot-coat abraded and damaged areas of zinc coating which expose base metal on hot-dip zinc-coated items with MPI 18 (Organic Zinc-Rich Coating). Prime or spot prime with MPI 134 (Waterborne Galvanized Primer) or MPI 135 (Non-Cementitious Galvanized Primer) depending on finish coat compatibility.
- F. 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. Do not fill weep holes. Finish to match adjacent surfaces.
 5. 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.
- G. Gypsum Plaster and Gypsum Board:
1. Remove efflorescence, loose and chalking plaster or finishing materials.
 2. Remove dust, dirt, and other deterrents to paint adhesion.

3. Fill holes, cracks, and other depressions with CID-A-A-1272A [Plaster, Gypsum (Spackling Compound) finished flush with adjacent surface, with texture to match texture of adjacent surface. Patch holes over 1 inch in diameter as specified in Section for plaster or gypsum board.

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 2-component and 2-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 3 coats; prime, body, and finish. When 2 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 applications 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.
- G. Do not spray paint in existing occupied spaces unless approved by COR, except in spaces sealed from existing occupied spaces.
 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 sterilizers and other recessed equipment and similar prefinished items.

- H. 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.
- E. Wood:
 - 1. Use same kind of primer specified for exposed face surface.
 - a. Interior Wood Except for Transparent Finish: MPI 45 (Interior Primer Sealer) or MPI 46 (Interior Enamel Undercoat), thinned if recommended by manufacturer.
 - b. Transparent finishes as specified under Transparent Finishes on Wood except Floors.
- F. Metals Except Boilers, Incinerator Stacks, and Engine Exhaust Pipes:
 - 1. Steel and Iron: MPI 95 (Fast Drying Metal Primer).
 - 2. Zinc-Coated Steel and Iron: MPI 134 (Waterborne Galvanized Primer).
 - 3. Aluminum Scheduled to be Painted: MPI 95 (Fast Drying Metal Primer).
 - 4. Machinery Not Factory Finished: MPI 9 (Exterior Alkyd Enamel (EO)).
 - 5. Asphalt-Coated Metal: MPI 1 (Aluminum Paint (AP)).
- G. Gypsum Board:
 - 1. Surfaces scheduled to have MPI 140 (High-Performance Interior Latex, MPI Gloss Level 4).
 - 2. Primer: MPI 50 (Interior Latex Primer Sealer) except use MPI 45 (Interior Primer Sealer) in shower and bathrooms.
 - 3. Surfaces Scheduled to Receive Vinyl-Coated Fabric Wallcovering: Use MPI 45 (Interior Primer Sealer).
 - 4. Use MPI 101 (cold-curing epoxy primer) for surfaces scheduled to receive MPI 77 (epoxy cold-cured, gloss (EC)), or MPI 98 (high-build epoxy coating).
- H. Concrete Masonry Units Except Glazed or Integrally Colored and Decorative Units: MPI 4 (Block Filler) on interior surfaces.
- I. Interior Surfaces of Ceiling and Walls:
 - 1. MPI 53 (interior latex, flat, MPI Gloss Level 1 (LE)), or MPI 52 (Interior Latex, MPI Gloss Level 3 (LE)), or MPI 54 (Interior Latex,

Semi-Gloss, MPI Gloss Level 5 (LE)), as indicated in the Finish Schedule on the Drawings.

2. Use MPI 77 (Epoxy Cold-Cured, Gloss (EC)), or MPI 98 (High-Build Epoxy Coating) as indicated in the Finish Schedule on the Drawings.

3.6 EXTERIOR FINISHES

- A. Apply following finish coats where indicated in the Finish Schedule on the Drawings.
- B. Wood:
 1. Do not apply finish coats on surfaces concealed after installation, top and bottom edges of wood doors.
 2. Two coats of MPI 11 (Exterior Latex, Semi-Gloss (AE)) on exposed surfaces, except where transparent finish is specified.
 3. Two coats of MPI 71 (Polyurethane, Moisture Cured, Clear Flat (PV)) for transparent finish.
- C. Steel and Ferrous Metal: Two coats of MPI 94 (Exterior Alkyd, Semi-Gloss (EO)) on exposed surfaces, except on surfaces over 200 degrees F.

3.7 INTERIOR FINISHES

- A. Apply following finish coats over prime coats in spaces or on surfaces as indicated in the Finish Schedule on the Drawings.
- 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. Apply 2 coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) unless specified otherwise.
 - b. Two coats of MPI 51 (Interior Alkyd, Eggshell (AK)).
 - c. Ferrous Metal over 200 degrees F: Boilers, Incinerator Stacks, and Engine Exhaust Pipes: One coat MPI 22 (High-Heat-Resistant Coating (HR)).
- C. Gypsum Board:
 1. One coat of MPI 45 (Interior Primer Sealer) plus 2 coats of MPI 140 (Interior High-Performance Latex, MPI Gloss Level 4).
 2. One coat of MPI 101 (Cold-Curing Epoxy Primer) plus 2 coats of MPI 77 (Epoxy Cold-Cured, Gloss (EC)).
- D. Plaster: One coat of MPI 50 (Interior Latex Primer Sealer) plus 2 coats of MPI 140 (Interior High-Performance Latex, MPI Gloss Level 4).
- E. Masonry and Concrete Walls:
 1. Over MPI 4 (Interior/Exterior Latex Block Filler) on CMU surfaces.
 2. Two coats of MPI 140 (Interior High-Performance Latex MPI Gloss level 4).

F. Wood:

1. Sanding:

- a. Use 220-grit sandpaper.
- b. Sand sealers and varnish between coats.
- c. Sand enough to scarify surface to assure good adhesion of subsequent coats, to level roughly applied sealer and varnish, and to knock off "whiskers" of any raised grain as well as dust particles.

2. Sealers:

- a. Apply sealers specified except sealer may be omitted where pigmented, penetrating, or wiping stains containing resins are used.
- b. Allow manufacturer's recommended drying time before sanding, but not less than 24 hours or 36 hours in damp or muggy weather.
- c. Sand as specified.

3. Paint Finish: One coat of MPI 45 (Interior Primer Sealer) plus 2 coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) (SG).

4. Transparent Finishes on Wood Except Floors:

a. Stain Finish:

- 1) One coat of MPI 90 (Interior Wood Stain, Semi-Transparent (WS)).
- 2) Use wood stain of type and color required to achieve finish specified. Do not use varnish type stains.
- 3) One coat of sealer as written in 2.1 E.
- 4) Two coats of MPI 31 (Polyurethane Moisture Cured, Clear Gloss (PV)).

3.8 REFINISHING EXISTING PAINTED SURFACES

- A. Clean, patch and repair existing surfaces as specified under surface preparation.
- B. Remove and reinstall items as specified under surface preparation.
- C. Remove existing finishes or apply separation coats to prevent non compatible coatings from having contact.
- D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.
- E. Except where scheduled for complete painting, apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.
- F. In existing rooms and areas where alterations occur, clean existing stained and natural finished wood retouch abraded surfaces and then give entire surface one coat of MPI 31 (Polyurethane, Moisture Cured, Clear Gloss).

- G. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.
- H. Coat knots and pitch streaks showing through old finish with MPI 36 (Knot Sealer) before refinishing.
- I. Sand or dull glossy surfaces prior to painting.
- J. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.9 PAINT COLOR

- A. Color and gloss of finish coats is indicated in the Finish Schedule on the Drawings.
- 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 shall not show through the finish coat and shall mask surface imperfections or contrasts.
- D. Painting, Caulking, Closures, and Fillers Adjacent to Casework: Paint to match color of wall.

3.10 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, 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: Paint items having no color specified in Finish Schedule on the Drawings to match surrounding surfaces.
- I. Apply paint systems on properly prepared and primed surface as follows:
1. Exterior Locations:
 - a. Apply 2 coats of MPI 94 (Exterior Alkyd, Semi-gloss (EO)) to the following ferrous metal items: Vent and exhaust pipes with temperatures under 200 degrees F, roof drains, fire hydrants, post indicators, yard hydrants, exposed piping and similar items.
 - b. Apply 2 coats of MPI 11 (Exterior Latex, Semi Gloss (AE)) to the following metal items: Galvanized and zinc-copper alloy metal.
 2. Interior Locations:
 - a. Apply 2 coats of MPI 47 (Interior Alkyd, Semi-Gloss (AK)) to following items:
 - 1) Metal less than 200 degrees F of items such as bare piping, fittings, hangers and supports.
 - 2) Equipment and systems such as hinged covers and frames for control cabinets and boxes, cast-iron radiators, electric conduits and panel boards.
 - 3) Heating, ventilating, air conditioning, plumbing equipment, and machinery having shop prime coat and not factory finished.
 - b. Paint electrical conduits containing cables rated 600 volts or more using 2 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: 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 1 coat of MPI 11 (Exterior Latex Semi-Gloss (AE)).

3.11 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 and existing work including colors and gloss of finish selected is specified in Finish Schedule on the Drawings.
 2. Painting of disturbed, damaged and repaired or patched surfaces when entire space is not scheduled for complete repainting or refinishing.
 3. Identity painting and safety painting.
- B. Building and Structural Work Not Painted:
1. Prefinished Items:
 - a. Casework, doors, metal panels, wallcovering, and similar items specified factory finished under other Sections.

- b. Factory finished equipment.
- 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 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. Ceilings, walls, columns in interstitial spaces.

3.12 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 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 - 60 psig and above.
 - b. Medium Pressure - 15 to 59 psig.
 - c. Low Pressure - 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 ABBREVIATIONS
Blow-off		Yellow	Black	Blow-off
Boiler Feedwater		Yellow	Black	Blr Feed
A/C Condenser Water Supply		Green	White	A/C Cond Wtr Sup
A/C Condenser Water Return		Green	White	A/C Cond Wtr Ret
Chilled Water Supply		Green	White	Ch. Wtr Sup
Chilled Water Return		Green	White	Ch. Wtr Ret
Shop Compressed Air		Yellow	Black	Shop Air
Air-Instrument Controls		Green	White	Air-Inst Cont
Drain Line		Green	White	Drain
Emergency Shower		Green	White	Emg Shower
High-Pressure Steam		Yellow	Black	H.P. _____ *
High-Pressure Condensate Return		Yellow	Black	H.P. Ret _____ *
Medium-Pressure Steam		Yellow	Black	M.P. Stm _____ *
Medium-Pressure Condensate Return		Yellow	Black	M.P. Ret _____ *
Low-Pressure Steam		Yellow	Black	L.P. Stm _____ *
Low-Pressure Condensate Return		Yellow	Black	L.P. Ret _____ *
High-Temperature Water Supply		Yellow	Black	H. Temp Wtr Sup
High-Temperature Water Return		Yellow	Black	H. Temp Wtr Ret
Hot Water Heating Supply		Yellow	Black	H. W. Htg Sup
Hot Water Heating Return		Yellow	Black	H. W. Htg Ret
Gravity Condensate Return		Yellow	Black	Gravity Cond Ret
Pumped Condensate Return		Yellow	Black	Pumped Cond Ret
Vacuum Condensate Return		Yellow	Black	Vac Cond Ret
Fuel Oil - Grade		Brown	White	Fuel Oil-Grade *
(Diesel Fuel included under Fuel Oil)				
Boiler Water Sampling		Yellow	Black	Sample
Chemical Feed		Yellow	Black	Chem Feed
Continuous Blow-Down		Yellow	Black	Cont. B D
Pumped Condensate		Black		Pump Cond
Pump Recirculating		Yellow	Black	Pump-Recirc.
Vent Line		Yellow	Black	Vent
Alkali		Yellow	Black	Alk

Bleach		Yellow	Black	Bleach
Detergent		Yellow	Black	Det
Liquid Supply		Yellow	Black	Liq Sup
Reuse Water		Yellow	Black	Reuse Wtr
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
Ice Water				
Supply	White	Green	White	Ice Wtr
Return	White	Green	White	Ice Wtr Ret
Reagent Grade Water		Green	White	RG
Reverse Osmosis		Green	White	RO
Sanitary Waste		Green	White	San Waste
Sanitary Vent		Green	White	San Vent
Storm Drainage		Green	White	St Drain
Pump Drainage		Green	White	Pump Disch
Chemical Resistant Pipe				
Waste		Yellow	Black	Acid Waste
Vent		Yellow	Black	Acid Vent
Atmospheric Vent		Green	White	ATV
Silver Recovery		Green	White	Silver Rec
Oral Evacuation		Green	White	Oral Evac
Fuel Gas		Yellow	Black	Gas
Fire Protection Water				
Sprinkler		Red	White	Auto Spr
Standpipe		Red	White	Stand
Sprinkler		Red	White	Drain
Hot Water Supply Domestic/Solar Water				H.W. Sup Dom/SW
Hot Water Return Domestic/Solar Water				H.W. Ret Dom/SW

7. Electrical conduits containing feeders over 600 volts, paint legends using 2-inch-high black numbers and letters, showing the voltage class rating. Provide legends where conduits pass through walls and floors and at maximum 20-foot intervals in between. Use labels with yellow background with black border and words Danger High Voltage Class.

B. Fire and Smoke Partitions:

1. Identify partitions above ceilings on both sides of partitions except within shafts in letters not less than 2-1/2 inches high.

2. Stenciled Message: "SMOKE BARRIER" or "FIRE BARRIER" as applicable.
3. Locate not more than 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.

3.13 PROTECTION, CLEANUP, AND TOUCHUP

- 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.

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SECTION 10 11 13
MARKER BOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies marker boards and related items. Refer to Drawings for additional information and requirements regarding the marker boards and accessories.
- B. Boards may be either factory or field assembled.
- C. Where shown, assemble marker boards with tackboards into a single unit.

1.2 RELATED WORK

- A. Color of aluminum anodic coating and marker board writing surface: As shown in Finish Schedule on the Drawings.

1.3 QUALITY ASSURANCE

- A. Boards shall be the products of one manufacturer.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Shop Drawings: Identifying all parts by name and material and showing design, construction, installation, anchorage and relation to adjacent construction.
- C. Manufacturer's Literature and Data: Marker boards.
- D. Samples:
 - 1. Marker board writing surface, 6 by 6 inches, each color, mounted on backing.
 - 2. Integrally colored anodized aluminum, 6-inch length.
 - 3. Each accessory (after approval, may be used in the work).

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 (ANSI):
 - Z97.1-09.....Safety Glazing Materials Used in Buildings -
Safety Performance Specifications and Methods of
Test
- C. American Society for Testing and Materials (ASTM):
 - B221/B221M-08.....Aluminum and Aluminum Alloy Extruded Bars, Rods,
Wire, Shapes and Tubes
 - C1036-06.....Flat Glass

C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated
and Uncoated Glass

F104-03(R2009).....Nonmetallic Gasket Materials

D. Composite Panel Association (CPA):

A208.1-09.....Particleboard

A135.4-04.....Basic Hardboard

E. Porcelain Enamel Institute (PEI)

1001-11.....Architectural Porcelain Enamel

PART 2 - PRODUCTS

2.1 MARKER BOARD

- A. Marker boards shall consist of a writing surface, snap on aluminum frame, marker trough, mullions, display rail and accessories, grounds and other items specified and shown.

2.2 FABRICATION

A. Materials:

1. Aluminum, Extruded: ASTM B221.
2. Backing: Hardboard, AHBA A135.4 or particleboard, CPA A208.1.

B. Components:

1. Writing Surface: Factory assembly consisting of face sheet of 24-gage sheet steel with porcelain enamel board texture finish conforming to PEI 1001, laminated to a hardboard or particleboard backing, 3/8- to 1/2-inch) thick, and a 0.005-inch-thick aluminum foil back sheet laminated to back-face.
2. Frames (Trim): Extruded aluminum, 0.060-inch thick, snap-on type, approximate face width 1-3/4 inches, depth and configuration as required to return to wall and engage clips.
3. Trough: Extruded aluminum, 0.092-inch thick, not less than 3-inch projection from writing surface with grooved top surface, closed ends and return to wall surface at underside. Design to be snap-on type with concealed fasteners.
4. Accessories: Fabricate from aluminum with holders from spring steel. Design to suit display rail. Furnish accessories as follows:

<u>Accessory Type</u>	<u>Lineal feet of rail per accessory</u>
Paper holder	Full length of marker board
Map hook	Full length of marker board

5. Mullions: Snap-on type, same material and face width as frames, designed to finish flush with frame.

- 6. Grounds: Continuous zinc-coated (galvanized) steel or extruded aluminum members designed to support the board writing surface and clips for snap-on frames, map rail and chalk tray.
- 7. Clips: Manufacturer's standard as required to support frame, mullions, display rail, and trough.
- C. Boards 12 feet or less in length shall be in one piece. Larger units shall have one joint at center. Joints shall have metal spline, with faces in same plane and edges shall touch along entire length.
- D. Finish exposed aluminum surfaces as follows: AA 45 chemically etched medium matte, with clear anodic coating Class II Architectural, 0.4 mils thick (AA-M12C22A32).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install units in accordance with the manufacturer's installation instructions, use concealed fasteners.
- B. Inspect surfaces and related construction to receive units. Partitions shall have reinforcing to receive fasteners. Verify type and placement of reinforcement.
- C. Do not proceed with the installation until reinforcement is in place and surfaces are flat.
- D. Assemble units as specified by the manufacturer.

3.2 INSTALLATION OF MARKER BOARD

- A. Mount board with adhesive and blocking pads spaced 16 inches on center each way.
- B. Grounds designed to receive clips for snap-on trim shall be continuous and be secured 12 inches on center. Space clips 12 inches on center.
- C. Miter trim at corners, conceal fasteners. Modify trim as required to conform to surrounding construction details.

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SECTION 10 11 23
TACKBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies tackboards (bulletin boards) and glass door bulletin boards and related items. Refer to the Drawings for additional information and requirements regarding the tackboards, bulletin boards, and accessories.
- B. Boards may be either factory or field assembled.
- C. Where shown, assemble both marker boards and tackboards into a single unit.

1.2 RELATED WORK

- A. Color of Aluminum Anodic Coating Tackboard: As indicated in Finish Schedule on the Drawings.

1.3 QUALITY ASSURANCE

- A. Boards shall be the products of one manufacturer.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Shop Drawings: Identifying all parts by name and material and showing design, construction, installation, anchorage and relation to adjacent construction.
- C. Manufacturer's Literature and Data:
 - 1. Bulletin board.
 - 2. Glass door bulletin board.
- D. Samples:
 - 1. Tackboard, 6 by 6 inches, each color, mounted on backing.
 - 2. Cork filled map rail, 6-inch length.
 - 3. Each accessory (after approval, may be used in the work).

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. National Association of Architectural Metal Manufacturers (NAAMM):
 - AMP 500 Series.....Metal Finishes Manual
 - AMP 501.....Finishes for Aluminum
- C. American National Standards Institute(ANSI):
 - Z97.1-09.....Safety Glazing Materials Used in Buildings -
Safety Performance Specifications and Methods of
Test

- D. American Society for Testing and Materials (ASTM):
B221/B221M-08.....Aluminum and Aluminum Alloy Extruded Bars, Rods,
Wire, Shapes and Tubes
C1036-06.....Flat Glass
C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated
and Uncoated Glass
F104-03(R2009).....Nonmetallic Gasket Materials
E. Composite Panel Association (CPA):
A208.1-09.....Particleboard
A135.4-04.....Basic Hardboard

PART 2 - PRODUCTS

2.1 BULLETIN BOARD

- A. Bulletin board shall consist of a tackboard, snap-on aluminum frame, grounds and other items specified and shown.

2.2 GLASS DOOR BULLETIN BOARD

- A. Glass door bulletin board shall consist of a tackboard, aluminum tubular frame, sliding aluminum framed glazed doors and other items specified and shown.

2.3 FABRICATION

- A. Materials:
1. Aluminum, Extruded: ASTM B221.
 2. Cork: ASTM F104, Type II, mildew resistant, Class 2.
 3. Glass: ASTM C1036, Clear, Class 1, Quality q3, 1/4-inch thick.
 4. Tempered Glass: ASTM C1048, Clear Kind FT, Condition A, Type I, Class 1, Quality q3, 1/4-inch thick. Safety glass, ANSI Z97.1, labeled.
 5. Backing: Hardboard, AHBA A135.4 or particleboard, CPA A208.1.
- B. Components:
1. Tackboard: Cork face, 1/4-inch thick, factory laminated to a hardboard or particleboard backing of thickness required so that the face of the cork will be in the same plane as the face of the marker board writing surface, 1/4- to 3/8-inch thick.
 2. Frames (Trim): Extruded aluminum, 0.060-inch thick, snap-on type, approximate face width 1-3/4 inches, depth and configuration as required to return to wall and engage clips.
 3. Display Rail: Snap-on type, same materials as frames, approximate face width 1 inch with 1/4-inch-thick cork insert.
 4. Mullions: Snap-on type, same material and face width as frames, designed to finish flush with frame.
 5. Grounds: Continuous zinc-coated (galvanized) steel or extruded aluminum members designed to support the tackboard and clips for snap-on frames, and map rail

- 6. Clips: Manufacturer's standard as required to support frame, mullions, and display rail,
- 7. Tubular Frame (For Glass Door Bulletin Board): Extruded aluminum, 0.092-inch thick; tubular or open back in section, with flanges for concealed attachment, designed to support door hardware and tackboard.
- C. Bulletin boards 12 feet or less in length shall be in 1 piece. Larger units shall have 1 joint at center. Joints shall have metal spline, with faces in same plane and edges shall touch along entire length.
- D. Finish Exposed Aluminum Surfaces as Follows: AA 45 chemically etched medium matte, with clear anodic coating Class II Architectural, 0.4 mils thick (AA-M12C22A32).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install units in accordance with the manufacturer's installation instructions, use concealed fasteners.
- B. Inspect surfaces and related construction to receive units. Partitions shall have reinforcing to receive fasteners. Verify type and placement of reinforcement.
- C. Do not proceed with the installation until reinforcement is in place and surfaces are flat.
- D. Assemble units as specified by the manufacturer.

3.2 INSTALLATION OF BULLETIN BOARD (EXCEPT GLASS DOOR BULLETIN BOARDS)

- A. Mount bulletin boards with adhesive and blocking pads spaced 16 inches on center each way.
- B. Grounds designed to receive clips for snap-on trim shall be continuous and be secured 12 inches on center. Space clips 12 inches on center.
- C. Miter trim at corners, conceal fasteners. Modify trim as required to conform to surrounding construction details.

3.3 INSTALLATION OF GLASS DOOR BULLETIN BOARDS

- A. Glass door bulletin board units shall be factory assembled, except tackboard may be either field mounted or shop mounted on frame.
- B. Mounting bolts or screws shall be oval head of stainless steel or chromium-plated steel or brass. Space fasteners 20 inches on center, except not less than 3 fasteners each side, top and bottom. Heads of fasteners shall not show on the frame face.

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SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies wall guards (crash rails or bumper guards), handrails, chair rails, corner guards, and high-impact wallcovering.

1.2 RELATED WORK

- A. Armor Plates and Kick Plates Not Specified in This Section: Section 08 71 00, DOOR HARDWARE.
- B. Color and Texture of Aluminum and Resilient Material: As indicated in the Finish Schedule on the Drawings.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings: Show design and installation details.
- C. Manufacturer's Literature and Data:
1. Handrails.
 2. Chair rails.
 3. Wall guards (crash rails).
 4. Corner guards.
 5. High-impact wallcovering.
- D. Test Report: Showing that resilient material complies with specified fire and safety code requirements.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer.
- B. Protect from damage from handling and construction operations before, during and after installation.
- C. Store in a dry environment of approximately 70 degrees F for at least 48 hours prior to installation.

1.5 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):
- A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip
- B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes

D256-06.....Impact Resistance of Plastics

D635-06.....Rate of Burning and/or Extent and Time of
Burning of Self-Supporting Plastics in a
Horizontal Position

E84-09.....Surface Burning Characteristics of Building
Materials

C. The National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500-06.....Metal Finishes Manual

D. National Fire Protection Association (NFPA):
80-10.....Standard for Fire Doors and Windows

E. Society of American Automotive Engineers (SAE):
J 1545-05.....Instrumental Color Difference Measurement for
Exterior Finishes.

F. Underwriters Laboratories Inc. (UL):
Annual Issue.....Building Materials Directory

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A167, Type 302B.
- B. Aluminum Extruded: ASTM B221, Alloy 6063, Temper T5 or T6. Aluminum alloy used for colored anodizing coating shall be as required to produce specified color.
- C. Resilient Material:
 - 1. Extruded and injection-molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements:
 - a. Minimum impact resistance of 25 ft. lbs. per sq. ft. when tested in accordance with ASTM D256 (Izod impact, ft. lbs. per inch notch).
 - b. Class 1 fire rating when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less.
 - c. Rated self extinguishing when tested in accordance with ASTM D635.
 - d. Material shall be labeled and tested by Underwriters Laboratories or other approved independent testing laboratory.
 - e. Integral color with all colored components matched in accordance with SAE J 1545 to within plus or minus 1.0 on the CIE-LCH scales.
 - f. Same finish on exposed surfaces.

2.2 CORNER GUARDS

- A. Resilient, Shock-Absorbing Corner Guards: Surface mounted as shown on Drawings, formed to profile shown.

1. Snap-on corner guard formed from resilient material, minimum 0.078-inch thick, free floating on a continuous 0.063-inch-thick extruded aluminum retainer. Provide appropriate mounting hardware, cushions and base plates as required.
2. Provide factory-fabricated end closure caps at top and bottom of surface mounted corner guards.

2.3 CHAIR RAILS, WALL GUARDS AND HANDRAILS

A. Resilient Chair Rails, Wall Guards and Handrails:

1. Handrails: Snap-on covers of resilient material, minimum 0.078-inch thick, shall be free-floated on a continuous, extruded aluminum retainer, minimum 0.072-inch thick, anchored to wall at maximum 30 inches on center. For profiles, sizes, and locations, see Drawings.
2. Chair Rails and Wall Guards (Crash Rails): Snap-on covers of resilient material, minimum 0.110-inch thick, shall be free-floated over 2-inch-wide aluminum retainer clips, minimum 0.090-inch thick, anchored to wall at maximum 24 inches on center, supporting a continuous aluminum retainer, minimum 0.062-inch thick; or, shall be free-floated over a continuous extruded aluminum retainer, minimum 0.090-inch thick anchored to wall at maximum 24 inches on center. For profiles, sizes, and locations, see Drawings.
3. Provide handrails, chair rails and wall guards (crash rails) with prefabricated and closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories as required. End caps and corners shall be field adjustable to assure close alignment with handrails, chair rails and wall guards (crash rails). Screw or bolt closure caps to aluminum retainer.

2.4 HIGH-IMPACT WALLCOVERING

- A. Fabricate from vinyl acrylic or polyvinyl chloride-resilient material, minimum 0.06-inch thick, designed especially for interior use.
- B. Coordinate with guard rail protection material and supplier for proper fit, installation and color.
- C. Provide adhesive as recommended by the wallcovering manufacturer.

2.5 FASTENERS AND ANCHORS

- A. Provide fasteners and anchors as required for each specific type of installation.
- B. Where type, size, spacing or method of fastening is not shown or specified, submit shop drawings showing proposed installation details.

2.6 FINISH

- A. In accordance with NAAMM AMP 500 series.

B. Aluminum:

1. Exposed Aluminum: AAC22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mil thick.
2. Concealed Aluminum: Mill finish as fabricated, uniform in color and free from surface blemishes.

- C. Resilient Material: Embossed texture and color in accordance with SAE J 1545 and as indicated in the Finish Schedule on the Drawings.

PART 3 - INSTALLATION

3.1 RESILIENT CORNER GUARDS

- A. Install corner guards on walls in accordance with manufacturer's instructions.

3.2 RESILIENT HANDRAILS, RESILIENT CHAIR RAILS AND RESILIENT WALL GUARDS (CRASH RAIL)

- A. Secure guards to walls with mounting cushions, brackets, and fasteners in accordance with manufacturer's details and instructions.
- B. Install handrails, chair rails, and wall guards at elevations in compliance with ADA/ABA, at existing hospital height, if existing height is in compliance with applicable codes and regulations.

3.3 HIGH-IMPACT WALLCOVERING

- A. Surfaces to receive protection shall be clean, smooth and free of obstructions.
- B. Apply with adhesive in controlled environment according to manufacturer's recommendations.

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SECTION 10 28 00
TOILET AND SHOWER ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies manufactured items usually used in dressing rooms, toilets, baths, locker rooms and at sinks in related spaces.
- B. Items Specified:
1. Paper towel dispenser.
 2. Combination paper towel dispenser and disposal unit.
 3. Waste receptacles.
 4. Toilet tissue dispenser.
 5. Grab bars.
 6. Shower curtain rods.
 7. Clothes hooks, robe or coat.
 8. Towel bars.
 9. Metal-framed mirror.
 10. Frameless, polished-edge mirrors.
 11. Medicine cabinet.
 12. Foot-operated soap dispenser.
 13. Soap dishes.
 14. Paper cup dispenser.
 15. Mop racks.
 16. Stainless-steel shelves, Type 44, Type 45, or Type 45C, as shown on Drawings.
 17. Stainless-steel shelves at wheelchair lavatory.
 18. Diaper changing station.
- C. This Section also specifies custom-fabricated items used in toilets and related spaces.

1.2 RELATED WORK

- A. Color of Finishes: As indicated in the Finish Schedule on the Drawings.
- B. Color of Vinyl Fabric: As indicated in the Finish Schedule on the Drawings.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Shop Drawings:
1. Each product specified.
 2. Paper towel dispenser and combination dispenser and disposal units.

3. Metal-framed mirrors, showing shelf where required, fillers, and design and installation of units when installed on ceramic tile wainscots and offset surfaces.
4. Shower curtain rods, showing required length for each location.
5. Grab bars, showing design and each different type of anchorage.
6. Medicine cabinets showing design and installation.
7. Foot-operated soap dispenser, showing anchorage and components.
8. Show material and finish, size of members, and details of construction, installation and anchorage of mop racks.

C. Samples:

1. One of each type of accessory specified.
2. After approval, samples may be used in the work.

D. Manufacturer's Literature and Data:

1. All accessories specified.
2. Show type of material, gages or metal thickness in inches, finishes, and when required, capacity of accessories.
3. Show working operations of spindle for toilet tissue dispensers.
4. Mop racks.

E. Manufacturer's Certificates:

1. Attesting that soap dispensers are fabricated of material that will not be affected by liquid soap or aseptic detergents, PhisoHex and solutions containing hexachlorophene.
2. Anodized finish as specified.

1.4 QUALITY ASSURANCE

- A. Each 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 accessory type shall be the same and be made by the same manufacturer.
- C. Each accessory shall be assembled 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.

1.5 PACKAGING AND DELIVERY

- A. Pack accessories individually to protect finish.
- B. Deliver accessories to the Project only when installation work in rooms is ready to receive them.

- C. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- D. Deliver products to site in sealed packages of containers; labeled for identification with manufacturer's name, brand, and contents.

1.6 STORAGE

- A. Store products in weathertight and dry storage facility.
- B. Protect from damage from handling, weather and construction operations before, during and after installation in accordance with manufacturer's instructions.

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):
 - A167-99(R2009).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 - A176-99(R2009).....Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
 - A269-10.....Seamless and Welded Austenitic Stainless-Steel Tubing for General Service
 - A312/A312M-09.....Seamless and Welded Austenitic Stainless-Steel Pipes
 - A653/A653M-10.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
 - B456-03(R2009).....Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
 - C1036-06.....Flat Glass
 - C1048-04.....Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass
 - D635-10.....Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position
 - F446-85(R2009).....Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area

D3453-07.....Flexible Cellular Materials - Urethane for
Furniture and Automotive Cushioning, Bedding,
and Similar Applications

D3690-02(R2009).....Vinyl-Coated and Urethane-Coated Upholstery
Fabrics

C. The National Association of Architectural Metal Manufacturers (NAAMM):
AMP 500 Series.....Metal Finishes Manual

D. American Welding Society (AWS):
D10.4-86 (R2000).....Welding Austenitic Chromium-Nickel Stainless
Steel Piping and Tubing

E. Federal Specifications (Fed. Specs.):
A-A-3002.....Mirrors, Glass
FF-S-107C (2).....Screw, Tapping and Drive
FF-S-107C.....Screw, Tapping and Drive
WW-P-541E(1).....Plumbing Fixtures (Accessories, Land Use) Detail
Specification

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: ASTM B221, Alloy 6063-T5 and Alloy 6463-T5.
- B. Stainless Steel:
 - 1. Plate or Sheet: ASTM A167, Type 302, 304, or 304L, except ASTM A176 where Type 430 is specified, 0.0299-inch thick unless otherwise specified.
 - 2. Tube: ASTM A269, Alloy Type 302, 304, or 304L.
- C. Stainless-Steel Tubing: ASTM A269, Grade 304 or 304L, seamless or welded.
- D. Stainless-Steel Pipe: ASTM A312; Grade TP 304 or TP 304L.
- E. Steel Sheet: ASTM A653, zinc-coated (galvanized) coating designation G90.
- F. Glass:
 - 1. ASTM C1036, Type 1, Class 1, Quality q2, for mirrors, and for mirror doors in medicine cabinets.
 - 2. ASTM C1036, Type 1 Class 1 Quality q3, for shelves in medicine cabinets.
- G. Foam Rubber: ASTM D3453, Grade BD, Type 2.
- H. Vinyl Covering: ASTM D3690, Vinyl-coated fabric, Class A.
- I. Plywood: PS1, Grade CD.

2.2 FASTENERS

- A. Exposed Fasteners: Stainless steel or chromium-plated brass, finish to match adjacent surface.
- B. Concealed Fasteners: Steel, hot-dip galvanized (except in high moisture areas such as showers or bath tubs use stainless steel).
- C. Toggle Bolts: For use in hollow masonry or frame construction.
- D. Hex Bolts: For through-bolting on thin panels.
- E. Expansion Shields: Lead or plastic as recommended by accessory manufacturer for component and substrate for use in solid masonry or concrete.
- F. Screws:
 - 1. ASME B18.6.4.
 - 2. Fed Spec. FF-S-107, Stainless steel Type A.
- G. Adhesive: As recommended by manufacturer for products to be joined.

2.3 FINISH

- A. In accordance with NAAMM AMP 500 series.
- B. Anodized Aluminum: AA-C22A41, Chemically etched medium matte, with clear anodic coating, Class I Architectural, 0.7-mil thick.
- C. AA-M32: Mechanical finish, medium satin.
 - 1. Chromium Plating: ASTM B456, satin or bright as specified, Service Condition No. SC2.
 - 2. Stainless Steel: NAAMM AMP 503, Finish 4.
 - 3. Ferrous Metal:
 - a. Shop Prime: Clean, pretreat, and apply 1 coat of primer and bake.
 - b. Finish: Over primer, apply 2 coats of alkyd or phenolic resin enamel, and bake.
 - 4. Nylon-Coated Steel: Nylon coating powder formulated for a fluidized bonding process to steel to provide a hard smooth, medium gloss finish, not less than 0.012-inch thick, rated as self-extinguishing when tested in accordance with ASTM D635.

2.4 FABRICATION - GENERAL

- A. Welding, AWS D10.4.
- B. Grind, dress, and finish welded joints to match finish of adjacent surface.
- C. Form exposed surfaces from one sheet of stock, free of joints.
- D. Provide steel anchors and components required for secure installation.
- E. Form flat surfaces without distortion. Keep exposed surfaces free from scratches and dents. Reinforce doors to prevent warp or twist.

- F. Isolate aluminum from dissimilar metals and from contact with building materials as required to prevent electrolysis and corrosion.
- G. Hot-dip galvanized steel, except stainless steel, anchors and fastening devices.
- H. Shop assemble accessories and package with all components, anchors, fittings, fasteners and keys.
- I. Key items alike.
- J. Provide templates and rough-in measurements as required.
- K. Round and deburr edges of sheets to remove sharp edges.

2.5 PAPER TOWEL DISPENSERS

- A. Surface-mounted type with sloping top.
- B. Dispensing capacity for 300 sheets of any type of paper toweling.
- C. Fabricate of stainless steel.
- D. Provide door with continuous hinge at bottom, and either spring tension cam lock or tumbler lock, keyed alike, at top and a refill sight slot in front.

2.6 COMBINATION PAPER TOWEL DISPENSER AND DISPOSAL UNITS

- A. Recessed type.
- B. Dispensing capacity for 400 sheets of any type of paper toweling.
- C. Fabricate of stainless steel.
- D. Form face frames, from one piece.
- E. Provide each door with continuous stainless-steel piano hinge and tumbler lock, keyed alike.
- F. Provide removable waste receptacle approximately 10.5-gallon capacity, fabricated of 0.018-inch-thick stainless steel.

2.7 WASTE RECEPTACLES

- A. Semi-recessed type, without doors. Fed. Spec WW-P-541, Type II.
- B. Fabricate of stainless steel.
- C. Form face frame from one piece.
- D. Provide removable waste receptacle of approximately 12-gallon capacity, fabricated of stainless steel.
- E. Waste receptacle key locked in place.

2.8 TOILET TISSUE DISPENSERS

- A. Double-roll, surface-mounted type.
- B. Mount on continuous backplate.
- C. Removable spindle ABS plastic or chrome-plated plastic.
- D. Wood rollers are not acceptable.

2.9 GRAB BARS

- A. Fed. Spec WW-P-541/8B, Type IV, bars, surface mounted, Class 2, grab bars and ASTM F446.
- B. Fabricate of stainless steel.
 - 1. Stainless Steel: Grab bars, flanges, mounting plates, supports, screws, bolts, and exposed nuts and washers.
- C. Concealed mount, except grab bars mounted at floor or swing up.
- D. Bars:
 - 1. Fabricate from 1-1/2-inch outside diameter tubing.
 - a. Stainless steel, minimum 0.0478-inch thick.
 - 2. Fabricate in one continuous piece with ends turned toward walls, except swing up and where grab bars are shown continuous around 3 sides of showers, bars may be fabricated in 2 sections, with concealed slip joint between.
 - 3. Continuous weld intermediate support to the grab bar.
 - 4. Swing up bars manually operated. Designed to prevent bar from falling when in raised position.
- E. Flange for Concealed Mounting:
 - 1. Minimum of 0.1046-inch thick, approximately 3-inch diameter by 1/2-inch deep, with provisions for not less than 3 set screws for securing flange to back plate.
 - 2. Insert grab bar through center of the flange and continuously weld perimeter of grab bar flush to back side of flange.
- F. Flange for Exposed Mounting:
 - 1. Minimum 3/16-inch thick, approximately 3-inch diameter.
 - 2. Insert grab bar through flange and continuously weld perimeter of grab bar flush to backside of flange.
 - 3. Where mounted on floor, provide 4 equally spaced holes, sized to accommodate 3/8-inch-diameter bolts, not more than 3/8-inch from edge of flange.
- G. In lieu of providing flange for concealed mounting, and back plate as specified, grab rail may be secured by being welded to a back plate and be covered with flange.
- H. Back Plates:
 - 1. Minimum 0.1046-inch-thick metal.
 - 2. Fabricate in 1 piece, approximately 1/4-inch deep, with diameter sized to fit flange. Provide slotted holes to accommodate anchor bolts.

3. Furnish through-bolt fasteners and cap nuts, where grab bars are mounted on solid phenolic or solid polyethylene partitions.

2.10 SHOWER CURTAIN RODS

- A. Stainless-steel tubing, ASTM A569, minimum 0.050-inch wall thickness, 1-1/4-inch outside diameter.
- B. Flanges, stainless-steel rings, 2-5/8-inch minimum outside diameter, with 2 holes opposite each other for 1/4-inch stainless-steel fastening bolts. Provide a set screw within the curvature of each flange for securing the rod.
- C. Intermediate support for rods over 6 feet long. Provide adjustable ceiling flanges with set screws, tubular hangers and stirrups.

2.11 CLOTHES HOOKS-ROBE OR COAT

- A. Fabricate hook units either of chromium-plated brass with a satin finish or stainless steel, using 1/4-inch minimum thick stock, with edges and corners rounded smooth to the thickness of the metal, or 1/8-inch minimum radius.
- B. Fabricate each unit as a double hook on a single shaft, integral with or permanently fastened to the wall flange, provided with concealed fastenings.

2.12 TOWEL BARS

- A. Fed. Spec. WW-P-541/8B, Type IV, Bar, Surface mounted; Class 1, towel.
- B. Either stainless steel or chromium-plated copper alloy.
- C. Bar Length: 18 and 24 inches, as shown.
- D. Finish of brackets or supports same as bar.

2.13 METAL FRAMED MIRRORS

- A. Fed. Spec. A-A-3002 metal frame; stainless steel, Type 302 or 304./
- B. Mirror Glass:
 1. Minimum 1/4-inch thick.
 2. Set mirror in a protective vinyl glazing tape.
- C. Frames:
 1. Channel or angle shaped section with face of frame not less than 3/8-inch wide. Fabricate with square corners.
 2. Use 0.0359-inch-thick stainless steel.
 3. Filler:
 - a. Where mirrors are mounted on walls having ceramic tile wainscots not flush with wall above, provide fillers at void between back of mirror and wall surface.

- b. Fabricate fillers from same material and finish as the mirror frame, contoured to conceal the void behind the mirror at sides and top.
- 4. Attached Shelf for Mirrors:
 - a. Fabricate shelf of the same material and finish as the mirror frame.
 - b. Make shelf approximately 5 inches in depth, and extend full width of the mirror.
 - c. Close the ends and the front edge of the shelf to the same thickness as the mirror frame width.
 - d. Form stainless-steel shelf with concealed brackets to attach to mirror frame.
- D. Back Plate:
 - 1. Fabricate backplate for concealed wall hanging of either zinc-coated or cadmium-plated 0.036-inch-thick sheet steel, die cut to fit face of mirror frame, and furnish with theft resistant concealed wall fastenings.
 - 2. Use set screw type theft-resistant concealed fastening system for mounting mirrors.
- E. Mounting Bracket:
 - 1. Designed to support mirror tight to wall.
 - 2. Designed to retain mirror with concealed set screw fastenings.

2.14 FRAMELESS MIRRORS

- A. Mirror Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality Q1 (mirror select); silvering, protective coating and physical characteristics complying with ASTM C1503; 6 mm minimum thickness, with polished beveled edges, and of size as noted on the Drawings.
- B. Mirror Attachment Accessories: Stainless-steel clips with neoprene setting blocks, or mirror adhesive chemically compatible with mirror coating and wall substrate. Install as indicated on Drawings.

2.15 MEDICINE CABINETS

- A. Fed. Spec. WW-P-541/8B, Type III Medicine cabinets.
 - 1. Mirror Glass: Minimum 3/16-inch thick. Set mirror in a protective vinyl glazing tape.
 - 2. Glass Shelves: Minimum 1/4-inch thick, with bulb-edges at front. Support shelves on adjustable aluminum brackets. Provide 3 shelves to each cabinet.
 - 3. Cabinet Body: Fabricate from 0.036-inch-thick stainless steel. Form body in one piece, without seams, and with rounded inside corners.

B. Hinged Door Type:

1. Class 2, swing door, Style R, recessed.
2. Fabricate mirror door approximately 16 by 22 inches.
3. Cabinet concealed when doors are closed.
4. Mirror Door Frame: Channel shape, 0.036-inch-thick stainless steel.
5. Furnish door with full-length, stainless-steel piano hinge, magnetic or friction catches, rubber bumpers, and a 90-degree restraining arm with spring-type stop.

C. Sliding Door Type:

1. Class 1, slide door, Style R, recessed.
2. Fabricate sliding doors for approximately 26- by 22-inch opening.
3. Provide nylon glides in stainless-steel tracks, door pulls and rubber bumpers.
4. Entire contents of the cabinet concealed when doors closed.

2.16 FOOT-OPERATED SOAP DISPENSER

- A. Wall-mounted liquid soap dispenser, designed with an adjustable needle valve to allow dispensing of 2 milliliters of liquid with each depression of foot pump.
- B. Connect foot pump, by a 6-foot air tube, to a 30-ounce liquid container. Provide air intake tube with a special feature to prevent liquid from dripping after release of pedal.
- C. Operate pump by a slip-resistant, rubber padded pedal.
- D. Complete unit shall not be adversely affected by the liquid soap, aseptic detergent, or hexachlorophene solutions.
- E. Provide a removable gummed label, attached to container, stating that soap or detergent may be used in the dispensers.

2.17 SOAP DISHES

- A. Fed. Spec. WW-P-541/8B, Type VI, Holder.
- B. Class 1, Surface Mounted:
 1. One piece with provisions for exposed fasteners.
 2. Fabricate from chromium-plated brass approximately 4-1/2 by 3-3/4 inches overall size with drainage openings at bottom.

2.18 PAPER CUP DISPENSER

- A. Fabricate of stainless steel.
- B. Provide door with either concealed stainless-steel pivoting rod or piano hinge, and either spring tension cam lock or tumbler lock, keyed alike when more than one accessory unit is provided and with a cup level refill sight slot in the door front.
- C. Fabricate for flat bottom cups.

D. 3-ounce Dispenser Unit:

1. Surface-mounted, single-stack dispenser unit having a capacity of approximately 100 cups.
2. Form door from one piece to cover front and sides warp free.

E. 4-ounce Dispenser Unit:

1. Recessed type single stack dispenser unit having a capacity of approximately 100 cups.
2. Form face frame in one piece.
3. Fabricate door double-pan warp free.

F. Combination 3- to 6-ounce Dispenser and Disposal Unit:

1. Recessed type, having a capacity of approximately 170 cups.
2. Fabricate as twin-stack dispenser unit with an adjustable dispensing mechanism to dispense any size cup.
3. Fabricate face frames in one piece and doors double pan warp free.
4. Fabricate recessed disposal unit with a removable waste receptacle having a capacity of not less than 3.1 gallons.

2.19 MOP RACKS

A. Minimum 40 inches long with 5 holders.

B. Clamps:

1. Minimum of 0.050-inch-thick stainless-steel bracket retaining channel with a hard rubber serrated cam; pivot mounted to channel.
2. Clamps to hold handles from 1/2-inch minimum to 1-1/4-inch maximum diameter.

C. Support:

1. Minimum of 0.0375-inch-thick, stainless-steel, hat-shape channel to hold clamps away from wall as shown.
2. Drill wall flange for 1/8-inch fasteners above and below clamp locations.

D. Secure clamps to support with oval head machine screws or rivets into continuous reinforcing back of clamps.

E. Finish on Stainless Steel: AMP 503-No. 4.

2.20 STAINLESS-STEEL SHELVES (TYPE 44)

A. Shelves:

1. Fabricate shelves of 0.0478-inch-thick sheet to size and design shown.
2. Fabricate shelves of hollow metal type construction, forming a depression as shown, with closed fronts, backs, ends and bottoms. Reinforce shelves with 0.0478-inch-thick sheet steel hat channel

stiffeners, full depth, welded to underside of top at bracket locations.

3. Miter cuts, where made at corners of shelves, continuously welding.
- B. Form brackets of 1/8-inch-thick steel as shown. Drill brackets for 1/4-inch anchor bolts.
- C. Weld or screw brackets to shelves.

2.21 STAINLESS-STEEL SHELVES, TYPES 45, 45C

- A. Fabricate shelves and brackets to design shown of 0.0478-inch-thick stainless steel.
- B. Round and finish smooth projecting corners of shelves and edge corners of brackets. Drill brackets for 1/4-inch anchor bolts.
- C. Screw or weld brackets to shelves.

2.22 STAINLESS-STEEL SHELVES AT WHEELCHAIR LAVATORY

- A. Side-wall Mounted:
 1. Fabricate to size and shape shown of 0.0478-inch-thick sheet.
 2. Turn up edges and weld corners closed.
 3. Fabricate brackets and weld to shelf. Drill brackets for 1/4-inch anchor bolts.
- B. Back-wall Mounted:
 1. Fabricate to size and shape shown of plate and tube.
 2. Turn up edges and weld corners of shelf.
 3. Weld tube to back plate and shelf, weld back plate to shelf, filler plate to tube, and corners of shelf with continuous welds.
 4. Drill back plate for 1/4-inch anchor bolts.

2.23 DIAPER CHANGING STATION

- A. Wall-mounted, folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Style: Horizontal.
 2. Material: Polyethylene.
 3. Mounting: Surface.
 4. Color: Gray.
 5. Minimum Rated Load: 250 pounds.
 6. Manufacturers:
 - a. American Specialties, Inc.: www.americanspecialties.com.
 - b. Bradley Corporation: www.bradleycorp.com.
 - c. Diaper Deck & Company: www.diaperdeck.com.
 - d. Koala Kare Products: www.koalabear.com.
 - e. Or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before starting work, notify Contracting Officer's Representative (COR) in writing of any conflicts detrimental to installation or operation of units.
- B. Verify with the COR the exact location of accessories.

3.2 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. Toggle bolt to steel anchorage plates in frame partitions or hollow masonry. Expansion bolt to concrete or solid masonry.
- C. Install accessories in accordance with the manufacturer's printed instructions and ASTM F446.
- D. Install accessories plumb and level and securely anchor to substrate.
- E. Install accessories in a manner that will permit the accessory to function as designed and allow for servicing as required without hampering or hindering the performance of other devices.
- F. Position and install dispensers and other devices in countertops, clear of drawers, permitting ample clearance below countertop between devices, and ready access for maintenance as needed.
- G. Align mirrors, dispensers and other accessories even and level, when installed in battery.
- H. Install accessories to prevent striking by other moving, items or interference with accessibility.

3.3 SCHEDULE OF ACCESSORIES

- A. As indicated on the Drawings.

3.4 CLEANING

- A. After installation, clean as recommended by the manufacturer and protect from damage until completion of the Project.

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SECTION 10 44 13
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 DESCRIPTION

A. 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

A. Recessed type with flat trim of size and design shown.

2.2 FABRICATION

A. Form body of cabinet from 0.0359-inch-thick sheet steel.

B. Fabricate door and trim from 0.0478-inch-thick sheet steel with all face joints fully welded and ground smooth.

1. Glaze doors with 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

3.1 INSTALLATION

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 39 inches above finished floor.

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SECTION 12 32 00
MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies plastic laminate casework as detailed on the Drawings, including related components and accessories required to form integral units. Wood casework items shown on the Drawings, but not specified below shall be included as part of the Work under this Section, and applicable portions of the Specification shall apply to these items. Each like item of casework shall be of the same design and by one manufacturer.
- B. Where shown, provide plastic laminate casework items including base cabinets, countertops, and wall cabinets, as shown on the Drawings.

1.2 RELATED WORK

- A. Color and Finish of Plastic Laminate: As shown on the Finish Schedule on the Drawings.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. The fabrication of casework shall be by a manufacturer who produces casework similar to the casework specified and shown.

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. Sinks, trim and fittings.
 - 2. Locks for doors and drawers.
 - 3. Adhesive cements.
- C. Samples: Countertop, plastic laminate, 6-inch square.
- D. Shop Drawings (1/2 full size):
 - 1. All casework, showing details of construction, including materials, hardware and accessories.
 - 2. Cabinets and counters showing faucets in connection with sink bowls, and electrical fixtures and receptacles which are mounted on cabinets and counters.
 - 3. Fastenings and method of installation.
- E. Mock-Up: Where required for special casework and where 4 or more similar units are involved, submit a mock-up of a typical unit for approval by Contracting Officer's Representative (COR).

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A167-99 (R2009).....Stainless and Heat-Resisting chromium-Nickel Steel Plate, Sheet and Strip
 - A1008-10.....Steel, Sheet, Cold-Rolled, Carbon, Structural, High Strength Low Alloy
 - C1036-06.....Flat Glass
- C. U.S. Department of Commerce Product Standards (Prod. Std.):
 - PS1-95.....Construction and Industrial Plywood
- D. Hardwood, Plywood and Veneer Association (HPVA):
 - HP-1-09.....Hardwood and Decorative Plywood
- E. Architectural Woodwork Institute (AWI):
 - Architectural Woodwork Quality Standards, Guide Specifications Quality Certification Program - 1999
- F. American Society of Mechanical Engineers (ASME):
 - A112.18.1-05.....Plumbing Fixture Fittings
- G. National Electrical Manufacturers Association (NEMA):
 - LD3-05.....High Pressure Decorative Laminates
 - LD3.1-95.....Performance, Application Fabrication and Installations of High-Pressure Decorative Laminates

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE

- A. NEMA LD-3.
- B. Exposed decorative surfaces including countertops, both sides of cabinet doors, and for items having plastic laminate finish. General purpose Type HGL.
- C. Cabinet Interiors Including Shelving: Both of following options to comply with NEMA, LD3.1 as a minimum.
 - 1. Plastic-laminate-clad plywood.
- D. Backing sheet on bottom of plastic laminate covered wood tops. Backer Type BKL.
- E. Post-Forming Fabrication, Decorative Surface: Post-forming Type HGP.

2.2 PLYWOOD, SOFTWOOD

- A. Prod. Std. PS1, 5-ply construction from 1/2-inch to 1-1/8-inch thickness, and 7-ply for 1-1/4-inch thickness.

2.3 PARTICLEBOARD

A. The use of particleboard is not allowed.

2.4 RUBBER OR VINYL BASE

A. Unless otherwise indicated on the Drawings, furnish straight (for carpet), cove (for resilient floor); 4-inch-high, 1/8-inch-thick, flexible to conform to irregularities in walls, partitions and floors.

2.5 PLUMBING FIXTURES

A. ASME A112.18.1, except die-cast zinc-alloy material is not acceptable.

2.6 GLASS: ASTM C1036

A. For Doors: Type I, Class 1, Quality q4.

2.7 SHEET STEEL

A. ASTM A1008.

2.8 STAINLESS STEEL

A. ASTM A167, with No. 4 finish.

2.9 HARDWARE

A. Where pin tumbler locks are specified, furnish locks with 7-pin removable cylinder cores tied to the door hardware locking system by Yale Hardware as specified under Section 08 71 00 - DOOR HARDWARE. Locks for each type casework shall be keyed differently and shall be master-keyed for each type service, such as Nurses, Psychiatric, and Administration. Provide 2 keys for each lock. Exposed hardware, except as otherwise specified, shall be satin-finished, chromium-plated brass or nickel-plated brass.

B. Marking of Locks and Keys:

1. The name of the manufacturer, or trademark by which manufacturer can readily be identified, legibly marked on each lock.
2. The key change number marked on the exposed face of lock, and also stamped on each key.
3. Key change numbers shall provide sufficient information for replacement of the key by the manufacturer.

C. Hinged Doors:

1. Doors 36 inches and more in height shall have 3 hinges and doors less than 36 inches in height shall have 2 hinges. Each door shall close against 2 rubber bumpers.
2. Hinges: Fabricate hinges with minimum 0.072-inch-thick chromium-plated steel leaves, and with minimum 0.139-inch-diameter stainless-steel pin. Hinges shall be 5-knuckle design with 2-1/2-inch-high leaves and hospital type tips.

3. Fasteners: Provide full-thread wood screws to fasten hinge leaves to door and cabinet frame. Finish screws to match finish of hinges.

D. Door Catches:

1. Friction or Magnetic type, fabricated with metal housing.
2. Provide 1 catch for cabinet doors 48 inches high and under, and 2 for doors over 48 inches high.

E. Locks:

1. Cylinder type pin tumbler.
2. Equip doors and drawers where shown with locks as specified under paragraph 2.9 A. of this Section.

- F. Drawer and Door Pulls: Doors and drawers shall have wire pulls, per B02001, fabricated of either chromium-plated brass, chromium-plated steel, stainless steel, or anodized aluminum.

G. Drawer Slides:

1. Full extension steel slides with nylon ball-bearing rollers.
2. Slides shall have positive stop.
3. Equip drawers with rubber bumpers.

- H. Shelf Standards (Except For Fixed Shelves): Bright zinc-plated steel for recessed mounting with screws, 5/8-inch-wide by 3/16-inch-high providing 1/2-inch adjustment, complete with shelf supports.

- I. Gate Bolt: Surface-mounted barrel type with strike.

- J. Hinged Gates: Gates shall have two double-acting hinges or pivots, size as required.

2.10 FABRICATION

- A. Casework shall be of the flush overlay design and, except as otherwise specified, be of premium grade construction and of component thickness in conformance with AWI Quality Standards.

- B. Fabricate casework of plastic-laminated covered plywood as follows:

1. Where shown, gates, doors, drawers, shelves, and all semi-concealed surfaces shall be plastic laminated.
2. Glazed doors shall have 3/16-inch-thick glass, set in glazing compound.

- C. Electrical fixtures, receptacles, wiring and junction boxes required for fixtures and receptacles:

1. Factory installed in casework.
2. For electrical lighting fixtures, see Drawings.
3. For electric receptacles and lighting fixtures installed below or adjacent to wall cabinets or above countertops, see Electrical Sections of Specifications.

4. Install wiring in built-in raceways and terminate at junction box mounted on rear of cabinet and counter.
5. For final hook-up at junction box see Electrical Sections of Specifications.

D. Base:

1. Provide rubber or vinyl base with close, flush joints; set with adhesive.
2. Remove adhesive from exposed surfaces.
3. Install base at floor line after casework has been accurately leveled.
4. Rub base to glossy finish.

E. Countertops:

1. Countertops, splashbacks, and reagent type shelves shall be plastic laminate factory glued to either a plywood (PS1) core.
2. Countertops shall be 1-1/4 inches thick.
3. Splashbacks and reagent type shelves shall be finished 3/4-inch thick and be secured to countertops with concealed metal fastenings and with contact surfaces set in waterproof adhesive.
4. Provide cut-outs for plumbing trim where shown.
5. Cover exposed edges of countertops, splashbacks, and reagent type shelves with plastic.

F. Sink Bowls:

1. 18-gage stainless steel, of size and design shown.
2. All interior corners of bowls shall be formed to manufacturer's standard radii.
3. Sinks shall have rims with flanged edges overlapping tops to provide tight joints.
4. Secure sink bowls with concealed fastenings.
5. For service lines from service fixtures, see other sections of specifications.

G. Provide the following plumbing trim and fittings:

1. Faucets: ASME A112.18.1 Type I, compression type, countertop-mounted, chromium-plated brass, having 2 valves and with swing-spout and gooseneck spout as shown, elevated to clear handles.
2. Fittings shall have an elongated escutcheon for spout and handles, replaceable valve seats and 4 arm or lever style indexed chromium-plated brass or stainless-steel handles; handles either with or without hood.

H. Faucets:

1. ASME A112.18.1 Type I, compression type, splashback-mounted, chromium-plated brass, having 2 valves and with swing-spout and/or gooseneck spout as indicated.
 2. Fittings shall have exposed body union inlets and adjustable flanges.
 3. Valves shall have indexed chromium-plated brass or stainless-steel lever handles and replaceable valves seats; handles either with or without hood.
- I. Drain:
1. Cast or wrought brass or stainless steel with flat strainer.
 2. Surfaces of drains exposed from above shall have a chromium-plated finish.
- J. Traps: Cast brass.
- K. Spray Hose:
1. Hose shall drop below countertop when not in use and be of sufficient length to reach the entire length of the countertop.
 2. Concealed trim may be rough brass.
- L. Support Members for Tops of Tables:
1. Construct as detailed.
 2. Provide miscellaneous steel members and anchor as shown.
- M. Legs for Counters:
1. Fabricate legs for counters of 0.0635-inch-thick, 1-1/2-inch-square tubular stainless steel where shown.
 2. Secure legs to countertops and provide legs at bottom with shoes not less than 1 inch in height.
 3. Fabricate shoes of either stainless steel, aluminum or chromium-plated brass.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set casework in place; level, plumb and accurately scribe and secure to walls, and/or floors.
- B. The installation shall be complete including all trim and hardware. Leave the casework clean and free from defects.

3.2 FASTENINGS

- A. Fastenings for securing casework to adjoining construction shall be as detailed on the Drawings or approved shop drawings.
- B. See Section 05 50 00, METAL FABRICATIONS for reinforcement of walls and partitions for casework anchorage.

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SECTION 21 05 11
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Excavation and Backfill: Section 31 20 00, EARTH MOVING.
- D. Concrete and Grout: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- E. Building Components for Attachment of Hangers: Section 05 31 00, STEEL DECKING.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 84 00, FIRESTOPPING.
- H. Flashing for Wall and Roof Penetrations: Section 07 60 00, FLASHING AND SHEET METAL.
- I. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.
- K. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS
- L. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- M. Section 21 05 12, GENERAL MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT.
- N. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years. See other specification sections for any exceptions.
 - 2. Equipment Service: Products shall be supported by a service organization which maintains a complete inventory of repair parts and is located reasonably close to the site.

3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 5. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 6. Asbestos products or equipment or materials containing asbestos shall not be used.
- B. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Resident Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- C. Guaranty: In GENERAL CONDITIONS.
- D. Supports for sprinkler piping shall be in conformance with NFPA 13.
- E. Supports for standpipe shall be in conformance with NFPA 14.

1.4 SUBMITTALS

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

1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, Article, INSTRUCTIONS, for systems and equipment.
2. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
A36/A36M-2001.....Carbon Structural Steel
A575-96.....Steel Bars, Carbon, Merchant Quality, M-Grades R
(2002)
E84-2003.....Standard Test Method for Burning Characteristics
of Building Materials
E119-2000.....Standard Test Method for Fire Tests of Building
Construction and Materials
- C. National Fire Protection Association (NFPA):
90A-96.....Installation of Air Conditioning and Ventilating
Systems
101-97.....Life Safety Code

PART 2 - PRODUCTS

2.1 LIFTING ATTACHMENTS

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

2.2 ELECTRIC MOTORS

- A. Section 21 05 12, GENERAL MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION EQUIPMENT, specifies the applicable requirements for electric motors. Provide special energy efficient motors as scheduled. Unless otherwise specified for a particular application use electric motors with the following requirements.
- B. Single-phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC).
- C. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type. Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.

- D. Rating: Continuous duty at 100 percent capacity in an ambient temperature of 40 degrees centigrade (104 degrees F); minimum horsepower as shown on drawings; maximum horsepower in normal operation not to exceed nameplate rating without service factor.
- E. Insulation Resistance: Not less than one-half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

2.3 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 energy efficient type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.

2.4 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 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. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm (1/4-inch) for service designation on 19 gage 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
2. Valve lists: Typed or printed plastic coated card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
3. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color coded thumb tack in ceiling.

2.5 FIRESTOPPING

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

2.6 GALVANIZED REPAIR COMPOUND

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

AK2.7 PIPE PENETRATIONS

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

through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

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

2.8 TOOLS AND LUBRICANTS

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

2.9 WALL, FLOOR AND CEILING PLATES

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

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

PART 3 - EXECUTION

3.1 INSTALLATION

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

- drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Resident Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Resident Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Resident Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- F. Work in Animal Research Areas: Seal all pipe penetrations with silicone sealant to prevent entrance of insects.
- G. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints.
- H. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 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.

3.3 LUBRICATION

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

3.4 STARTUP AND TEMPORARY OPERATION

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

3.5 OPERATING AND PERFORMANCE TESTS

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

3.6 INSTRUCTIONS TO VA PERSONNEL

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

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SECTION 21 10 00
WATER -BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The design and installation of a hydraulically calculated automatic fire sprinkler system complete and ready for operation, for the entire renovation including the penthouse, mechanical equipment rooms, attic space, elevator machine rooms, elevator pits, linen and trash chutes, and accessible shafts.
- B. Installation of new sectional valves in the sprinkler system feed mains as indicated on the drawings.
- C. Modification of the existing sprinkler system as indicated on the drawings. Size system by pipe schedule in accordance with NFPA 13 and NFPA 14 the latest editions.
- D. Provide access doors or panels where control or drain valves are located behind plaster or gypsum walls or ceilings as necessary to install piping above suspended plaster or gypsum ceilings.
- J. Painting of exposed piping and supports to follow Section 09 91 00, PAINTING.

1.2 RELATED WORK

- A. Treatment of penetrations through rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Access panels for plaster ceilings: Section 08 31 13, ACCESS DOORS AND FRAMES.
- C. Painting of exposed pipe: Section 09 91 00, PAINTING.
- D. Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION.
- E. Alarm Supervision: Section 28 31 00, FIRE DETECTION AND ALARM.
- F. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 DESIGN CRITERIA

- A. The design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system shall be in accordance with the required advisory provisions of NFPA 13.

Exception to NFPA Fire Codes are as follows:

- 1. Sprinklers are not required in interstitial areas, except along AGV track systems if the vehicle is combustible.

B. Base system design hydraulic calculations using the area/density method on the following criteria and in accordance with NFPA 13 latest edition.

1. Sprinkler Protection:

- a. All patient care, sleeping, treatment, office, waiting areas, educational areas, dining areas, corridors and attics: Light hazard, (0.10 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).
- b. Kitchen, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts (if required), Elevator Machine Rooms, Refrigeration Service Rooms, and storage between 9 and 23 m² (100 and 250 sq. ft.) Ordinary Hazard, Group 1, 6.1 L/minute/m² (0.15 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).
- c. Clean and soiled linen rooms, trash rooms, clean and soiled utility rooms, laundry, laboratories, retail sales and storage rooms, storage room over 23 m² (250 sq. ft.), boiler plants, loading docks, warehouse spaces, energy centers, Pharmacy and SPD areas: Ordinary Group 2, 8.1 L/minute/m² (0.20 gpm/sq. ft.) over the hydraulically most remote 140 m² (1500 sq. ft.).
- d. File Storage Areas with "Rolling Files" Racks: Ordinary Group 2 for the entire area of the space up to 140 m² (1500 sq. ft.) area of sprinkler operation.
- e. Supply warehouse with storage height less than 3650 mm (12 ft. high): Ordinary Hazard Group 2. Storage height exceeding 3650 mm (12 ft.), per NFPA 13 latest edition.
- f. Provide sprinklers in accessible shafts per NFPA 13 latest edition.
- g. Provide sprinklers in gravity type metal chutes per NFPA 82.

2. Add water allowance of 15 L/s (250 gpm) for inside and outside hose streams to the sprinkler requirements at the connection to the distribution main.

3. Hydraulic Calculations: The calculated demand including hose stream requirements shall fall no less than 10 percent below the available supply curve.

4. Water Supply:

- a. Elevation of static and elevation of residual test gage: 600 mm (2 ft.) above site grade

- b. Static pressure: - kPa (psi)
- c. Residual pressure: - kPa (psi)
- d. Flow: L/s (gpm)
- e. Date: Time: -
- C. For each sprinkler zone provide a control valve, flow switch, self-contained test, drain assembly and pressure gage.
- D. Provide a separate sprinkler valve for each traction elevator machine room and other areas as required by NFPA 13 latest edition.
- E. Provide a guard for each sprinkler in the janitors' closets, the elevator machine room and sprinklers within 2100 mm (7 ft.) of the floor and other areas as required by NFPA 13.
- F. Locate sprinklers in patient bedrooms assuming all privacy curtains have 13 mm (1/2 in.) openings in mesh extending 450 mm (18 in.) from ceiling.
- G. Seismic Protection: Seismically brace all new and existing piping systems in accordance with Zone of NFPA 13 latest edition.

1.4 QUALIFICATIONS:

- A. Designer's Qualifications: Design work and shop drawings shall be prepared by a licensed engineer practicing in the field of Fire Protection Engineering or a NICET (National Institute for Certification in Engineering Technologies) Level III sprinkler technician.
- B. Installer's Qualifications: The installer shall possess a valid State fire protection contractor's license. The installer shall provide documentation of having successfully completed three projects of similar size and scope.
- C. On-site emergency service within four hours notification.

1.5 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Sprinkler design shall be done by a certified professional. All plans shall be stamped by qualified P.E.
- C. Emergency service point of contact name and 24 hour emergency telephone number.
- D. Manufacturer's Literature and Data:
 - 1. Pipe and fittings.
 - 2. Valves
 - 3. Drips
 - 4. . Sprinklers-each type, temperature and model

5. Inspectors Test Alarm Modules
 6. Sprinkler Plugs
 7. Pressure Gages
 8. Pressure Switches
 9. Pipe Hangers and Supports
 10. Water Flow Switches
 11. Valve Tamper Switches
 16. Water Measuring Device
 17. Valve Cabinet
- E. Detailed drawings in accordance with NFPA 13 the latest editions.
Drawings shall be prepared using CADD software stamped by fire protection professional engineer and include all new and existing sprinklers and piping. Use format in use at the VA medical center. Drawings are subject to change during the bidding and construction periods. Any wall and ceiling changes occurring prior to the submittal of contractors shop drawings shall be incorporated into the contractors detailed design at no additional contract cost.
- F. Hydraulic calculations for each sprinkler system in accordance with NFPA 13 latest edition.
- G. Operation and Maintenance Data:
1. Indicating Valves
 2. Water Flow and valve tamper switches
 3. Alarm Valves
 4. Pre-action Valves
 5. Air Compressor
 6. Fire Pump
 7. Excess Pressure Pump
 8. Copy of NFPA 25
- H. Recommended preventive maintenance schedule.
- 1.6 AS-BUILT DOCUMENTATION**
- A. A Mylar as-built drawing and two blue-line copies shall be provided for each drawing. One copy of final CADD drawing files shall also be provided on 89 mm (3 1/2 in.), 1.44 mb diskette, for each drawing.
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- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of hydraulic calculations for each sprinkler system updated to include submittal review comments and any changes to the

installation which affect the calculations including one electronic set in PDF format.

- D. Four copies of the hydrostatic report and NFPA 13 material and test certificate for each sprinkler system.
- E. Four sets of operation and maintenance data updated to include submittal review comments and any equipment substitutions including one copy of NFPA 25.
- F. Manufacturers literature, hydraulic calculations, reports and operation and maintenance data shall be in a labeled 3-ring binder.

1.7 **WARRANTY**

- A. All work performed and materials and equipment furnished under this contract shall be free from defects for a period of one year from date of acceptance by the government.
- B. All new piping and equipment incorporated into the new system shall be hydrostatically tested and warranted as new.

1.8 **APPLICABLE PUBLICATIONS**

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA)
 - 13-2010.....Installation of Sprinkler Systems
 - 14-2010.....Installation of Standpipe and Hose Systems
 - 17A-2009.....Standard for wet chemical extinguishing systems
 - 20-2003.....Installation of Centrifugal Fire Pump
 - 24-2010.....Installation of Private Fire Service Mains and
Their Appurtenances
 - 25-2011.....Inspection, Testing and Maintenance of water
Based Fire Protection Systems
 - 70-2011.....National Electrical Code
 - 72-2010.....National Fire Alarm Code
 - 82-2009.....Incinerators, Waste and Linen Handling Systems
and Equipment
 - 170-2009.....Standards for Fire Safety Symbols
 - 291-2010.....Fire Flow Testing and Marking of Hydrants
- C. Underwriters Laboratories Inc. (UL)
 - 2011.....Fire Protection Equipment Directory
- D. Factory Mutual Engineering Corporation (FM)
 - 2010.....Approval Guide

- E. American Society for Testing and Materials (ASTM)
F442-09Chlorinated Poly (Vinyl Chloride) (CPVC)
Plastic Pipe
- F. American Society of Sanitary Engineering (ASSE)
1015-2009Double Check Backflow Prevention Assembly
- G. Not Used.
- H. Contractor shall provide all necessary test equipment, parts and labor to perform required maintenance.
- I. All inspections, testing and maintenance work required by NFPA 25, NFPA 20, NFPA 13 and recommended by the equipment manufacturer shall be provided. Work shall include operation of sprinkler system alarm and supervisory devices.
- J. Maintenance and testing shall be performed on a quarterly basis. A computerized preventive maintenance schedule shall be provided and shall describe the protocol for preventive maintenance of equipment. The schedule shall include a systematic examination, adjustment, and cleaning of all equipment.
- K. Non-included Work: Maintenance service shall not include the performance of any work due to improper use, accidents or negligence for what the contractor is not responsible.
- L. Service and emergency personnel shall report to the Engineering Office or their authorized representative upon arrival at the hospital and again upon the completion of the required work. A copy of the work ticket containing a complete description of work performed and parts replaced shall be provided.
- M. Emergency Service:
1. Normal and overtime emergency call-back service shall consist of an on-site response to calls within four hours of notification.
 2. Overtime emergency call-back service shall be limited to minor adjustments and repairs to affect the integrity of the system.
 3. The sprinkler system must be operational before the responding service person leaves the facility.

PART 2 - PRODUCTS

2.1 GENERAL

All devices and equipment shall be Underwriters Laboratories Inc. listed for their intended purpose. All sprinklers shall be Factory Mutual approved.

2.2 PIPING AND FITTINGS

- A. Pipe and fittings from inside face of building 300 mm (12 in.) above finished floor to a distance of approximately 1500 mm (5 ft.) outside building: Ductile Iron, flanged fittings and 316 stainless steel bolting.
- B. Fire Protection water supply within the building up to sprinkler system isolation valves shall be black steel, per NFPA 13.
- C. Sprinkler piping downstream of the isolation valve on wet-pipe systems shall be black steel.
- D. Sprinkler piping of a dry pipe system shall be galvanized. Schedule 40 minimum.
- E. MRI Suite: Copper.
- F. Threaded or flanged fittings shall be ANSI B16.3 cast iron, class 125 minimum. Threaded fittings are not permitted on pipe with wall thickness less than schedule 40.
- G. All fittings on galvanized piping shall be galvanized in accordance with ASTM A53.
- H. Slip type or clamp-on type rubber gasketed fittings shall be listed for each piping application.
- I. Piping Materials Standards:
 - 1. Ferrous piping - follow ASTM A 795 Standard
 - 2. Welded and seamless steel pipe - follow ANSI/ASTM A 53
 - 3. Wrought steel pipe - follow ANSI/ASME 836.10M
 - 4. Electric resistance welded steel pipe - follow ASTM A 135
 - 5. Seamless copper tube - follow ASTM B 75
 - 6. Seamless copper water tube - follow ASTM B 88
 - 7. Wrought seamless copper and copper alloy tube - follow ASTM B 251
 - 8. Fluxes for soldering applications of copper and copper alloy tube - follow ASTM B 813
 - 9. Brazing filler metal - follow AWS A5.8
 - 10. Solder metal, 95-5 - follow ASTM B 32
 - 11. Alloy material - follow ASTM B 446
 - 12. Non-metallic piping CPVC pipe - follow ASTM F 442
- J. Fitting Materials Standards:
 - 1. Cast iron threaded fitting, Class 125 and 250 - follow ASME B16.4
 - 2. Cast iron pipe flanges and flanged fittings - follow ASME B16.1
 - 3. Malleable iron threaded fittings, Class 150 and 300 steel - follow ASME B16.3

4. Factory made wrought steel buttweld fittings - follow ASME B16.9
5. Buttwelding ends for pipe, valves, flanges, and fitting - follow ASME B16.25
6. Wrought copper and copper alloy solder joint pressure fittings - follow ASME B16.22
7. Cast copper alloy solder joint pressure fitting - follow ASME B16.18
8. Chlorinated polyvinyl chloride (CPVC) - follow ASTM F 437
- K. Pipe Identification - All pipe, including specially listed pipe allowed by NFPA 13, shall be marked continuously along its length by the manufacturer in such a way as to properly identify the type of pipe. Pipe identification shall include the manufacturer's name, model designation, or schedule.

2.3 VALVES

A. Listed Indicating Valves:

1. Gate: OS&Y, 2400 kPa (350 psi)-Water Working Pressure (WWP)
2. Butterfly: Gear operated, indicating type, 2400 kPa (350 psi) water working pressure (WWP). Butterfly valves are to be installed in a manner that does not interfere with the operation of any system component.
3. Ball (inspectors test and drain only): iron body, stainless steel trim, for 2050 kPa (300 psi) service, indicating type.
4. Ball and butterfly valves shall not be used on incoming water service, and on the suction side of either the fire pump or jockey pump.

B. Check Valves: Swing type, rubber faced or wafer type spring loaded butterfly check valve, 2400 kPa (350 lb.) water working pressure (WWP)

C. Alarm Check: Iron body, bronze mounted, variable pressure type with retarding chamber. Provide basic trimmings for alarm test by pass, gages, drain connections, mounting supports for retarding chamber, and drip funnel. Provide pressure sensitive alarm switch to actuate the fire alarm system.

D. Drain Valves: Threaded bronze angle, globe, ball or butterfly, 4100 kPa (600 psi), Water or gas (WOG) equipped with reducer and hose connection with cap or connected to a drain line.

E. Self-contained Test and Drain Valve:

1. Ductile iron body with bronze "Drainn and "Testn bonnets. Acrylic sight glass for viewing test flow. Various sized orifice inserts to simulate flow through 14 mm (17/32 in.), 13 mm (1/2 in.), 12 mm

- (7/16 in.), and 10 mm (3/8 in.) diameter sprinklers, 32 mm (1 1/4 in.) female threaded outlets or 32 mm (1 1/4 in.) one-quarter turn locking lug outlets for plain end pipe (end preparation to be in accordance with manufacturer's recommendation).
2. Bronze body, with chrome plated bronze ball, brass stem, steel handle, Teflon seat and sight glasses. Provide valve with three position indicator plate (off, test, and drain), 6 mm (1/4 in.) tapping for pressure gage and various other orifice inserts to simulate flow through 10 mm (3/8 in.), 12 mm (7/16 in.), 13 mm (1/2 in.), and 14 mm (17/32 in.) diameter sprinklers.
- F. Dry Pipe Valve: Flanged, iron body. Provide basic trimmings for alarm test bypass, water flow alarm, high and low pressure switches, gages, drain connections, drip funnel, accelerator and necessary pipe, fittings and accessories required to provide a complete installation.
- G. Standpipe Hose Valve: 65 mm (2 1/2 in.) screwed, brass hose angle valve, 2400 kPa (350 psi) water working pressure, WWP, male hose threads same as local fire department service, 65 mm x 40 mm (2 1/2 in. x 1 1/2 in.) reducer, and with permanently attached polished brass cap and chain: Provide for valves installed in a cabinet a 65 mm (2 1/2 in.) attached cap and chain and a 65 mm x 40 mm (2 1/2 in. x 1 1/2 in.) reducer placed in cabinet.
- H. Standpipe hose valve cabinets: Cabinets shall be white glossy polyester coated 20 gage steel with continuous steel hinge with brass pin, recessed type 600 x 600 x 250 mm (24 x 24 x 10 in.).
- I. Double Check Backflow Prevention Assembly: Provide two independent check valves with OS&Y shut off valves, ball type test cocks. Maximum friction loss through assembly shall not exceed 35 kPa (5 psi) at design flow. Unit shall be functional in vertical or horizontal position, rated for 1200 kPa (175 psi) working pressure. Check valve assembly shall be in accordance with AWWA Class D. Double check backflow prevention assembly shall be FM approved, ASSE approved and UL listed.

2.4 AUTOMATIC BALL DRIPS

Cast brass 20 mm (3/4 in.) in line automatic ball drip with both ends threaded with iron pipe threads.

2.5 SPRINKLERS

- A. Quick response sprinklers shall be standard type except as noted below. The maximum distance from the deflector to finished ceiling shall be

50 mm (2 in.) for pendent sprinklers. Pendent sprinklers in finished areas shall be provided with semi-recessed adjustable screwed escutcheons and installed within the center one-third of their adjustment. The sprinkler shall be installed in the flush position with the element exposed below the ceiling line. At the specified locations, provide the following type of sprinklers. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval, and the following:

LOCATION	TYPE
Mechanical Equipment Rooms, Electrical & Electrical Switch Gear Rooms	Quick Response, Upright or Telephone Closets, Transformer Vaults Pendent Brass [93 oc (200 °F)]
Elevator Shafts, Dumbwaiter Shafts, Elevator Machine Rooms, Elevator Pits	Standard Upright or Sidewall Brass [93 oc (200 °F)]
Gravity Type Linen & Trash Chutes	Standard Upright or Pendent Brass [66-74 oc (150-165 °F)]
Warehouse [Storage under 3600 mm (12 ft.)]	Quick Response, Pendent or Upright, Brass [77-74 oc (150- 165 °F)]
warehouse [Storage over 3600 mm (12 ft.)]	See NFPA 13
Cold rooms, Freezers, Controlled Temperature Rooms and Unheated Areas	Standard Pendent, Dry Type [66- 74 oc (150-165 °F)]
Kitchen Hoods, Exhaust Ducts & Duct Collars	Standard Pendent or Upright (Extra High Temperature [163-191 oc (325- 375 op.)]J
Generator Rooms	Standard Pendent or Upright [141 oc (286 op)]J
Mental Health and Behavioral Unit: Nursing Bedroom, Toilets and all areas with plaster/ dry wall ceilings within the area	Institutional Quick Response; Chrome plated with 85 lb. breakaway, Pendent, Horizontal Sidewall [66-74 oc (150-165 op)]J
Patient Sleeping, Patient Bathrooms, and Corridors within a Patient Ward	Residential, Quick Response, Recessed Pendent, Chrome Plated, [66-74 oc (150-165 °F)]
All Patient Treatment, Elevator Lobbies and Corridors	Quick Response, Recessed Pendent, Chrome Plated [66-74 oc [150- 165 op)]J
Operating Rooms, Radiology Rooms, Nuclear Medicine Rooms	Quick Response, Recessed Pendent, Chrome Plated, Sidewall [66-74 oc (150-165 °F)]
All Areas Not Listed Above	Quick Response, Recessed Pendent, Sidewall, Chrome Plated [66-74 oc (150-165 °F)]

B. Do not use quick response sprinklers in the same sprinkler zone with other sprinklers types. In sprinkled light hazard patient zones that are expanded into fully sprinkled zones, revise the existing system to contain quick response sprinklers.

C. Sprinklers to be installed as per NFPA 13.

2.7 TOOLS AND REPLACEMENT PARTS

A. Sprinkler Cabinet:

1. Provide a minimum 5 percent spare sprinklers with escutcheons with a minimum of two of each type/or as required by NFPA-13, whichever is more demanding .
2. Provide a minimum of two of each type sprinkler wrenches used.
3. Install cabinets in each building where directed by the Resident Engineer.
4. Spare sprinklers shall be kept in a cabinet where ambient temperatures do not exceed 100 Deg F.

B. Sprinkler system water flow switch: one of each size provided.

C. Sprinkler system valve tamper switch: one of each type provided.

D. Sprinkler system pressure switch: one of each type provided .

E. Provide two sprinkler plugs attached to multi-section extension poles 2400 mm (8 ft.) minimum.

2.8 IDENTIFICATION SIGNS

Provide for all new and existing sectional valves, riser control valves, system control valves, drain valves, test and drain connections and alarm devices with securely attached identification signs (enamel on metal) in accordance with NFPA 13.

2.9 HANGERS AND EARTHQUAKE BRACING

In accordance with NFPA 13 and 14. Comply with seismic requirements as per 15050 for seismic zone locations .

2.10 WATERFLOW SWITCHES

- A. Integral, mechanical, non-coded, non-accumulative retard type, with two sets of SPDT auxiliary contacts and adjustable from 0 to 90 seconds. Set flow switches at an initial setting between 20 and 30 seconds.
- B. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

2.11 VALVE SUPERVISORY SWITCHES

- A. Provide each indicating sprinkler, standpipe and fire pump control valve with adequate means for mounting a valve supervisory switch.
- B. Mount switch so as not to interfere with normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem is moved no more than one fifth of the distance from its normal position.

- C. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 20 mm (3/4 in.) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.
- D. Switch housing to be finished in red baked enamel.
- E. Supervisory switches for ball and butterfly valves may be integral with the valve.
- F. All conduit and wiring connected thereto shall be provided in Section 28 31 00, FIRE DETECTION AND ALARM.

2.12 PRESSURE SWITCHES

- A. Provide with 15 mm (1/2 in.) NPT male pressure connection.
- B. Alarm switch shall be activated by any flow of water equal to or in excess of the discharge from one sprinkler.
- C. Supervisory switch shall be activated by either high or low air pressure condition.
- D. Furnish switch in a red baked enamel, weatherproof, oil resistant housing with tamper resistant screws.

2.13 WALL, FLOOR AND CEILING PLATES

- A. Exposed piping passing through walls, floors or ceilings shall be provided with chrome colored escutcheon plates.
- B. Comply with NFPA 101 Fire Barrier Penetration codes.

2.14 KITCHEN VENTILATOR HOOD FIRE PROTECTION

- A. Provide piping from the building sprinkler system to the stub-out point on the ventilator control cabinet.
- B. Water pressure at the control cabinet shall be a minimum of 276 kPa (40 psi), maximum 552 kPa (80 psi). Provide a pressure reducing valve if the water pressure exceeds 552 kPa (80 psi).
- C. Activation of the flow switch shall shut off the electrical equipment and initiate a local alarm and the fire alarm for the affected zone.

2.15 PRESSURE GAUGE

- A. Provide a 690 kPa (100 psi) pressure gauge at each flow alarm switch location, at the top of each sprinkler or standpipe riser, at each main drain connection, and on the suction and discharge of the fire pump.

2.16 HANGERS

- A. Hangers shall be designed to support five times the weight of the water filled pipe plus 250 Lb (114Kg) at each point of piping support.
- B. These points of support shall be adequate to support the system.
- C. The spacing between hangers shall not exceed the value given for the type of pipe as indicated in NFPA 13 tables.

- D. Hanger components shall be ferrous.
- E. Detailed calculations shall be submitted, when required by the reviewing Authority, showing stress developed in hangers, piping, fittings and safety factors allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Supervisory Switches: For each indicating sprinkler zone control valve, provide a supervisory switch that is connected to the fire alarm system. Standpipe hose valves and test and drain valves shall not be provided with supervisory switches.
- B. Waterflow Switches: For each sprinkler zone and where indicated on drawings, provide a waterflow switch. Install waterflow switch and adjacent valves in easily accessible locations.
- C. Sprinkler Zone: Each sprinkler zone shall coincide with each smoke zone.
- D. Piping connections:
 - 1. Sprinkler System Only: Start at flanged outlet within the building at exterior wall.
- E. Drains, Test Pipes and Accessories:
 - 1. Provide a drain at base of risers, drain connection on valved sections, and drains at other locations for complete drainage of the system. Provide valve in drain lines and connect to the central drain riser. Discharge riser outside over splash block, indirectly over standpipe drain connected to storm sewer, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow onto the floor.
 - 2. Provide test pipes in accordance with NFPA 13. Test pipes shall be valved and piped to discharge through proper orifice as specified above for drains.
- F. Conceal all piping, except in pipe basements, stairwells and rooms without ceilings.
- H. Install new piping and sprinklers aligned with natural building and other sprinklers lines.
- I. Piping arrangement shall avoid contact with other piping and equipment and allow clear access to other equipment or devices requiring access or maintenance .

- J. Cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections, shall be affixed near to the pipe where the originated. They shall be displayed until final inspection and then removed.
- K. Firestopping shall comply with Section 07 84 00, FIRESTOPPING. All holes through stairways, smoke barrier walls, and fire walls shall be sealed on a daily basis.
- L. Provide hydraulic design information signage as required by NFPA 13.
- M. Install access doors in ceilings of rooms where above ceiling access is required.

3.2 **TEST**

- A. Automatic Sprinkler System: NFPA 13 and 25.

3.3 **INSTRUCTIONS**

Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the fire pump and sprinkler system, on the dates requested by the COTR.

- - - END - - -

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Design, installation and testing shall be in accordance with NFPA 13 except for specified exceptions.
- B. The design and installation of a hydraulically calculated automatic wet system complete and ready for operation, for all renovated portions of Building B108, including the, mechanical equipment rooms, attic space, telephone rooms.
- D. Modification of the existing sprinkler system as indicated on the drawings and as further required by these specifications.

1.2 RELATED WORK

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

1.3 QUALITY ASSURANCE

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

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

1. Qualifications:

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

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

3. Manufacturers Data Sheets:

- a. For backflow preventers, provide flow test curves from UL, FM, or the Foundation for Hydraulic Research and Cross-Connection Control to verify pressure loss calculations.
- b. Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.

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

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

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

- a. One complete set of reproducible as-built drawings showing the installed system with the specific interconnections between the waterflow switch or pressure switch and the fire alarm equipment.
- b. Complete, simple, understandable, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble shooting manual. Provide maintenance instructions on replacing any components of the system including internal parts,

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

4. Water Supply: Base water supply on a flow test of:
- a. Location _____
 - b. Elevation Static Test Gauge _____ m
(_____ ft)
 - c. Elevation Residual Test Gauge _____ m
(_____ ft)
 - d. Static pressure: _____ kPa (_____ psi)
 - e. Residual pressure: _____ kPa (_____ psi)
 - f. Flow: _____ L/s (_____ gpm)
 - g. Date: _____ Time _____
5. Zoning:
- a. For each sprinkler zone provide a control valve, flow switch and a test and drain assembly with pressure gauge.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Fire Protection Association (NFPA, latest edition):
 - 13-.....Installation of Sprinkler Systems
 - 101-.....Safety to Life from Fire in Buildings and Structures (Life Safety Code)
 - 170-.....Fire Safety Symbols
- C. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment Directory - 2010
- D. Factory Mutual Engineering Corporation (FM): Approval Guide - 2010
- E. Uniform Building Code - 2006
- F. Foundation for Cross-Connection Control and Hydraulic Research-2005

PART 2 PRODUCTS

2.1 PIPING & FITTINGS

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

2.2 VALVES

- A. Valves in accordance with NFPA 13.
- B. Do not use quarter turn ball valves for 50 mm (2 inch) or larger drain valves.
- C. The wet system control valve shall be a listed indicating type valve. Control valve shall be UL Listed and FM Approved for fire protection

installations. System control valve shall be rated for normal system pressure but in no case less than 175 PSI. (No Substitutions Allowed).

- D. Alarm valve shall be UL Listed and Factory Mutual Approved. The alarm valve shall be equipped with a removable cover assembly. The alarm valve shall be listed for installation in the vertical or horizontal position. The alarm valve shall be equipped with gauge connections on the system side and supply side of the valve clapper. The alarm valve shall be equipped with an external bypass to eliminate false water flow alarms. The alarm valve trim piping shall be externally galvanized. Maximum water working pressure to 250 PSI.

- G. Automatic Ball Drips: Cast brass 20 mm (3/4 inch) in-line automatic ball drip with both ends threaded with iron pipe threads.

2.3 SPRINKLERS

- A. All sprinklers except "institutional" type sprinklers shall be FM approved. Provide quick response sprinklers in all areas, except where specifically prohibited by their listing or approval.
1. Cold storage rooms: Standard response dry pendant sprinklers.
- B. Temperature Ratings: In accordance with NFPA 13,.

2.5 SPRINKLER CABINET

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

2.6 IDENTIFICATION SIGNS/HYDRAULIC PLACARDS

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

2.7 SWITCHES:

- A. Contain in a weatherproof die cast/red baked enamel, oil resistant, aluminum housing with tamper resistant screws, 13 mm (1/2 inch) conduit entrance and necessary facilities for attachment to the valves. Provide two SPDT switches rated at 2.5 amps at 24 VDC.
- B. Water flow Alarm Switches: Mechanical, non-coded, non-accumulative retard and adjustable from 0 to 60 seconds minimum. Set flow switches at an initial setting between 20 and 30 seconds.
- C. Pressure Switches: Activation by any flow of water equal to or in excess of the discharge from one sprinkler. Water Flow Indicating Pressure Switch will activate an alarm by way of an alarm pressure switch. The alarm pressure switch shall be compatible with system devices. The

alarm pressure enclosure shall be UL Listed and Factory Mutual Approved for the application in which it is used. The alarm pressure switch shall have the ability to be wired for Class A or Class B service.

- D. Valve Supervisory Switches for Ball and Butterfly Valves: May be integral with the valve.

2.8 GAUGES

Provide gauges as required by NFPA 13.

2.9 PIPE HANGERS AND SUPPORTS

Supports, hangers, etc., of an approved pattern placement to conform to NFPA 13. System piping shall be substantially supported to the building structure. The installation of hangers and supports shall adhere to the requirements set forth in NFPA 13, Standard for Installation of Sprinkler Systems. Materials used in the installation or construction of hangers and supports shall be listed and approved for such application. Hangers or supports not specifically listed for service shall be designed and bear the seal of a professional engineer.

2.11 WALL, FLOOR AND CEILING PLATES

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be accomplished by the licensed contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.
- B. Installation of Piping: Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Install concealed piping in spaces that have finished ceilings. Where ceiling mounted equipment exists, such as in operating and radiology rooms, install sprinklers so as not to obstruct the movement or operation of the equipment. Sidewall heads may need to be utilized. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of 2250 mm (seven feet six inches). To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
- C. Welding: Conform to the requirements and recommendations of NFPA 13.

- D. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drips and drains where necessary and required by NFPA 13.
- E. Supervisory Switches: Provide supervisory switches for sprinkler control valves.
- F. Waterflow Alarm Switches: Install waterflow switch and adjacent valves in easily accessible locations.
- G. Inspector's Test Connection: Install and supply in conformance with NFPA 13, locate in a secured area, and discharge to the exterior of the building.
- H. Kitchen Ventilator Hood Fire Protection: Provide piping from the building sprinkler system to the stub-out point on the ventilator control cabinet. Size piping in accordance with manufacturer specifications.
- I. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.
- J. Sleeves: Provide for pipes passing through masonry or concrete. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material in accordance with Section 07 84 00, FIRESTOPPING. Where core drilling is used in lieu of sleeves, also seal space. Seal penetrations of walls, floors and ceilings of other types of construction, in accordance with Section 07 84 00, FIRESTOPPING.
- K. Provide pressure gauge at each water flow alarm switch location and at each main drain connection.
- L. Firestopping shall comply with Section 07 84 00, FIRESTOPPING.
- N. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.
- O. Securely attach identification signs to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch.
- P. Repairs: Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.
- Q. Interruption of Service: There shall be no interruption of the existing sprinkler protection, water, electric, or fire alarm services without

prior permission of the Contracting Officer. Contractor shall develop an interim fire protection program where interruptions involve in occupied spaces. Request in writing at least one week prior to the planned interruption.

3.2 INSPECTION AND TEST

- A. Preliminary Testing: Flush newly installed systems prior to performing hydrostatic tests in order to remove any debris which may have been left as well as ensuring piping is unobstructed. Hydrostatically test system, including the fire department connections, as specified in NFPA 13, in the presence of the Contracting Officers Technical Representative (COTR) or his designated representative. Test and flush underground water line prior to performing these hydrostatic tests.
- B. Final Inspection and Testing: Subject system to tests in accordance with NFPA 13, and when all necessary corrections have been accomplished, advise COTR/Resident Engineer to schedule a final inspection and test. Connection to the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. Furnish all instruments, labor and materials required for the tests and provide the services of the installation foreman or other competent representative of the installer to perform the tests. Correct deficiencies and retest system as necessary, prior to the final acceptance. Include the operation of all features of the systems under normal operations in test.

3.3 INSTRUCTIONS

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

- - - E N D - - -

SECTION 22 05 11
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section shall apply to all sections of Division 22.
- B. Definitions:
 - 1. Exposed: Piping and equipment exposed to view in finished rooms.
 - 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 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.
- D. Section 31 20 00, EARTH MOVING: Excavation and Backfill.
- E. Section 05 31 00, Building Components for Attachment of Hangers.
- F. Section 05 50 00, METAL FABRICATIONS.
- G. Section 07 84 00, FIRESTOPPING.
- H. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for Wall and Roof Penetrations.
- H. Section 07 92 00, JOINT SEALANTS.
- J. Section 09 91 00, PAINTING.
- K. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- L. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT .

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 Resident Engineer (RE)/Contracting Officers Technical Representative (COTR).
 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 Resident Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
- 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 RE/COTR for resolution. Written hard copies or computer files of manufacturer's installation instructions shall be provided to the RE/COTR 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 will 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 will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.

- E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- F. Upon request by Government, lists of previous installations for selected items of equipment shall be provided. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
- G. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
 - 1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
 - 2. Equipment and materials identification.
 - 3. 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 RE/COTR. 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
- E. 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 will 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

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 may 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, sensitive medical equipment, etc., 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. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.

- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 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, fans, etc. 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 may be designed and installed in accordance with the International Building Code (IBC), latest edition, and SECTION 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Submittals based on the International Building Code (IBC), latest edition, SECTION 13 05 41 requirements, or 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 Resident Engineer 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 Resident Engineer 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 Resident Engineer 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 may 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 Section 05 31 00, STEEL DECKING. For 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. 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.

I. 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.

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.

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.
- C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Resident Engineer.
- D. 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.
- E. 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.
- F. 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.

- G. 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.
- H. 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.
- I. 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 Resident Engineer, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the Resident Engineer.
- 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

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 will not be allowed, except as permitted by RE/COTR 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 RE/COTR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to RE/COTR 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 must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. 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 will 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 may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of 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 may be offered and will 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 RE/COTR 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 will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the Resident Engineer.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work shall be provided.

- D. For horizontal and vertical plumbing pipe supports, refer to the International Plumbing Code (IPC), 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.
 4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

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 RE/COTR 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 RE/COTR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating plant, cleanliness and safety shall be maintained. The plant shall be kept in an operating condition. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Work shall be confined to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Dust and debris shall not be permitted to accumulate in the area to the detriment of plant operation. All flame cutting shall be performed to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. All work shall be performed in accordance with recognized fire protection standards. Inspections will be made by personnel of the VA Medical Center, and the Contractor shall follow all directives of the RE or COTR 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 RE/COTR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.
- E. Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.

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 Resident Engineer.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests 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 RE/COTR 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

Instructions shall be provided in accordance with Article,
INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- - - E N D - - -

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.

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 Valves
 5. 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 Unions
SP-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

C. 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).

D. 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 pumps 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.
- E. 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, TPFPE 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).
- C. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.

- D. 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.

2.5 CHAINWHEELS

- A. Valve chain wheel assembly with sprocket rim brackets and chain shall be constructed according to the following:
 - 1. Brackets: type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to valve stem.

3. Chain: hot dipped galvanized steel of size required to fit sprocket rim.

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.

- - E N D - - -

SECTION 22 07 11
PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

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

this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.

- 12. R: Pump recirculation.
- 13. CW: Cold water.
- 14. SW: Soft water.
- 15. HW: Hot water.
- 16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

1.2 RELATED WORK

- A. Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT: Insulation containing asbestos material.
- B. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- F. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- E. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Criteria:
 - 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:
 - 4.3.3.1** Pipe insulation and coverings, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.
 - 4.3.3.1.1** Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)
 - 4.3.3.3** Pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test

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

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

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

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

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

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

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

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

1.4 SUBMITTALS

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

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.

a. Insulation materials: Specify each type used and state surface burning characteristics.

b. Insulation facings and jackets: Each type used.

c. Insulation accessory materials: Each type used.

- d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
- e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

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

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - L-P-535E (2)-91.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
 - MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation
 - MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation
 - MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
 - MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):
 - A167-04Standard 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
- C534-08Standard Specification for Preformed Flexible
Elastomeric Cellular Thermal Insulation in
Sheet and Tubular Form
- C547-07Standard Specification for Mineral Fiber pipe
Insulation
- C552-07Standard Specification for Cellular Glass
Thermal Insulation
- C553-08Standard 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)
- C612-10Standard Specification for Mineral Fiber Block
and Board Thermal Insulation
- C1126-10.....Standard Specification for Faced or Unfaced
Rigid Cellular Phenolic Thermal Insulation
- C1136-10Standard 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
- E84-10Standard 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):
- 101-09Life Safety Code
- 251-06.....Standard methods of Tests of Fire Endurance of
Building Construction Materials
- 255-06.....Standard Method of tests of Surface Burning
Characteristics of Building Materials

F. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning
Characteristics of Building Materials with
Revision of 08/03

G. Manufacturer's Standardization Society of the Valve and Fitting
Industry (MSS):

SP58-2002.....Pipe Hangers and Supports Materials, Design,
and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (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-5, Density 32 kg/m³ (2 pcf), k = 0.04 (0.27) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F)
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 Mineral wool or refractory fiber

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

2.3 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 kg/m³ (7.5 pcf) nominal, k = 0.033 (0.29) at 240 degrees C (75 degrees F).
- B. Pipe insulation for use at temperatures up to 200 degrees C (400 degrees F) with all service vapor retarder jacket.

2.6 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

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

2.7 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), Kg/m ³ (lb/ ft ³)	232 (14.5)	288 (18)
Thermal conductivity: Min W/ m K (Btu in/h ft ² 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 = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.

- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- F. Factory composite materials may be used provided
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- 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 breeching: 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/m³ (3.0 pcf).

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

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.10 ADHESIVE, MASTIC, CEMENT

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

- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

2.11 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel
- C. Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- D. Bands: 13 mm (1/2 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.12 REINFORCEMENT AND FINISHES

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

2.13 FIRESTOPPING MATERIAL

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

2.14 FLAME AND SMOKE

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

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Where removal of insulation of piping and equipment is required to comply with Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT and Section 02 82 13.13, GLOVEBAG ASBESTOS ABATEMENT, such areas shall be reinsulated to comply with this specification.
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- E. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- F. Construct insulation on parts of equipment such as cold water pumps and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- G. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- H. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight

system. Access doors and other items requiring maintenance or access shall be removable and sealable.

I. Plumbing work not to be insulated:

1. Piping and valves of fire protection system.
2. Chromium plated brass piping.
3. Water piping in contact with earth.
4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
5. Distilled water piping.

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

K. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.

Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

L. Firestop Pipe insulation:

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

M. 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).

N. 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, ventilated (not air conditioned) spaces, etc.)in high humidity areas.

O. 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 may 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 may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
 - 2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
 - 3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.
- C. Rigid Cellular Phenolic Foam:
 - 1. Rigid closed cell phenolic insulation may be provided for piping, ductwork and equipment for temperatures up to 121 degrees C (250 degrees F).
 - 2. Note the NFPA 90A burning characteristics requirements of 25/50 in paragraph 1.3.B

3. Provide secure attachment facilities such as welding pins.
4. Apply insulation with joints tightly drawn together
5. Apply adhesives, coverings, neatly finished at fittings, and valves.
6. Final installation shall be smooth, tight, neatly finished at all edges.
7. Minimum thickness in millimeters (inches) specified in the schedule at the end of this section.
8. Condensation control insulation: Minimum 25 mm (1.0 inch) thick for all pipe sizes.
 - a. Plumbing piping as follows:
 - 1) Body of roof and overflow drains horizontal runs and offsets (including elbows) of interior downspout piping in all areas above pipe basement.
 - 2) Waste piping from electric water coolers and icemakers to drainage system.
 - 3) Waste piping located above basement floor from ice making and film developing equipment and air handling units, from equipment(including trap) to main vertical waste pipe.
 - 4) MRI quench vent piping.
 - 5) Bedpan sanitizer atmospheric vent
 - 6)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 Resident Engineer 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.
- F. Flexible Elastomeric Cellular Thermal Insulation:
- 1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
 - 2. Pipe and tubing insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
 - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
 - 3. 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 COMMISSIONING

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

3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

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

38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	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 (40-60 degrees F)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	25 (1.0)	25 (1.0)	25 (1.0)	25 (1.0)

- - - E N D - - -

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 SUBMITTALS

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

1.4 APPLICABLE PUBLICATIONS

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

B16.22-2012.....Wrought Copper and Copper Alloy Solder Joint
Pressure Fittings

B16.51-2011.....Copper and Copper Alloy Press-Connect Fittings
NSF/ANSI 61-2012.....Drinking Water System Components - Health
Effects

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

A47/A47M-99(2009).....Ferritic Malleable Iron Castings

A53/A53M-12.....Pipe, Steel, Black and Hot-Dipped, Zinc Coated
Welded and Seamless

A183-03(2009).....Carbon Steel Track Bolts and Nuts 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, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.6 SPARE PARTS

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

PART 2 - PRODUCTS

2.1 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.

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.

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 may be used with copper tubing.
- c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split un-plated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Pipe Hangers: Height adjustable clevis type.
 - 4) Adjustable Floor Rests and Base Flanges: Steel.
 - 5) Concrete Inserts: "Universal" or continuous slotted type.
 - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 7) Riser Clamps: Malleable iron or steel.
 - 8) Rollers: Cast iron.
 - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
 - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
 - 12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints.
- 6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- 7. Penetrations:

- a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
 - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00.
- 8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer's installation instructions. Depth of insertion must be marked on the tube prior to inserting the tube into the fitting. Ensure the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.
- B. Piping shall conform to the following:
 - 1. Domestic Water:
 - a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
 - b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

- A. General: Test system either in its entirety or in sections. Submit testing plan to Resident Engineer/COR 14 days prior to test date.
- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psi (1040 kPa) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage

with a shutoff and bleeder valve at the highest point of the piping being tested.

- C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 200 psi (1040 kPa) gage during inspection and prove tight.
- D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.

3.3 STERILIZATION

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

3.4 COMMISSIONING

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

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SECTION 22 13 00
FACILITY SANITARY AND VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

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. 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 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
B75-02.....Standard Specification for Seamless Copper Tube
B306-02.....*Standard Specification for Copper Drainage Tube*
(DWV)
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. interior waste and vent piping above grade.
2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI 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. Copper Tube, (DWV):

1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

C. Polyvinyl Chloride (PVC)

1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 60°C (140°F).
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
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 may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

- A. Type A (FD-A) floor drain shall comply with ANSI A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 2.2 kg (16-ounce) soft copper membrane, 600 mm

(24 inches) square or another approved waterproof membrane shall be provided.

- B. 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.
- C. Type C (FD-C) floor drain shall comply with ANSI A112.6.3. The type C floor drain shall have a cast iron body, double drainage pattern, clamping device, light duty square or round nickel bronze adjustable strainer and grate with vandal proof screws. The grate shall be square, 150 mm (6 inches) minimum.
- D. Type D (FD-D) floor drain shall comply with ANSI A112.6.3. The type D floor drain shall have a Cast iron body with flange, integral reversible clamping device, seepage openings and 175 mm (7 inch) diameter or square satin nickel bronze or satin bronze strainer with 100 mm (4 inch) flange.
- F. Type F (FD-F) floor drain shall comply with ANSI A112.6.3. The type F floor drain shall be have a cast iron body with flange, integral reversible clamping device, seepage openings and a 225 mm (9 inch) two-piece satin nickel-bronze or satin bronze strainer for use with seamless vinyl floors.
- G. Type G (FD-G) floor drain shall comply with ANSI A112.6.3. The type G floor drain shall have a cast iron body, shallow type with double drainage flange and removable, perforated aluminum sediment bucket. The type G drain shall have all interior and exposed exterior surfaces coated with acid resistant porcelain enamel finish. The floor drain shall have a clamping device. The frame and grate shall be nickel bronze. The grate shall be approximately 200 mm (8 inches) in diameter. The space between body of drain and basket shall be sufficient for free flow of waste water.
- H. Type H (FD-H) floor drain shall comply with ANSI A112.6.3. The type H drain shall have a cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar. The grate shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square. The drain body shall be 150 mm (6 inches) deep.

- I. Type I (FD-I) floor drain shall comply with ANSI A112.6.3. The type I floor drain shall have a cast iron body, wide flange for seamless floor, double drainage pattern, with all interior surfaces and exposed exterior surfaces provided with acid resistant enamel finish. The type I floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket with, perforations with not less than 19 300 square mm (30 square inches) of free area. The sediment basket shall be approximately 100 mm (4 inches) deep, and be provided with grips for easy handling. The floor drain shall be provided with a loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.
- M. Type M (FD-M) floor drain shall comply with ANSI A112.6.3 The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension. Minimum dimensions as follows:
1. Area of strainer and collar - 23 000 square mm (36 square inches).
 2. Height of funnel - 95 mm (3-3/4 inches).
 3. Diameter of lower portion of funnel - 50 mm (2 inches).
 4. Diameter of top portion of funnel - 100 mm (4 inches).
 5. Provide paper collars for construction purposes.
- N. Type N (FD-N) floor drain shall comply with ANSI A112.6.3. The type N floor drain shall have a cast iron body, wide flange for seamless floors, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish. The type N floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 9 000 square mm (14 square inches) of free area and approximately 50 mm (2 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate approximately 200 mm (8 inches) shall be round and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.
- P. Type P (FD-P) floor drain shall comply with ANSI A112.6.3. The type P floor drain shall have a cast iron body, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant

enamel finish. The type P floor drain shall have a clamping device, secured nickel bronze rim, an aluminum enameled finish sediment basket perforated with not less than .027 square m (42 square inches) of free area and approximately 100 mm (4 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate shall be approximately .0077 square m (12 inches square) and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

- Q. Type R (FD-R) floor drain shall comply with ANSI A112.6.3. The type R floor drain shall have a cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 200 mm (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces and rim shall have an acid resisting finish.
- R. Type S (FD-S) floor sink shall comply with ANSI A112.6.3. The type S floor sink shall be constructed from type 304 stainless steel and shall be 300 mm (12 inches) square, and 200 mm (8 inches deep). The interior surface shall be polished. The double drainage flange shall be provided with weep holes, internal dome strainer, and heavy duty non-tilting loose set grate. A clamping device shall be provided.
- S. Type T (FD-T) floor drain shall comply with ANSI A112.6.3. The type T drain shall be Funnel Type, chemical resistant floor drain with integral p-trap. Double drainage pattern floor drain shall have an integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly jointing perforated or slotted floor-level grate and funnel extension. Minimum dimensions as follows:
1. Height of funnel - 95 mm (3-3/4 inches).
 2. Diameter of lower portion of funnel - 50 mm (2 inches).
 3. Diameter of top portion of funnel - 100 mm (4 inches).
- T. Type V (FD-V) floor drain shall comply with ANSI A112.6.3. The type V floor drain shall have an oval funnel and cast iron body. Funnel strainer shall consist of a slotted cast iron floor-level grate funnel extension. Minimum dimensions as follows:
1. Area of strainer and collar - 23 000 Square mm (36 square inches).

- 2. Height of funnel - 95 mm (3-7/8 inches).
- 3. Funnel size - 90 by 225 mm (3-1/2 by 9 inches).
- U. Open Sight Drains (OSDs) shall be cast iron, constructed as shown by detail.
- V. Type X (FD-X) floor drain shall comply with ANSI A112.6.3. The type X floor drain shall be a chemical resistant floor drain and integral p-trap. Double drainage pattern floor drain shall have integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly joining a perforated or slotted floor level grate.
- W. 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 may 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.

2.9 WATERPROOFING

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A 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 may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- L. 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. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".

N. 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 or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service

2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.

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 (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 may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. 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 (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 (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 may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce (2 ounces) of peppermint into each line or stack.

- - - E N D - - -

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

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

1.3 SUBMITTALS

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

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
The American Society of Mechanical Engineers (ASME):
A112.6.1M-02 (R2008).....Floor Affixed Supports for Off-the-Floor
Plumbing Fixtures for Public Use
A112.19.1M-08Enameled 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):
A276-2010Stainless and Heat-Resisting Steel Bars and
Shapes
WW-P-541-E/GENPlumbing 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):
61-2009Drinking 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 Resident Engineer.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
- E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.3 ESCUTCHEONS

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

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

2.5 CARRIERS

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, // chair carrier for thin wall construction. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

2.6 WATER CLOSETS

- B. (WC-1/WC-2) Water Closet (Wall Hung, ASME/ANSI A112.19.2M, Figure 9) office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, wall outlet. Top of rim shall be between 406 mm and 432 mm (16 inches and 17 inches) above finished floor. Handicapped water closet shall have rim set 457 mm (18 inches) above finished floor.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
2. Fittings and Accessories: Gaskets - neoprene; bolts with chromium plated caps nuts and washers.
3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation, water saver design 4.8 L (1.28 gallons) per flush with maximum 10 percent variance, 25 mm (1 inch) screwdriver back check angle stop with vandal resistant cap, adjustable tailpiece, a high back pressure vacuum breaker, spud coupling for 38 mm (1 1/2 inches) top spud, wall and spud flanges, and sweat solder adapter with cover tube and set screw wall flange. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass. Seat bumpers shall be integral part of flush valve. Set centerline of inlet 292 mm (11 1/2 inches) above rim.

2.7 URINALS

- A. (UR-1) Urinal (Wheelchair, Wall Hung, ANSI A112.19.2M, Figure 30) bowl with integral flush distribution, wall to front of flare 356 mm (14 inches). Wall hung with integral trap, siphon jet flushing action 2 L (0.5 gallon per flush) with 51 mm (2 inches) back outlet and 19 mm (3/4 inch) top inlet spud.
 1. Support urinal with chair carrier and install with rim 381 mm (15 inches) above finished floor.
 2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, exposed flush valve, battery powered active infrared sensor for automatic operation, 19 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11 1/2 inches) above urinal. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

2.9 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.

- C. (LAV-1) Lavatory (Counter Mounted ASME/ANSI A112.19.2M, Figure 25)
straight back, approximately 508 mm by 457 mm (20 inches by 18 inches)
and a 102 mm (4 inches) maximum apron, first quality vitreous china.
Punching for faucet on 102 mm (4 inches) centers. Set with rim 864 mm
(34 inches) above finished floor.
1. Faucet: Solid cast brass construction, vandal resistant, heavy-duty
battery powered active infra-red sensor for automatic operation,
center set. Control shall be washerless ceramic disc cartridge type.
Provide laminar flow control device, adjustable hot water limit stop,
and vandal proof screws.
 2. Drain: Cast or wrought brass with flat grid strainer offset
tailpiece, chrome plated. Provide cover per A.D.A 4-19.4.
 3. Stops: Angle type, see paragraph 2.2 Stops. Provide cover per A.D.A
4-19.4.
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4
inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17
gauge) tubing extensions to wall. Exposed metal trap surface and
connection hardware shall be chrome plated with a smooth bright
finish. Set trap parallel to wall. Provide cover per A.D.A 4-19.4.
- D. (LAV-2) Lavatory (Elbow Control, ASME/ANSI A112.19.2M, Figure 16)
straight back, approximately 508 mm by 457 mm (20 inches by 18 inches)
and a 102 mm (4 inches) maximum apron, first quality vitreous china.
Punching for faucet on 203 mm (8 inches) centers. Set with rim 864 mm
(34 inches) above finished floor.
1. Faucet: Solid cast brass construction with washerless ceramic disc
mixing cartridge type and centrally exposed rigid gooseneck spout
with outlet 127-152 mm (5-6 inches) above rim. Provide laminar flow
control device. One hundred millimeters (4 inches) elbow handles on
faucets shall be cast, formed or drop forged copper alloy. Faucet,
wall and floor escutcheons shall be either copper alloy or CRS.
Exposed metal parts, including exposed part under valve handle when
in open position, shall have a smooth bright finish.
 2. Drain: Cast or wrought brass with flat grid strainer and offset
tailpiece, chrome plated finish.
 3. Stops: Angle type, See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4
inches) P-trap. Adjustable with connected elbow and 1.4 mm thick (17
gauge) tubing extensions to wall. Exposed metal trap surfaces and
connection hardware shall be chrome plated with a smooth bright
finish. Set trap parallel to wall.

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

2.10 SINKS AND LAUNDRY TUBS

- A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.
- B. (MS-1) 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.
- C. (SK-2) Sink, (CRS, Double Compartment, Counter Top, ASME/ANSI A112.19.3M, Kitchen Sinks, Figure 6) self rimming, approximately 838 mm by 559 mm (33 inches by 22 inches) with two compartments inside dimensions approximately 343 mm by 406 mm by 191 mm (13 1/2 inches by 16 inches by 6 inches), minimum 20 gage CRS. Corners and edges shall be well rounded.
 - 1. Faucet: Kitchen sink, solid brass construction, swing spout, chrome plated copper alloy with spray and hose.
 - 2. Drain: Drain plug with cup strainer, stainless steel.
 - 3. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap with cleanout plug, continuous drain with wall connection and escutcheon.
 - 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- Q. (SK-1) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks, Figure 5) self rimming, back faucet ledge, approximately 533 mm by 559 mm (21 inches by 22 inches) with single compartment inside dimensions approximately 406 mm by 483 mm by 191 mm (16 inches by 19

inches by 6 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:

1. Faucet: Solid brass construction, deck mounted combination faucet with monel or ceramic seats, removable replacement unit containing all parts subject to wear, swivel gooseneck spout with approximately 203 mm (8 inches) reach with spout outlet 152 mm (6 inches) above deck and // 102 mm (4 inches) wrist blades // single lever // with hose spray. Faucet shall be polished chrome plated.
2. Drain: Drain plug with cup strainer, stainless steel.
3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.11 DISPENSER, DRINKING WATER

- A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.
- B. (EDF-2) Electric Water Cooler (Mechanically Cooled, Wall Hung, Self-contained, Wheelchair) bubbler style, 5 ml/s (5 gph) minimum capacity, lead free. Top shall be CRS anti-splash design. Cabinet, CRS, satin finish, approximately 457 mm by 457 mm by 635 mm (18 inches by 18 inches by 25 inches) high with mounting plate. Set bubbler 914 mm (36 inches) above finished floor. Unit shall be push bar operated with front and side bar and automatic stream regulator. All trim polished chrome plated.
- E. (EDF-1) Electric Water Cooler: Mechanically cooled, self contained, wheel chair, bubbler style fully exposed dual height stainless steel fountain, recessed in wall refrigeration system, stainless steel grille, stainless steel support arm, wall mounting box, energy efficient cooling system consisting of a hermetically sealed reciprocating type compressor, 115v, 60 Hz, single phase, fan cooled condenser, permanently lubricated fan motor. Set highest bubbler 1016 mm (40 inches) above finished floor.

2.12 SHOWER BATH FIXTURE

- A. (SH-1) Shower Bath Fixture (Detachable, Wall Mounted, Concealed Supplies, Type T/P Combination Valve):
 1. Shower Installation: Wall mounted detachable spray assembly, 600 mm (36 inch) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.
 2. Shower Head Assembly: Plastic shower head with flow control to limit discharge to 160 ml/s (2.5 gpm), 1524 mm (60 inches) length of rubber

lined CRS, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design showerhead to fit in palm of hand. Provide CRS or chrome plated metal wall bar with an adjustable swivel hanger for showerhead. Fasten wall bar securely to wall for hand support.

3. Valves: Type T/P combination thermostatic and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 40 degrees C (105 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 160 ml/s at 310 kPa (2.5 gpm at 45 psi) pressure drop.

2.14 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

- F. (RVB-1) Recessed Valve Box for refrigerator ice makers: Fabricate of 18-gage steel with highly corrosion resistant epoxy finish. Unit to have 13 mm (1/2 inch) combination MPT brass sweat connection, ball type shut-off valve. Size 229 mm by 375 mm (9 inches by 14 3/4 inches) rough wall opening 203 mm by 330 mm by 92 mm (8 inches by 13 inches by 3 5/8 inches). Centerline of box shall be 25 mm (12 inches) above finished floor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.

- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
- I. Do not use aerators on lavatories and sinks.

3.2 CLEANING

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

- - - E N D - - -

SECTION 23 05 11
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 RELATED WORK

- A. Section 00 72 00, GENERAL CONDITIONS
- B. Section 01 00 00, GENERAL REQUIREMENTS
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES
- D. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC and STEAM GENERATION
- E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT
- F. Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC
- G. Section 23 07 11, HVAC, PLUMBING, and Boiler Plant Insulation
- H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC
- I. Section 23 21 13, HYDRONIC PIPING
- J. Section 23 22 13, STEAM and CONDENSATE HEATING PIPING
- K. Section 23 31 00, HVAC DUCTS and CASINGS
- L. Section 23 34 00, HVAC FANS
- M. Section 23 36 00, AIR TERMINAL UNITS
- N. Section 23 37 00, AIR OUTLETS and INLETS
- O. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS
- P. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training
- Q. 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. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance:
 - 1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
 - 2. After HVAC air balance work is completed and permanent drive sheaves are in place, perform field mechanical balancing and adjustments required to meet the specified vibration tolerance.
- D. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
 - 2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 - 3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the natural gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Resident Engineer.
 - 4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
 - 5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
 - 6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on

- equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.
- E. Equipment Service Organizations:
1. HVAC: Products and systems shall be supported by service organizations that maintain a complete inventory of repair parts and are located within 50 miles to the site.
- F. HVAC Mechanical Systems Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
1. 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.
- G. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Resident Engineer for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Resident Engineer at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.
 2. Provide complete layout drawings required by Paragraph, SUBMITTALS. Do not commence construction work on any system until the layout drawings have been approved.
- H. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with telephone numbers and e-mail addresses.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and with requirements in the individual specification sections.

- B. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- C. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- D. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
- E. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.
- F. Layout Drawings:
 - 1. Submit complete consolidated and coordinated layout drawings for all new systems, and for existing systems that are in the same areas. Refer to Section 00 72 00, GENERAL CONDITIONS, Article, SUBCONTRACTS AND WORK COORDINATION.
 - 2. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed layout drawings of all piping and duct systems.
 - 3. Do not install equipment foundations, equipment or piping until layout drawings have been approved.
 - 4. In addition, for HVAC systems, provide details of the following:
 - a. Mechanical equipment rooms.
 - b. Hangers, inserts, supports, and bracing.
 - c. Pipe sleeves.
 - d. 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 Resident Engineer.
 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 Resident Engineer. 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.

1.7 JOB CONDITIONS - WORK IN EXISTING BUILDING

- A. Building Operation: Government employees will be continuously operating and managing all facilities, including temporary facilities that serve the medical center.
- B. Maintenance of Service: Schedule all work to permit continuous service as required by the medical center.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the Resident Engineer during periods when the demands are not critical to the operation of the medical center. These non-critical periods are limited to between 8 pm and 5 am in the appropriate off-season (if applicable). Provide at least one week advance notice to the Resident Engineer.
- D. Phasing of Work: Comply with all requirements shown on drawings or specified.

- E. Building Working Environment: Maintain the architectural and structural integrity of the building and the working environment at all times. Maintain the interior of building at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. No storm water or ground water leakage permitted. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA.
- F. Acceptance of Work for Government Operation: As new facilities are made available for operation and these facilities are of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

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

2.2 COMPATIBILITY OF RELATED EQUIPMENT

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

2.3 BELT DRIVES

- A. Type: ANSI/RMA standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
- B. Dimensions, rating and selection standards: ANSI/RMA IP-20 and IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended ANSI/RMA service factor (not less than 20 percent) in addition to the ANSI/RMA allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 25 m/s (5000 feet per minute).
- E. Adjustment Provisions: For alignment and ANSI/RMA standard allowances for installation and take-up.
- F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.
- G. Multiple Belts: Matched to ANSI/RMA specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
- H. Sheaves and Pulleys:
 - 1. Material: Pressed steel, or close grained cast iron.
 - 2. Bore: Fixed or bushing type for securing to shaft with keys.
 - 3. Balanced: Statically and dynamically.
 - 4. Groove spacing for driving and driven pulleys shall be the same.
- I. Drive Types, Based on ARI 435:
 - 1. Provide adjustable-pitch drive as follows:
 - a. Fan speeds up to 1800 RPM: 7.5 kW (10 horsepower) and smaller.
 - b. Fan speeds over 1800 RPM: 2.2 kW (3 horsepower) and smaller.
 - 2. Provide fixed-pitch drives for drives larger than those listed above.
 - 3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.

2.4 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where

motors and drives are inside factory fabricated air handling unit casings.

- B. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, non-resonant. Guard shall be an assembly of minimum 22-gage sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (one-inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.
- C. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- D. Access for Speed Measurement: 25 mm (One inch) diameter hole at each shaft center.

2.5 LIFTING ATTACHMENTS

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

2.6 ELECTRIC MOTORS

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

2.7 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for specifications.
- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
- C. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.

- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the AC power system.
- E. Controller shall be provided with the following operating features and accessories:
 - 1. Suitable for variable torque load.
 - 2. Provide thermal magnetic circuit breaker or fused switch with external operator and incoming line fuses. Unit shall be rated for minimum 30,000 AIC. Provide AC input line reactors (3% impedance) on incoming power line.

2.8 EQUIPMENT AND MATERIALS IDENTIFICATION

- A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 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.

2.9 FIRESTOPPING

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

2.10 GALVANIZED REPAIR COMPOUND

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

2.11 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Supports for Roof Mounted Items:
 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 mm by 100 mm (2 by 4) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 280 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
 2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- C. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-69. Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.
- D. Attachment to Concrete Building Construction:
 1. Concrete insert: MSS SP-58, Type 18.
 2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Resident Engineer 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 Resident Engineer for each job condition.
- E. Attachment to Steel Building Construction:
 1. Welded attachment: MSS SP-58, Type 22.

2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23mm (7/8-inch) outside diameter.
- F. Attachment to existing structure: Support from existing floor/roof frame.
- G. Attachment to Wood Construction: Wood screws or lag bolts.
- H. 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.
- I. 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.
- J. 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.
3. High and Medium Pressure Steam (MSS SP-58):
- a. Provide eye rod or Type 17 eye nut near the upper attachment.
 - b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.
 - c. Piping with Vertical Expansion and Contraction:
 - 1) Movement up to 20 mm (3/4-inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4-inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.
 4. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.
- K. 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 must carry, and the type of support it will be used with.
 - a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 1 inch past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
 - b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS-SP 69. To

support the load, the shields may 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 may be used on steel clevis hanger type supports, roller supports or flat surfaces.

L. Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.

2.12 PIPE PENETRATIONS

A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.

B. To prevent accidental liquid spills from passing to a lower level, provide the following:

1. For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.

2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.

3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.

C. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Resident Engineer.

D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.

E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.

F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.

G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.

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

2.13 DUCT PENETRATIONS

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

2.14 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the Resident Engineer, 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 Resident Engineer.
- E. Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.15 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

- B. Thickness: Not less than 2.4 mm (3/32-inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3-inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

2.16 ASBESTOS

Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Submit the drawings for review as required by Part 1. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Cutting Holes:
 - 1. Cut holes through concrete and masonry by rotary core drill.
Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Resident Engineer 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 Resident Engineer. If the Contractor

- considers it necessary to drill through structural members, this matter shall be referred to Resident Engineer for approval.
3. Do not penetrate membrane waterproofing.
- F. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- I. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Resident Engineer. Damaged or defective items in the opinion of the Resident Engineer, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- J. Concrete and Grout: Use concrete and shrink compensating grout 25 MPa (3000 psi) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- K. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- L. Install steam piping expansion joints as per manufacturer's recommendations.
- M. Work in Existing Building:
1. Perform as specified in Article, OPERATIONS AND STORAGE AREAS, Article, ALTERATIONS, and Article, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).

2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, Article, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
3. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Resident Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Resident Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Resident Engineer's approval, carefully cut opening through construction no larger than absolutely necessary for the required installation.
- O. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 ft.) above the equipment of to ceiling structure, whichever is lower (NFPA 70).
- P. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost to the Government.
 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury

can occur to personnel by contact with operating facilities. The requirements of Paragraph 3.1 apply.

- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.3 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Rigging plan and methods shall be referred to Resident Engineer for evaluation prior to actual work.
- G. Restore building to original condition upon completion of rigging work.

3.4 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Resident Engineer.
- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a

minimum of 15 mm (1/2-inch) clearance between pipe or piping covering and adjacent work.

- D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-69. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. HVAC Vertical Pipe Supports:
 - 1. Up to 150 mm (6-inch pipe), 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
 - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:
 - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
 - 2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
 - 3. Tubing and capillary systems shall be supported in channel troughs.
- G. Floor Supports:
 - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
 - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
 - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
 - 4. For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

3.5 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the drawings, shall be provided by the Contractor after approval for structural integrity by the Resident Engineer. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Do not permit debris to accumulate in the area to the detriment of plant operation. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VA Medical Center, and Contractor shall follow all directives of the RE or COTR with regard to rigging, safety, fire safety, and maintenance of operations.
- C. Completely remove all piping, wiring, conduit, and other devices associated with the equipment not to be re-used in the new work. This includes all pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. Seal all openings, after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
- D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain Government property and shall be removed and delivered to Resident Engineer 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.

3.6 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 Resident Engineer in unopened containers that are properly identified as to application.
- C. Provide a separate grease gun with attachments for applicable fittings for each type of grease applied.
- D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

3.10 COMMISSIONING

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

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

3.11 STARTUP AND TEMPORARY OPERATION

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

3.12 OPERATING AND PERFORMANCE TESTS

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

3.13 INSTRUCTIONS TO VA PERSONNEL

Provide in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS, and Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.

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SECTION 23 05 12
GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION:

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

1.2 RELATED WORK:

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements common to more than one Section of Division 26.
- B. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Starters, control and protection for motors.
- C. Section 26 24 19, MOTOR-CONTROL CENTERS: Multiple motor control assemblies, which include motor starters.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- E. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT and STEAM GENERATION.
- F. Section 23 34 00, HVAC FANS.
- G. Section 23 36 00, AIR TERMINAL UNITS.
- H. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- I. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

1.3 SUBMITTALS:

- A. In accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS, submit the following:
- B. Shop Drawings:
 - 1. Provide documentation to demonstrate compliance with drawings and specifications.
 - 2. Include electrical ratings, efficiency, bearing data, power factor, frame size, dimensions, mounting details, materials, horsepower, voltage, phase, speed (RPM), enclosure, starting characteristics, torque characteristics, code letter, full load and locked rotor current, service factor, and lubrication method.
- C. Manuals:
 - 1. Submit simultaneously with the shop drawings, companion copies of complete installation, maintenance and operating manuals, including technical data sheets and application data.
- D. Certification: Two weeks prior to final inspection, unless otherwise noted, submit four copies of the following certification to the Resident Engineer:

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

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

1.4 APPLICABLE PUBLICATIONS:

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

B. National Electrical Manufacturers Association (NEMA):

MG 1-2006 Rev. 1 2009 ..Motors and Generators

MG 2-2001 Rev. 1 2007...Safety Standard for Construction and Guide for
Selection, Installation and Use of Electric
Motors and Generators

C. National Fire Protection Association (NFPA):

70-2008.....National Electrical Code (NEC)

D. Institute of Electrical and Electronics Engineers (IEEE):

112-04.....Standard Test Procedure for Polyphase Induction
Motors and Generators

E. American Society of Heating, Refrigerating and Air-Conditioning
Engineers (ASHRAE):

90.1-2007.....Energy Standard for Buildings Except Low-Rise
Residential Buildings

PART 2 - PRODUCTS

2.1 MOTORS:

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

B. All material and equipment furnished and installation methods shall conform to the requirements of Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS; and Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide premium efficiency type motors as scheduled. Unless otherwise specified for a particular application, use electric motors with the following requirements.

- C. Single-phase Motors: Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC) type. Provide capacitor-start type for hard starting applications.
 - 1. Contractor's Option - Electrically Commutated motor (EC Type): Motor shall be brushless DC type specifically designed for applications with heavy duty ball bearings and electronic commutation. The motor shall be speed controllable down to 20% of full speed and 85% efficient at all speeds.
- D. Poly-phase Motors: NEMA Design B, Squirrel cage, induction type.
 - 1. Two Speed Motors: Each two-speed motor shall have two separate windings. Provide a time- delay (20 seconds minimum) relay for switching from high to low speed.
- E. Voltage ratings shall be as follows:
 - 1. Single phase:
 - a. Motors connected to 120-volt systems: 115 volts.
 - b. Motors connected to 208-volt systems: 200 volts.
 - c. Motors connected to 240 volt or 480 volt systems: 230/460 volts, dual connection.
 - 2. Three phase:
 - a. Motors connected to 208-volt systems: 200 volts.
 - b. Motors, less than 74.6 kW (100 HP), connected to 240 volt or 480 volt systems: 208-230/460 volts, dual connection.
 - c. Motors, 74.6 kW (100 HP) or larger, connected to 240-volt systems: 230 volts.
 - d. Motors, 74.6 kW (100 HP) or larger, connected to 480-volt systems: 460 volts.
 - e. Motors connected to high voltage systems (Over 600V): Shall conform to NEMA Standards for connection to the nominal system voltage shown on the drawings.
- F. Number of phases shall be as follows:
 - 1. Motors, less than 373 W (1/2 HP): Single phase.
 - 2. Motors, 373 W (1/2 HP) and larger: 3 phase.
 - 3. Exceptions:
 - a. Hermetically sealed motors.
 - b. Motors for equipment assemblies, less than 746 W (one HP), may be single phase provided the manufacturer of the proposed assemblies cannot supply the assemblies with three phase motors.
- G. Motors shall be designed for operating the connected loads continuously in a 40°C (104°F) environment, where the motors are installed, without exceeding the NEMA standard temperature rises for the motor insulation.

If the motors exceed 40°C (104°F), the motors shall be rated for the actual ambient temperatures.

H. Motor designs, as indicated by the NEMA code letters, shall be coordinated with the connected loads to assure adequate starting and running torque.

I. Motor Enclosures:

1. Shall be the NEMA types as specified and/or shown on the drawings.

2. Where the types of motor enclosures are not shown on the drawings, they shall be the NEMA types, which are most suitable for the environmental conditions where the motors are being installed.

Enclosure requirements for certain conditions are as follows:

a. Motors located outdoors, indoors in wet or high humidity locations, or in unfiltered airstreams shall be totally enclosed type.

b. Where motors are located in an NEC 511 classified area, provide TEFC explosion proof motor enclosures.

c. Where motors are located in a corrosive environment, provide TEFC enclosures with corrosion resistant finish.

3. Enclosures shall be primed and finish coated at the factory with manufacturer's prime coat and standard finish.

J. Special Requirements:

1. Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Government.

2. Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.

3. Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:

a. Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.

b. Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.

c. Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.

4. Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on

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

Minimum Premium Efficiencies Open Drip-Proof				Minimum Premium Efficiencies Totally Enclosed Fan-Cooled			
Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM	Rating kW (HP)	1200 RPM	1800 RPM	3600 RPM
0.746 (1)	82.5%	85.5%	77.0%	0.746 (1)	82.5%	85.5%	77.0%
1.12 (1.5)	86.5%	86.5%	84.0%	1.12 (1.5)	87.5%	86.5%	84.0%
1.49 (2)	87.5%	86.5%	85.5%	1.49 (2)	88.5%	86.5%	85.5%
2.24 (3)	88.5%	89.5%	85.5%	2.24 (3)	89.5%	89.5%	86.5%
3.73 (5)	89.5%	89.5%	86.5%	3.73 (5)	89.5%	89.5%	88.5%
5.60 (7.5)	90.2%	91.0%	88.5%	5.60 (7.5)	91.0%	91.7%	89.5%
7.46 (10)	91.7%	91.7%	89.5%	7.46 (10)	91.0%	91.7%	90.2%
11.2 (15)	91.7%	93.0%	90.2%	11.2 (15)	91.7%	92.4%	91.0%
14.9 (20)	92.4%	93.0%	91.0%	14.9 (20)	91.7%	93.0%	91.0%
18.7 (25)	93.0%	93.6%	91.7%	18.7 (25)	93.0%	93.6%	91.7%
22.4 (30)	93.6%	94.1%	91.7%	22.4 (30)	93.0%	93.6%	91.7%
29.8 (40)	94.1%	94.1%	92.4%	29.8 (40)	94.1%	94.1%	92.4%
37.3 (50)	94.1%	94.5%	93.0%	37.3 (50)	94.1%	94.5%	93.0%
44.8 (60)	94.5%	95.0%	93.6%	44.8 (60)	94.5%	95.0%	93.6%
56.9 (75)	94.5%	95.0%	93.6%	56.9 (75)	94.5%	95.4%	93.6%
74.6 (100)	95.0%	95.4%	93.6%	74.6 (100)	95.0%	95.4%	94.1%
93.3 (125)	95.0%	95.4%	94.1%	93.3 (125)	95.0%	95.4%	95.0%

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

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

PART 3 - EXECUTION

3.1 INSTALLATION:

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

3.2 FIELD TESTS

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

3.3 STARTUP AND TESTING

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with Resident Engineer and Commissioning Agent. 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.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS.

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

PART 1 - GENERAL

1.1 DESCRIPTION

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 22 13, STEAM and CONDENSATE HEATING PIPING: Requirements for flexible pipe connectors to reciprocating and rotating mechanical equipment.
- C. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS: Requirements for optional Air Handling Unit internal vibration isolation.
- D. Section 23 31 00, HVAC DUCTS and CASINGS: requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining.
- E. SECTION 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC: requirements for sound and vibration tests.
- F. SECTION 23 37 00, AIR OUTLETS and INLETS: noise requirements for G-grilles.
- G. SECTION 23 34 00, HVAC FANS: sound and vibration isolation requirements for fans.
- H. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE in specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC 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
Bathrooms and Toilet Rooms	40
Conference Rooms	35
Corridors (Nurse Stations)	40
Corridors(Public)	40

Examination Rooms	35
Kitchens	50
Lobbies, Waiting Areas	40
Locker Rooms	45
Offices, Large Open	40
Offices, Small Private	35

2. For equipment which has no sound power ratings scheduled on the plans, the contractor shall select equipment such that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure shall be in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
3. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as, furniture. This allowance may not be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
4. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
5. 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 50 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.
6. Piping: Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

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

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):

2009Fundamentals 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 7-10Minimum 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. Spring Isolators with Vertical Limit Stops (Type SP): Similar to spring isolators noted above, except include a vertical limit stop to limit upward travel if weight is removed and also to reduce movement and spring extension due to wind loads. Provide clearance around restraining bolts to prevent mechanical short circuiting. // Isolators shall have a minimum seismic rating of one G. //
4. 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.
 6. Hangers used in seismic applications shall be provided with a neoprene and steel rebound washer installed $\frac{1}{4}$ ' clear of bottom of hanger housing in operation to prevent spring from excessive upward travel
- C. Thrust Restraints (Type THR): Restraints shall provide a spring element contained in a steel frame with neoprene pads at each end attachment. Restraints shall have factory preset thrust and be field adjustable to allow a maximum movement of 6 mm (1/4 inch) when the fan starts and stops. Restraint assemblies shall include rods, angle brackets and other hardware for field installation.

2.4 BASES

- A. Rails (Type R): Design rails with isolator brackets to reduce mounting height of equipment and cradle machines having legs or bases that do not require a complete supplementary base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension but not less than 100 mm (4 inches). Where rails are used with neoprene mounts for small fans or close coupled pumps, extend rails to compensate overhang of housing.
- B. Integral Structural Steel Base (Type B): Design base with isolator brackets to reduce mounting height of equipment which require a complete supplementary rigid base. To assure adequate stiffness, height of members shall be a minimum of 1/12 of longest base dimension, but not less than 100 mm (four inches).
- C. Inertia Base (Type I): Base shall be a reinforced concrete inertia base. Pour concrete into a welded steel channel frame, incorporating prelocated equipment anchor bolts and pipe sleeves. Level the concrete to provide a smooth uniform bearing surface for equipment mounting. Provide grout under uneven supports. Channel depth shall be a minimum of 1/12 of longest dimension of base but not less than 150 mm (six inches). Form shall include 13-mm (1/2-inch) reinforcing bars welded in

place on minimum of 203 mm (eight inch) centers running both ways in a layer 40 mm (1-1/2 inches) above bottom. Use height saving brackets in all mounting locations. Weight of inertia base shall be equal to or greater than weight of equipment supported to provide a maximum peak-to-peak displacement of 2 mm (1/16 inch).

- D. Curb Mounted Isolation Base (Type CB): Fabricate from aluminum to fit on top of standard curb with overlap to allow water run-off and have wind and water seals which shall not interfere with spring action. Provide resilient snubbers with 6 mm (1/4 inch) clearance for wind resistance. Top and bottom bearing surfaces shall have sponge type weather seals. Integral spring isolators shall comply with Spring Isolator (Type S) requirements.

2.5 SOUND ATTENUATING UNITS

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

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
CENTRIFUGAL FANS															
AIR HANDLING UNIT PACKAGES															
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

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. Hydronic Systems: Includes heating hot water.
6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flowrate from values (design) in the contract documents.

1.2 RELATED WORK

- A. Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION: General Mechanical Requirements.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General Mechanical Requirements.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise and Vibration Requirements.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Piping and Equipment Insulation.

- E. Section 23 36 00, AIR TERMINAL UNITS: Terminal Units Performance.
- F. Section 23 31 00, HVAC DUCTS AND CASINGS: Duct Leakage.
- G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Controls and Instrumentation Settings.
- H. Section 23 82 16, AIR COILS
- I. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS
- J. Section 23 34 00, HVAC FANS
- K. Section 23 37 00, AIR OUTLETS AND INLETS
- L. Section 23 21 13, HYDRONIC PIPING
- M. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS. Requirements for commissioning, systems readiness checklists, and training
- N. Section 23 05 12 GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT

1.3 QUALITY ASSURANCE

- A. Refer to Articles, Quality Assurance and Submittals, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC, Section 23 05 10, COMMON WORK RESULTS FOR BOILER PLANTS and STEAM GENERATION, and Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Qualifications:
 - 1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
 - 2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer 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 Resident Engineer 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 Resident Engineer. 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. Minimum outside air: 0 percent to plus 10 percent.
 - d. 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.
 - e. 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 Resident Engineer for one air distribution system (including all fans, three terminal units, three rooms randomly selected by the Resident Engineer) 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 Resident Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
 - 1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.
 - 2. Systems inspection report on equipment and installation for conformance with design.
 - 3. Duct Air Leakage Test Report.
 - 4. Systems Readiness Report.
 - 5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
 - 6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- E. Prior to request for Final or Partial Final inspection, submit completed Test and Balance report for the area.

1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
 - 2007HVAC 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):
 - 7th Edition 2005Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
 - 2nd Edition 2006Procedural Standards for the Measurement of Sound and Vibration
 - 3rd Edition 2009Procedural Standards for Whole Building Systems Commissioning of New Construction

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

3rd Edition 2002HVAC SYSTEMS Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 PLUGS

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

2.2 INSULATION REPAIR MATERIAL

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

PART 3 - EXECUTION

3.1 GENERAL

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

3.2 DESIGN REVIEW REPORT

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

3.3 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

TAB Agency shall perform the leakage test as outlined in "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC DUCTS and CASINGS for TAB

agency's role and responsibilities in witnessing, recording and reporting of deficiencies.

3.5 SYSTEM READINESS REPORT

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

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 Resident Engineer 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 Resident Engineer.

3.7 TAB PROCEDURES

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- C. Coordinate TAB procedures with existing systems and any phased construction completion requirements for the project. Provide TAB reports for pre construction air and water flow rate and for each phase of the project prior to partial final inspections of each phase of the

project. Return existing areas outside the work area to pre constructed conditions.

- D. Allow time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- E. Air Balance and Equipment Test: Include air handling units, fans, terminal units, room diffusers/outlets/inlets.
 - 1. 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.
 - 2. Variable air volume (VAV) systems:
 - a. Coordinate TAB, including system volumetric controls, with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
 - b. Section 23 36 00, AIR TERMINAL UNITS, specifies that maximum and minimum flow rates for air terminal units (ATU) be factory set. Check and readjust ATU flow rates if necessary. Balance air distribution from ATU on full cooling maximum scheduled cubic meters per minute (cubic feet per minute). Reset room thermostats and check ATU operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when the ATU is in the maximum heating mode. Record and report outdoor air flow rates under all operating conditions (The test shall demonstrate that the minimum outdoor air ventilation rate shall remain constant under all operating conditions).
 - c. Adjust operating pressure control setpoint to maintain the design flow to each space with the lowest setpoint.
 - 3. Record final measurements for air handling equipment performance data sheets.
- F. Water Balance and Equipment Test: Include circulating pumps, convertors, coils, coolers and condensers:
 - 1. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values on contract drawings.
 - 2. Primary-secondary (variable volume) systems: Coordinate TAB with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Balance systems at design water flow and then verify that variable flow controls function as designed.

3. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for convertors. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

3.8 VIBRATION TESTING

- A. Furnish instruments and perform vibration measurements as specified in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT. Field vibration balancing is specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC. Provide measurements for all rotating HVAC equipment of 373 watts (1/2 horsepower) and larger, including 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 Resident Engineer. 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 Resident Engineer.

3.9 SOUND TESTING

- A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 23 05 41, NOISE and VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
 1. Take readings in rooms, approximately fifteen (15) percent of all rooms. The Resident Engineer may designate the specific rooms to be tested.
- 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.
 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 Resident Engineer 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 Resident Engineer based on the recorded sound data.

3.10 MARKING OF SETTINGS

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

3.11 IDENTIFICATION OF TEST PORTS

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

3.12 PHASING

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

- - E N D - - -

SECTION 23 07 11
HVAC AND BOILER PLANT INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

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

12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
13. HPS: High pressure steam (415 kPa [60 psig] and above).
14. HPR: High pressure steam condensate return.
15. MPS: Medium pressure steam (110 kPa [16 psig] thru 414 kPa [59 psig]).
16. MPR: Medium pressure steam condensate return.
17. LPS: Low pressure steam (103 kPa [15 psig] and below).
18. LPR: Low pressure steam condensate gravity return.
19. PC: Pumped condensate.
20. CH: Chilled water supply.
21. CHR: Chilled water return.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- 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
- D. Section 23 21 13, HYDRONIC PIPING and Section 23 22 13, STEAM and CONDENSATE HEATING PIPING: Piping and equipment.
- E. Section 23 21 13, HYDRONIC PIPING: Hot water, chilled water, and glycol piping.
- F. Section 23 31 00, HVAC DUCTS AND CASINGS: Ductwork, plenum and fittings.
- G. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS. Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Criteria:

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

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2., shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

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

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

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

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

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

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

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

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

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

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

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

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

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

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

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

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

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

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

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

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

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

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

1.5 STORAGE AND HANDLING OF MATERIAL

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

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Federal Specifications (Fed. Spec.):
- L-P-535E (2)- 99.....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. Military Specifications (Mil. Spec.):
- MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation
- MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic Thermal Insulation
- MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and Water-Resistant, Vapor-Barrier
- MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread, Glass and Wire-Reinforced Glass
- D. American Society for Testing and Materials (ASTM):
- A167-99(2004).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- C411-05.....Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation
- C449-07.....Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
- C533-09.....Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
- C534-08.....Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- C547-07.....Standard Specification for Mineral Fiber pipe Insulation
- C552-07.....Standard Specification for Cellular Glass Thermal Insulation

- C553-08.....Standard Specification for Mineral Fiber
Blanket Thermal Insulation for Commercial and
Industrial Applications
- C585-09.....Standard Practice for Inner and Outer Diameters
of Rigid Thermal Insulation for Nominal Sizes
of Pipe and Tubing (NPS System) R (1998)
- C612-10.....Standard Specification for Mineral Fiber Block
and Board Thermal Insulation
- C1126-04.....Standard Specification for Faced or Unfaced
Rigid Cellular Phenolic Thermal Insulation
- C1136-10.....Standard Specification for Flexible, Low
Permeance Vapor Retarders for Thermal
Insulation
- D1668-97a (2006).....Standard Specification for Glass Fabrics (Woven
and Treated) for Roofing and Waterproofing
- E84-10.....Standard Test Method for Surface Burning
Characteristics of Building
Materials
- E119-09c.....Standard Test Method for Fire Tests of Building
Construction and Materials
- E136-09b.....Standard Test Methods for Behavior of Materials
in a Vertical Tube Furnace at 750 degrees C
(1380 F)
- E. National Fire Protection Association (NFPA):
- 90A-09.....Standard for the Installation of Air
Conditioning and Ventilating Systems
- 96-08.....Standards for Ventilation Control and Fire
Protection of Commercial Cooking Operations
- 101-09.....Life Safety Code
- 251-06.....Standard methods of Tests of Fire Endurance of
Building Construction Materials
- 255-06.....Standard Method of tests of Surface Burning
Characteristics of Building Materials
- F. Underwriters Laboratories, Inc (UL):
- 723.....UL Standard for Safety Test for Surface Burning
Characteristics of Building Materials with
Revision of 09/08

- G. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):
SP58-2009.....Pipe Hangers and Supports Materials, Design,
and Manufacture

PART 2 - PRODUCTS

2.1 MINERAL FIBER OR FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 48 kg/m³ (3 pcf), k = 0.037 (0.26) at 24 degrees C (75 degrees F), external insulation for temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- B. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 16 kg/m³ (1 pcf), k = 0.045 (0.31) at 24 degrees C (75 degrees F), for use at temperatures up to 204 degrees C (400 degrees F) with foil scrim (FSK) facing.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1, k = 0.037 (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

2.2 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

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

2.3 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance = 0.02 or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch) lap on longitudinal joints and minimum 75 mm (3 inch) butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt

strips shall be self-sealing type with factory-applied pressure sensitive adhesive.

- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas conveying fluids below ambient temperature. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 35 cm-kg (30 inch-pounds) for interior locations and 92 cm-kg (80 inch-pounds) for exterior or exposed locations or where the insulation is subject to damage.
- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 2000 kPa (300 psig) bursting strength with integral vapor retarder where required or specified. Weather proof if utilized for outside service.
- F. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.
- H. Aluminum Jacket-Piping systems: ASTM B209, 3003 alloy, H-14 temper, 0.6 mm (0.023 inch) minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.6 mm (0.024) inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 13 mm (0.5 inch) wide on 450 mm (18 inch) centers. System shall be weatherproof if utilized for outside service.

2.4 REMOVABLE INSULATION JACKETS

- A. Insulation and Jacket:

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

2.5 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/m³ (3.0 pcf).

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

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.6 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.

2.7 MECHANICAL FASTENERS

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

B. Staples: Outward clinching galvanized steel.

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

D. Bands: 13 mm (0.5 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.8 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.

2.9 FIRESTOPPING MATERIAL

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

2.10 FLAME AND SMOKE

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

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- 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 chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted 1 mm thick (20 gage) galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- 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. HVAC work not to be insulated:

1. Internally insulated ductwork and air handling units.
 2. Relief air ducts (Economizer cycle exhaust air).
 3. Exhaust air ducts and plenums, and ventilation exhaust air shafts.
 4. In hot piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
- 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. The elbow/ fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Firestop Pipe and Duct insulation:
1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
 2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe or duct chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions
- L. Freeze protection of above grade outdoor piping (over heat tracing tape): 26 mm (10 inch) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes. Provide metal jackets for all pipes. Provide for cold water make-up to cooling towers and condenser water piping and chilled water piping as described in Section 23 21 13, HYDRONIC PIPING (electrical heat tracing systems).
- M. Provide vapor barrier jackets over insulation as follows:
1. All piping and ductwork exposed to outdoor weather.
- N. Provide metal jackets over insulation as follows:
1. All piping and ducts exposed to outdoor weather.

2. Piping exposed in building, within 1800 mm (6 feet) of the floor, that connects to sterilizers, kitchen and laundry equipment. Jackets may be applied with pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling or floor penetrations.
3. A 50 mm (2 inch) overlap is required at longitudinal and circumferential joints.

3.2 INSULATION INSTALLATION

A. Mineral Fiber Board:

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

- c. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a maximum water vapor permeability of 0.001 perms.

B. Flexible Mineral Fiber Blanket:

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

6. Exhaust air branch duct from autopsy refrigerator to main duct: 40 mm (1-1/2 inch) thick insulation faced with FSK.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
 - a. Insulating and finishing cement for sizes less than 100 mm (4 inches) operating at surface temperature of 16 degrees C (61 degrees F) or more.
 - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 16 degrees C (60 degrees F) or less, vapor seal with a layer of glass fitting tape imbedded between two 2 mm (1/16 inch) coats of vapor barrier mastic.
 - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

D. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:

- a. Use proper size material. Do not stretch or strain insulation.
- b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
5. Minimum 20 mm (0.75 inch) thick insulation for pneumatic control lines for a minimum distance of 6 m (20 feet) from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 20 mm (3/4 inch) thick for the following:
 - a. Chilled water pumps
 - b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
 - c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
 - d. Piping inside refrigerators and freezers: Provide heat tape under insulation.
7. Exposed, unlined supply and return ductwork exposed to outdoor weather: 50 mm (2 inch) thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.

3.3 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature	Insulation Material	Less than	25 - 32 (1 - 1¼)	38 - 75	100 (4) and Above

Range/Service		25 (1)		(1½ - 3)	
122-177 degrees C (251-350 degrees F) (HPS, MPS)	Mineral Fiber (Above ground piping only)	75 (3)	100 (4)	113 (4.5)	113 (4.5)
93-260 degrees C (200-500 degrees F) (HPS, HPR)	Calcium Silicate	100 (4)	125 (5)	150 (6)	150 (6)
100-121 degrees C (212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Mineral Fiber (Above ground piping only)	62 (2.5)	62 (2.5)	75 (3.0)	75 (3.0)
100-121 degrees C (212-250 degrees F) (HPR, MPR, LPS, vent piping from PRV Safety Valves, Condensate receivers and flash tanks)	Rigid Cellular Phenolic Foam	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Mineral Fiber (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
38-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
39-99 degrees C (100-211 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Polyiso- cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	----	----
38-94 degrees C (100-200 degrees F) (LPR, PC, HWH, HWHR, GH and GHR)	Flexible Elastomeric Cellular Thermal (Above ground piping)	38 (1.5)	38 (1.5)	----	----

	only)				
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Rigid Cellular Phenolic Foam	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH and CHR within chiller room and pipe chase and underground)	Cellular Glass Closed- Cell	50 (2.0)	50 (2.0)	75 (3.0)	75 (3.0)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Cellular Glass Closed- Cell	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC and GCR (where underground)	Polyiso- cyanurate Closed-Cell Rigid	38 (1.5)	38 (1.5)	50 (2.0)	50 (2.0)
4-16 degrees C (40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Polyiso- cyanurate Closed-Cell Rigid (Exterior Locations only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)
(40-60 degrees F) (CH, CHR, GC, GCR and RS for DX refrigeration)	Flexible Elastomeric Cellular Thermal (Above ground piping only)	38 (1.5)	38 (1.5)	38 (1.5)	38 (1.5)

- - - E N D - - -

SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide (a) direct-digital control system(s) as indicated on the project documents, point list, interoperability tables, drawings and as described in these specifications.
1. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, Project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, Warranty, specified services and items required for complete and fully functional Controls Systems.
 2. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The contractor administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to operate independently. Failure of the ECC shall have no effect on the field controllers, including those involved with global strategies.
- 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 not provided by, but are nevertheless integrated with the work executed by, the contractor administered by this Section of

the technical specifications. The contractor administered by this Section of the technical specifications shall formally coordinate in writing and receive from other contractors formal acknowledgements in writing prior to submission the particulars of the products. These products include the following:

1. Fire alarm systems. If zoned fire alarm is required by the project-specific requirements, this interface shall require multiple relays, which are provided and installed by the fire alarm system contractor, to be monitored.
2. Terminal units' velocity sensors
3. Variable frequency drives. These controls, if not native BACnet, will require a BACnet Gateway.

D. Responsibility Table:

Work/Item/System	Furnish	Install	Low Voltage Wiring	Line Power
Terminal units	23	23	N/A	26
Controllers for terminal units	23 09 23	23	23 09 23	26
Automatic dampers (not furnished with equipment)	23 09 23	23	N/A	N/A
Automatic damper actuators	23 09 23	23 09 23	23 09 23	23 09 23
Manual valves	23	23	N/A	N/A
Automatic valves	23 09 23	23	23 09 23	23 09 23
Pipe insertion devices and taps, flow and pressure stations.	23	23	N/A	N/A
Thermowells	23 09 23	23	N/A	N/A
Smoke detectors	28 31 00	28 31 00	28 31 00	28 31 00
VFDs	23 09 23	26	23 09 23	26
Fan Coil Unit controls (not furnished with equipment)	23 09 23	23 09 23	23 09 23	26

- E. This facility's existing direct-digital control system is manufactured by Johnson Controls. 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.

1. Provide a new BACnet ECC, communications network, and controllers.

Provide a programmable internetworking gateway allowing for real-time communication between the existing direct-digital control system and the new BACnet control system. Real-time communication shall provide all object properties and read/write services shown on VA-approved interoperability schedules. The contractor administered by this Section of the technical specifications shall provide all necessary investigation and site-specific programming to execute the interoperability schedules.

- a. The combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified.

2. Upgrade the existing direct-digital control system's ECC to include all properties and services required by an ASHRAE Standard 135 BACnet B-AWS Profile. The upgraded ECC shall continue to communicate with the existing direct-digital control system's devices. The upgraded ECC shall communicate directly with the new native-BACnet devices over the existing control system's communications network without the use of a gateway. Provide programming converting the existing non-BACnet devices, objects and services to ASHRAE Standard 135 BACnet-complaint BIBBs. The contractor administered by this Section of the technical specifications shall provide all necessary investigation and site-specific programming to execute the interoperability schedules.

- a. The performance requirement for the combined system: the combined system shall operate and function as one complete system including one database of control point objects and global control logic capabilities. Facility operators shall have complete operations and control capability over all systems, new and existing including; monitoring, trending, graphing, scheduling, alarm management, global point sharing, global strategy deployment, graphical operations interface and custom reporting as specified.

3. Leave existing direct-digital control system intact and in place.

Provide a new ASHRAE Standard 135 BACnet-compliant ECC in the same room as the existing system's ECC, and provide a new standalone BACnet-compliant control system serving the work in this project. No interoperability is required.

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

1. The General Contractor of this project shall directly hire the Control System Integrator in a contract separate from the contract procuring the controls contractor administered by this Section of the technical specifications.

2. The contractor administered by this Section of the technical specifications shall coordinate all work with the Control System Integrator. The contractor administered by this Section of the technical specifications shall integrate the ASHRAE Standard 135, BACnet/IP control network(s) with the Control System Integrator's area control through an Ethernet connection provided by the Control System Integrator.

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

4. Responsibility Table:

Item/Task	Section 23 09 23 contractor	Control system integrator	VA
ECC expansion		X	

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

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

1.2 RELATED WORK

- A. Section 23 21 13, Hydronic Piping.
- B. Section 23 22 13, Steam and Condensate Heating Piping.
- C. Section 23 31 00, HVAC Ducts and Casings.
- D. Section 23 36 00, Air Terminal Units.
- E. Section 23 73 00, Indoor Central-Station Air-Handling Units.

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

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

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

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

- KK. JPEG: A standardized image compression mechanism stands for Joint Photographic Experts Group, the original name of the committee that wrote the standard.
- LL. Local Area Network (LAN): A communication bus that interconnects operator workstation and digital controllers for peer-to-peer communications, sharing resources and exchanging information.
- MM. Network Repeater: A device that receives data packet from one network and rebroadcasts to another network. No routing information is added to the protocol.
- NN. 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 must be unique throughout the BACnet internetwork.
- QQ. Object: The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.
- RR. Object Identifier: An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.
- SS. Object Properties: Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.
- TT. Operating system (OS): Software, which controls the execution of computer application programs.
- UU. PCX: File type for an image file. When photographs are scanned onto a personal computer they can be saved as PCX files and viewed or changed by a special application program as Photo Shop.

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

1.4 QUALITY ASSURANCE

A. Criteria:

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

that the Department of Veterans Affairs (VA) representative would observe the control systems in full operation.

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

B. Codes and Standards:

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

1.5 PERFORMANCE

A. The system shall conform to the following:

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

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

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

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

Note 1: for both absolute and differential pressure

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

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

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

1.6 WARRANTY

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

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

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

1.7 SUBMITTALS

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

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

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

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

1. Submit in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS.
2. Include the following documentation:
 - a. General description and specifications for all components, including logging on/off, alarm handling, producing trend reports, overriding computer control, and changing set points and other variables.
 - b. Detailed illustrations of all the control systems specified for ease of maintenance and repair/replacement procedures, and complete calibration procedures.
 - c. One copy of the final version of all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - d. Complete troubleshooting procedures and guidelines for all systems.
 - e. Complete operating instructions for all systems.
 - f. Recommended preventive maintenance procedures for all system components including a schedule of tasks for inspection, cleaning and calibration. Provide a list of recommended spare parts needed to minimize downtime.
 - g. Training Manuals: Submit the course outline and training material to the Owner for approval three (3) weeks prior to the training to VA facility personnel. These persons will be responsible for maintaining and the operation of the control systems, including programming. The Owner reserves the right to modify any or all of the course outline and training material.
 - h. Licenses, guaranty, and other pertaining documents for all equipment and systems.

- G. Submit Performance Report to Resident Engineer prior to final inspection.

1.8 INSTRUCTIONS

- A. Instructions to VA operations personnel: Perform in accordance with Article, INSTRUCTIONS, in Specification Section 01 00 00, GENERAL REQUIREMENTS, and as noted below.

1. The O/M Manuals shall contain approved submittals as outlined in Article 1.7, SUBMITTALS. The Controls subcontractor will review the manual contents with VA facilities personnel during second phase of training.

1.9 PROJECT CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

- A. The ECC and peripheral devices and system support equipment shall be designed to operate in ambient condition of 20 to 35°C (65 to 90°F) at a relative humidity of 20 to 80% non-condensing.
- B. The CUs used outdoors shall be mounted in NEMA 4 waterproof enclosures, and shall be rated for operation at -40 to 65°C (-40 to 150°F).
- C. All electronic equipment shall operate properly with power fluctuations of plus 10 percent to minus 15 percent of nominal supply voltage.
- D. Sensors and controlling devices shall be designed to operate in the environment, which they are sensing or controlling.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
Standard 135-10.....BACNET Building Automation and Control Networks
- C. American Society of Mechanical Engineers (ASME):
B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings.
B16.22-01.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. American Society of Testing Materials (ASTM):
B32-08.....Standard Specification for Solder Metal
B88-09.....Standard Specifications for Seamless Copper Water Tube
B88M-09.....Standard Specification for Seamless Copper Water Tube (Metric)
B280-08.....Standard Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service
D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing
- E. Federal Communication Commission (FCC):
Rules and Regulations Title 47 Chapter 1-2001 Part 15: Radio Frequency Devices.
- F. Institute of Electrical and Electronic Engineers (IEEE):

802.3-11.....Information Technology-Telecommunications and
Information Exchange between Systems-Local and
Metropolitan Area Networks- Specific
Requirements-Part 3: Carrier Sense Multiple
Access with Collision Detection (CSMA/CD)
Access method and Physical Layer Specifications

G. National Fire Protection Association (NFPA):

70-11.....National Electric Code
90A-09.....Standard for Installation of Air-Conditioning
and Ventilation Systems

H. Underwriter Laboratories Inc (UL):

94-10.....Tests for Flammability of Plastic Materials for
Parts and Devices and Appliances
294-10.....Access Control System Units
486A/486B-10.....Wire Connectors
555S-11.....Standard for Smoke Dampers
916-10.....Energy Management Equipment
1076-10.....Proprietary Burglar Alarm Units and Systems

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use new products that the manufacturer is currently manufacturing and that have been installed in a minimum of 25 installations. Spare parts shall be available for at least five years after completion of this contract.

2.2 CONTROLLERS

A. General. Provide an adequate number of BTL-Listed B-BC building controllers and an adequate number of BTL-Listed B-AAC advanced application controllers to achieve the performance specified in the Part 1 Article on "System Performance." Each of these controllers shall meet the following requirements.

1. The controller shall have sufficient memory to support its operating system, database, and programming requirements.
2. The building controller shall share data with the ECC and the other networked building controllers. The advanced application controller shall share data with its building controller and the other networked advanced application controllers.
3. The operating system of the controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
4. Controllers that perform scheduling shall have a real-time clock.

5. The controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. assume a predetermined failure mode, and
 - b. generate an alarm notification.
 6. The controller shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute and Initiate) and Write (Execute and Initiate) Property services.
 7. Communication.
 - a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
 - b. The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol for connection to a portable operator's terminal.
 8. Keypad. A local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. Provide a system security password shall be available to prevent unauthorized use of the keypad and display.
 9. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
 10. Memory. The controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
 11. The controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- B. Provide BTL-Listed B-ASC application specific controllers for each piece of equipment for which they are constructed. Application specific controllers shall communicate with other BACnet devices on the internetwork using the BACnet Read (Execute) Property service.

1. Each B-ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
2. Each B-ASC will contain sufficient I/O capacity to control the target system.
3. Communication.
 - a. Each controller shall reside on a BACnet network using the ISO 8802-3 (Ethernet) Data Link/Physical layer protocol for its communications. Each building controller also shall perform BACnet routing if connected to a network of custom application and application specific controllers.
 - b. Each controller shall reside on an ARCNET network using the ISO 8802-2 Data Link/Physical layer protocol for its communications.
 - c. Each controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown.
4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The application specific controller shall use nonvolatile memory and maintain all BIOS and programming information in the event of a power loss.
6. Immunity to power and noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
7. Transformer. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type.

C. Direct Digital Controller Software

1. The software programs specified in this section shall be commercially available, concurrent, multi-tasking operating system and support the use of software application that operates under DOS or Microsoft Windows.

2. All points shall be identified by up to 30-character point name and 16-character point descriptor. The same names shall be used at the ECC.
3. All control functions shall execute within the stand-alone control units via DDC algorithms. The VA shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters.
4. All controllers shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, or by loss of bus communication. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the ECC. Each ACU and RCU shall have capability for local readouts of all functions. The UCUs shall be read remotely.
5. All DDC control loops shall be able to utilize any of the following control modes:
 - a. Two position (on-off, slow-fast) control.
 - b. Proportional control.
 - c. Proportional plus integral (PI) control.
 - d. Proportional plus integral plus derivative (PID) control. All PID programs shall automatically invoke integral wind up prevention routines whenever the controlled unit is off, under manual control of an automation system or time initiated program.
 - e. Automatic tuning of control loops.
6. System Security: Operator access shall be secured using individual password and operator's name. Passwords shall restrict the operator to the level of object, applications, and system functions assigned to him. A minimum of six (6) levels of security for operator access shall be provided.
7. Application Software: The controllers shall provide the following programs as a minimum for the purpose of optimizing energy consumption while maintaining comfortable environment for occupants. All application software shall reside and run in the system digital controllers. Editing of the application shall occur at the ECC or

via a portable operator's terminal, when it is necessary, to access directly the programmable unit.

- a. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the ECC based on time and events. An alarm shall be able to start programs, login the event, print and display the messages. The system shall allow the operator to prioritize the alarms to minimize nuisance reporting and to speed operator's response to critical alarms. A minimum of six (6) priority levels of alarms shall be provided for each point.
- b. Remote Communications: The system shall have the ability to dial out in the event of an alarm to the ECC and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications. Remote access shall allow the operator to function the same as local access.
- c. Maintenance Management (PM): The program shall monitor equipment status and generate maintenance messages based upon the operators defined equipment run time, starts, and/or calendar date limits. A preventative maintenance alarm shall be printed indicating maintenance requirements based on pre-defined run time. Each preventive message shall include point description, limit criteria and preventative maintenance instruction assigned to that limit. A minimum of 480-character PM shall be provided for each component of units such as air handling units.

2.3 SENSORS (AIR, WATER AND STEAM)

- A. Sensors' measurements shall be read back to the DDC system, and shall be visible by the ECC.
- B. Temperature and Humidity Sensors shall be electronic, vibration and corrosion resistant for wall, immersion, and/or duct mounting. Provide all remote sensors as required for the systems.
 1. Temperature Sensors: thermistor type for terminal units and Resistance Temperature Device (RTD) with an integral transmitter type for all other sensors.
 - a. Duct sensors shall be rigid or averaging type as shown on drawings. Averaging sensor shall be a minimum of 1 linear ft of sensing element for each sq ft of cooling coil face area.

- b. Immersion sensors shall be provided with a separable well made of stainless steel, bronze or monel material. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
- c. Space sensors shall be equipped with in-space User set-point adjustment, override switch, numerical temperature display on sensor cover, and communication port. Match room thermostats. Provide a tooled-access cover.
 - 1) Public space sensor: setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Do not provide in-space User set-point adjustment. Provide an opaque keyed-entry cover if needed to restrict in-space User set-point adjustment.
 - 2) Psychiatric patient room sensor: sensor shall be flush with wall, shall not include an override switch, numerical temperature display on sensor cover, shall not include a communication port and shall not allow in-space User set-point adjustment. Setpoint adjustment shall be only through the ECC or through the DDC system's diagnostic device/laptop. Provide a stainless steel cover plate with an insulated back and security screws.
- d. Outdoor air temperature sensors shall have watertight inlet fittings and be shielded from direct sunlight.
- e. Room security sensors shall have stainless steel cover plate with insulated back and security screws.
- f. Wire: Twisted, shielded-pair cable.
- g. Output Signal: 4-20 ma.
- 2. Humidity Sensors: Bulk polymer sensing element type.
 - a. Duct and room sensors shall have a sensing range of 20 to 80 percent with accuracy of ± 2 to ± 5 percent RH, including hysteresis, linearity, and repeatability.
 - b. Outdoor humidity sensors shall be furnished with element guard and mounting plate and have a sensing range of 0 to 100 percent RH.
 - c. 4-20 ma continuous output signal.
- C. Static Pressure Sensors: Non-directional, temperature compensated.
 - 1. 4-20 ma output signal.
 - 2. 0 to 5 inches wg for duct static pressure range.

3. 0 to 0.25 inch wg for Building static pressure range.

D. Water flow sensors:

1. Type: Insertion vortex type with retractable probe assembly and 2 inch full port gate valve.
 - a. Pipe size: 3 to 24 inches.
 - b. Retractor: ASME threaded, non-rising stem type with hand wheel.
 - c. Mounting connection: 2 inch 150 PSI flange.
 - d. Sensor assembly: Design for expected water flow and pipe size.
 - e. Seal: Teflon (PTFE).

2. Controller:

- a. Integral to unit.
- b. Locally display flow rate and total.
- c. Output flow signal to BMCS: Digital pulse type.

3. Performance:

- a. Turndown: 20:1
- b. Response time: Adjustable from 1 to 100 seconds.
- c. Power: 24 volt DC

4. Install flow meters according to manufacturer's recommendations.

Where recommended by manufacturer because of mounting conditions, provide flow rectifier.

E. Water Flow Sensors: shall be insertion turbine type with turbine element, retractor and preamplifier/transmitter mounted on a two-inch full port isolation valve; assembly easily removed or installed as a single unit under line pressure through the isolation valve without interference with process flow; calibrated scale shall allow precise positioning of the flow element to the required insertion depth within plus or minute 1 mm (0.05 inch); wetted parts shall be constructed of stainless steel. Operating power shall be nominal 24 VDC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 digit display, for wall or panel mounting.

1. Performance characteristics:

- a. Ambient conditions: -40°C to 60°C (-40°F to 140°F), 5 to 100% humidity.
- b. Operating conditions: 850 kPa (125 psig), 0°C to 120°C (30°F to 250°F), 0.15 to 12 m per second (0.5 to 40 feet per second) velocity.
- c. Nominal range (turn down ratio): 10 to 1.

- d. Preamplifier mounted on meter shall provide 4-20 ma divided pulse output or switch closure signal for units of volume or mass per a time base. Signal transmission distance shall be a minimum of 1,800 meters (6,000 feet).
- e. Pressure Loss: Maximum 1 percent of the line pressure in line sizes above 100 mm (4 inches).
- f. Ambient temperature effects, less than 0.005 percent calibrated span per °C (°F) temperature change.
- g. RFI effect - flow meter shall not be affected by RFI.
- h. Power supply effect less than 0.02 percent of span for a variation of plus or minus 10 percent power supply.

F. Steam Flow Sensor/Transmitter:

- 1. Sensor: Vortex shedder incorporating wing type sensor and amplification technology for high signal-to-noise ratio, carbon steel body with 316 stainless steel working parts, 24 VDC power, NEMA 4 enclosure.
 - a. Ambient conditions, -40°C to 80°C (-40°F to 175°F).
 - b. Process conditions, 900 kPa (125 psig) saturated steam.
 - c. Turn down ratio, 20 to 1.
 - d. Output signal, 4-20 ma DC.
 - e. Processor/Transmitter, NEMA 4 enclosure with keypad program selector and six digit LCD output display of instantaneous flow rate or totalized flow, solid state switch closure signal shall be provided to the nearest DDC panel for totalization.
 - 1) Ambient conditions, -20°C to 50°C (0°F-120°F), 0 95 percent non-condensing RH.
 - 2) Power supply, 120 VAC, 60 hertz or 24 VDC.
 - 3) Internal battery, provided for 24-month retention of RAM contents when all other power sources are removed.
 - f. Sensor on all steam lines shall be protected by pigtail siphons installed between the sensor and the line, and shall have an isolation valve installed between the sensor and pressure source.

G. Flow switches:

- 1. Shall be either paddle or differential pressure type.
 - a. Paddle-type switches (liquid service only) shall be UL Listed, SPDT snap-acting, adjustable sensitivity with NEMA 4 enclosure.

- b. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap acting, NEMA 4 enclosure, with scale range and differential suitable for specified application.
- H. Current Switches: Current operated switches shall be self powered, solid state with adjustable trip current as well as status, power, and relay command status LED indication. The switches shall be selected to match the current of the application and output requirements of the DDC systems.

2.4 CONTROL CABLES

- A. General:
 - 1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with Sections 27 05 26 and 26 05 26.
 - 2. Cable conductors to provide protection against induction in circuits. Crosstalk attenuation within the System shall be in excess of -80 dB throughout the frequency ranges specified.
 - 3. Minimize the radiation of RF noise generated by the System equipment so as not to interfere with any audio, video, data, computer main distribution frame (MDF), telephone customer service unit (CSU), and electronic private branch exchange (EPBX) equipment the System may service.
 - 4. The as-installed drawings shall identify each cable as labeled, used cable, and bad cable pairs.
 - 5. Label system's cables on each end. Test and certify cables in writing to the VA before conducting proof-of-performance testing. Minimum cable test requirements are for impedance compliance, inductance, capacitance, signal level compliance, opens, shorts, cross talk, noise, and distortion, and split pairs on all cables in the frequency ranges used. Make available all cable installation and test records at demonstration to the VA. All changes (used pair, failed pair, etc.) shall be posted in these records as the change occurs.
 - 6. Power wiring shall not be run in conduit with communications trunk wiring or signal or control wiring operating at 100 volts or less.
- B. Analogue control cabling shall be not less than No. 18 AWG solid, with thermoplastic insulated conductors as specified in Section 26 05 21.

- C. Copper digital communication cable between the ECC and the B-BC and B-AAC controllers shall be 100BASE-TX Ethernet, Category 5e or 6, not less than minimum 24 American Wire Gauge (AWG) solid, Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP), with thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, as specified in Section 27 15 00.
 - 1. Other types of media commonly used within IEEE Std 802.3 LANs (e.g., 10Base-T and 10Base-2) shall be used only in cases to interconnect with existing media.
- D. Optical digital communication fiber, if used, shall be Multimode or Singlemode fiber, 62.5/125 micron for multimode or 10/125 micron for singlemode micron with SC or ST connectors as specified in TIA-568-C.1. Terminations, patch panels, and other hardware shall be compatible with the specified fiber and shall be as specified in Section 27 15 00. Fiber-optic cable shall be suitable for use with the 100Base-FX or the 100Base-SX standard (as applicable) as defined in IEEE Std 802.3.

2.5 THERMOSTATS AND HUMIDISTATS

- A. Room thermostats controlling unitary standalone heating and cooling devices not connected to the DDC system shall have three modes of operation (heating - null or dead band - cooling). Thermostats for patient bedrooms shall have capability of being adjusted to eliminate null or dead band. Wall mounted thermostats shall have polished or brushed aluminum finish, setpoint range and temperature display and external adjustment:
 - 1. Electronic Thermostats: Solid-state, microprocessor based, programmable to daily, weekend, and holiday schedules.
 - a. Public Space Thermostat: Public space thermostat shall have a thermistor sensor and shall not have a visible means of set point adjustment. Adjustment shall be via the digital controller to which it is connected.
 - b. Patient Room Thermostats: thermistor with in-space User set point adjustment and an on-casing room temperature numerical temperature display.
 - c. Psychiatric Patient Room Sensors: Electronic duct sensor as noted under Article 2.4.
 - d. Battery replacement without program loss.

- B. Strap-on thermostats shall be enclosed in a dirt-and-moisture proof housing with fixed temperature switching point and single pole, double throw switch.
- C. Freezestats shall have a minimum of 300 mm (one linear foot) of sensing element for each 0.093 square meter (one square foot) of coil area. A freezing condition at any increment of 300 mm (one foot) anywhere along the sensing element shall be sufficient to operate the thermostatic element. Freezestats shall be manually-reset.
- D. Room Humidistats: Provide fully proportioning humidistat with adjustable throttling range for accuracy of settings and conservation. The humidistat shall have set point scales shown in percent of relative humidity located on the instrument. Systems showing moist/dry or high/low are not acceptable.

2.6 FINAL CONTROL ELEMENTS AND OPERATORS

- A. Fail Safe Operation: Control valves and dampers shall provide "fail safe" operation in either the normally open or normally closed position as required for freeze, moisture, and smoke or fire protection.
- B. Spring Ranges: Range as required for system sequencing and to provide tight shut-off.
- C. Power Operated Control Dampers (other than VAV Boxes): Factory fabricated, balanced type dampers. All modulating dampers shall be opposed blade type and gasketed. Blades for two-position, duct-mounted dampers shall be parallel, airfoil (streamlined) type for minimum noise generation and pressure drop.
 - 1. Leakage: Except as specified in subparagraph 2 below, maximum leakage in closed position shall not exceed 7 L/S (15 CFMs) differential pressure for outside air and exhaust dampers and 200 L/S/ square meter (40 CFM/sq. ft.) at 50 mm (2 inches) differential pressure for other dampers.
 - 2. Frame shall be galvanized steel channel with seals as required to meet leakage criteria.
 - 3. Blades shall be galvanized steel or aluminum, 200 mm (8 inch) maximum width, with edges sealed as required.
 - 4. Bearing shall be nylon, bronze sleeve or ball type.
 - 5. Hardware shall be zinc-plated steel. Connected rods and linkage shall be non-slip. Working parts of joints shall be brass, bronze, nylon or stainless steel.

6. Maximum air velocity and pressure drop through free area the dampers:
 - a. Smoke damper in air handling unit: 305 meter per minute (1000 fpm).
 - b. Duct mounted damper: 600 meter per minute (2000 fpm).
 - c. Maximum static pressure loss: 50 Pascal (0.20 inches water gage).
- D. Smoke Dampers and Combination Fire/Smoke Dampers: Dampers and operators are specified in Section 23 31 00, HVAC DUCTS AND CASINGS. Control of these dampers is specified under this Section.
- E. Control Valves:
 1. Valves shall be rated for a minimum of 150 percent of system operating pressure at the valve location but not less than 900 kPa (125 psig).
 2. Valves 50 mm (2 inches) and smaller shall be bronze body with threaded or flare connections.
 3. Valves 60 mm (2 1/2 inches) and larger shall be bronze or iron body with flanged connections.
 4. Brass or bronze seats except for valves controlling media above 100 degrees C (210 degrees F), which shall have stainless steel seats.
 5. Flow characteristics:
 - a. Three way modulating valves shall be globe pattern. Position versus flow relation shall be linear relation for steam or equal percentage for water flow control.
 - b. Two-way modulating valves shall be globe pattern. Position versus flow relation shall be linear for steam and equal percentage for water flow control.
 - c. Two-way 2-position valves shall be ball, gate or butterfly type.
 6. Maximum pressure drop:
 - a. Two position steam control: 20 percent of inlet gauge pressure.
 - b. Modulating Steam Control: 80 percent of inlet gauge pressure (acoustic velocity limitation).
 - c. Modulating water flow control, greater of 3 meters (10 feet) of water or the pressure drop through the apparatus.
 7. Two position water valves shall be line size.
- F. Damper and Valve Operators and Relays:
 1. Electric operator shall provide full modulating control of dampers and valves. A linkage and pushrod shall be furnished for mounting the actuator on the damper frame internally in the duct or

externally in the duct or externally on the duct wall, or shall be furnished with a direct-coupled design. Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.

a. Minimum valve close-off pressure shall be equal to the system pump's dead-head pressure, minimum 50 psig for valves smaller than 4 inches.

2. Electronic damper operators: Metal parts shall be aluminum, mill finish galvanized steel, or zinc plated steel or stainless steel. Provide actuator heads which allow for electrical conduit attachment. The motors shall have sufficient closure torque to allow for complete closure of valve or damper under pressure. Provide multiple motors as required to achieve sufficient close-off torque.

a. VAV Box actuator shall be mounted on the damper axle or shall be of the air valve design, and shall provide complete modulating control of the damper. The motor shall have a closure torque of 35-inch pounds minimum with full torque applied at close off to attain minimum leakage.

3. See drawings for required control operation.

2.7 AIR FLOW CONTROL

A. Airflow and static pressure shall be controlled via digital controllers with inputs from airflow control measuring stations and static pressure inputs as specified. Controller outputs shall be analog or pulse width modulating output signals. The controllers shall include the capability to control via simple proportional (P) control, proportional plus integral (PI), proportional plus integral plus derivative (PID), and on-off. The airflow control programs shall be factory-tested programs that are documented in the literature of the control manufacturer.

A. Air Flow Measuring Station -- Electronic Thermal Type:

1. Air Flow Sensor Probe:

a. Each air flow sensor shall contain two individual thermal sensing elements. One element shall determine the velocity of the air stream while the other element shall compensate for changes in

temperature. Each thermal flow sensor and its associated control circuit and signal conditioning circuit shall be factory calibrated and be interchangeable to allow replacement of a sensor without recalibration of the entire flow station. The sensor in the array shall be located at the center of equal area segment of the duct and the number of sensors shall be adequate to accommodate the expected velocity profile and variation in flow and temperature. The airflow station shall be of the insertion type in which sensor support structures are inserted from the outside of the ducts to make up the complete electronic velocity array.

- b. Thermal flow sensor shall be constructed of hermetically sealed thermistors or nickel chromium or reference grade platinum wire, wound over an epoxy, stainless steel or ceramic mandrel and coated with a material suitable for the conditions to be encountered. Each dual sensor shall be mounted in an extruded aluminum alloy strut.

2. Air Flow Sensor Grid Array:

- a. Each sensor grid shall consist of a lattice network of temperature sensors and linear integral controllers (ICs) situated inside an aluminum casing suitable for mounting in a duct. Each sensor shall be mounted within a strut facing downstream of the airflow and located so that it is protected on the upstream side. All wiring shall be encased (out of the air stream) to protect against mechanical damage.
- b. The casing shall be made of welded aluminum of sufficient strength to prevent structural bending and bowing. Steel or iron composite shall not be acceptable in the casing material.
- c. Pressure drop through the flow station shall not exceed 4 Pascal (0.015" W.G.) at 1,000 meter per minute (3,000 FPM).

3. Electronics Panel:

- a. Electronics Panel shall consist of a surface mounted enclosure complete with solid-state microprocessor and software.
- b. Electronics Panel shall be A/C powered 120 VAC and shall have the capability to transmit signals of 0-5 VDC, 0-10 VCD or 4-20 ma for use in control of the HVAC Systems. The electronic panel shall have the capability to accept user defined scaling parameters for all output signals.

- c. Electronics Panel shall have the capability to digitally display airflow in CFM and temperature in degrees F. The displays shall be provided as an integral part of the electronics panel. The electronic panel shall have the capability to totalize the output flow in CFM for two or more systems, as required. A single output signal may be provided which will equal the sum of the systems totalized. Output signals shall be provided for temperature and airflow. Provide remote mounted air flow or temperature displays where indicated on the plans.
- d. Electronics Panel shall have the following:
- 1) Minimum of 12-bit A/D conversion.
 - 2) Field adjustable digital primary output offset and gain.
 - 3) Airflow analog output scaling of 100 to 10,000 FPM.
 - 4) Temperature analog output scaling from -45°C to 70°C (-50°F to 160°F).
 - 5) Analog output resolution (full scale output) of 0.025%.
- e. All readings shall be in I.P.units.
4. Thermal flow sensors and its electronics shall be installed as per manufacturer's instructions. The probe sensor density shall be as follows:

Probe Sensor Density	
Area (sq.ft.)	Qty. Sensors
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=16	16

- a. Complete installation shall not exhibit more than $\pm 2.0\%$ error in airflow measurement output for variations in the angle of flow of up to 10 percent in any direction from its calibrated orientation. Repeatability of readings shall be within $\pm 0.25\%$.
- C. Static Pressure Measuring Station: shall consist of one or more static pressure sensors and transmitters along with relays or auxiliary devices as required for a complete functional system. The span of the transmitter shall not exceed two times the design static pressure at the point of measurement. The output of the transmitter shall be true

representation of the input pressure with plus or minus 25 Pascal (0.1 inch) W.G. of the true input pressure:

1. Static pressure sensors shall have the same requirements as Airflow Measuring Devices except that total pressure sensors are optional, and only multiple static pressure sensors positioned on an equal area basis connected to a network of headers are required.
 2. For systems with multiple major trunk supply ducts, furnish a static pressure transmitter for each trunk duct. The transmitter signal representing the lowest static pressure shall be selected and this shall be the input signal to the controller.
 3. The controller shall receive the static pressure transmitter signal and CU shall provide a control output signal to the supply fan capacity control device. The control mode shall be proportional plus integral (PI) (automatic reset) and where required shall also include derivative mode.
 4. In systems with multiple static pressure transmitters, provide a switch located near the fan discharge to prevent excessive pressure during abnormal operating conditions. High-limit switches shall be manually-reset.
- D. Constant Volume Control Systems shall consist of an air flow measuring station along with such relays and auxiliary devices as required to produce a complete functional system. The transmitter shall receive its air flow signal and static pressure signal from the flow measuring station and shall have a span not exceeding three times the design flow rate. The CU shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate. The CU shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivative mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.
- E. Airflow Synchronization:
1. Systems shall consist of an air flow measuring station for each supply and return duct, the CU and such relays, as required to provide a complete functional system that will maintain a constant flow rate difference between supply and return air to an accuracy of $\pm 10\%$. In systems where there is no suitable location for a flow measuring station that will sense total supply or return flow, provide multiple flow stations with a differential pressure

transmitter for each station. Signals from the multiple transmitters shall be added through the CU such that the resultant signal is a true representation of total flow.

2. The total flow signals from supply and return air shall be the input signals to the CU. This CU shall track the return air fan capacity in proportion to the supply air flow under all conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Examine project plans for control devices and equipment locations; and report any discrepancies, conflicts, or omissions to Resident Engineer 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.
 4. Install all electrical work required for a fully functional system and not shown on electrical plans or required by electrical specifications. Where low voltage (less than 50 volt) power is required, provide suitable Class B transformers.
 5. Install all system components in accordance with local Building Code and National Electric Code.
 - a. Splices: Splices in shielded and coaxial cables shall consist of terminations and the use of shielded cable couplers. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties.
 - b. Equipment: Fit all equipment contained in cabinets or panels with service loops, each loop being at least 300 mm (12 inches) long. Equipment for fiber optics system shall be rack mounted, as applicable, in ventilated, self-supporting, code gauge steel enclosure. Cables shall be supported for minimum sag.
 - c. Cable Runs: Keep cable runs as short as possible. Allow extra length for connecting to the terminal board. Do not bend flexible coaxial cables in a radius less than ten times the cable outside diameter.
 - d. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners, through walls, panel cabinets, etc.
 6. Conceal cables, except in mechanical rooms and areas where other conduits and piping are exposed.
 7. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.
 8. Grounding: ground electrical systems per manufacturer's written requirements for proper and safe operation.
- C. Install Sensors and Controls:
1. Temperature Sensors:
 - a. Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations

shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.

- b. Calibrate sensors to accuracy specified, if not factory calibrated.
 - c. Use of sensors shall be limited to its duty, e.g., duct sensor shall not be used in lieu of room sensor.
 - d. Install room sensors permanently supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above the finished floor.
 - e. Mount sensors rigidly and adequately for the environment within which the sensor operates. Separate extended-bulb sensors 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.
2. Pressure Sensors:
- a. Install duct static pressure sensor tips facing directly downstream of airflow.
 - b. Install high-pressure side of the differential switch between the pump discharge and the check valve.
 - c. Install snubbers and isolation valves on steam pressure sensing devices.
3. Actuators:
- a. Mount and link damper and valve actuators according to manufacturer's written instructions.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed position.

- c. Check operation of valve/actuator combination to confirm that actuator modulates valve smoothly in both open and closed position.
- 4. Flow Switches:
 - a. Install flow switch according to manufacturer's written instructions.
 - b. Mount flow switch a minimum of 5 pipe diameters up stream and 5 pipe diameters downstream or 600 mm (2 feet) whichever is greater, from fittings and other obstructions.
 - c. Assure correct flow direction and alignment.
 - d. Mount in horizontal piping-flow switch on top of the pipe.
- D. Installation of network:
 - 1. Ethernet:
 - a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
 - b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 100 Base TX (Category 5e cabling) for the communications between the ECC and the B-BC and the B-AAC controllers.
 - 2. Third party interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.
- E. Installation of digital controllers and programming:
 - 1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
 - 2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
 - 3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
 - 4. Provide software programming for the applications intended for the systems specified, and adhere to the strategy algorithms provided.

5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooling tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.2 SEQUENCE OF OPERATION

- A. General: Sequence of Operation is hereby defined to mean the manner in which and methods by which the Building Control and Automation System functions. The requirements for each type of operation are specified in this section.
- B. Supplementary Device Requirements:
 1. Automatic Valves/Actuators: All automatic valves used for control of fluids shall be equipped with electric actuators complying with the requirements of this section.
 2. Automatic Dampers/Actuators: All automatic dampers used for control of air flows shall be equipped with electric actuators complying with the requirements of this section.
 3. HVAC Terminal Units: All HVAC terminal units (VAV, CV, etc.) shall be equipped with electric actuators and DDC controls complying with the requirements of this section.
- C. Sequence of Operation (DDC Sequences)
 1. Start/Stop Control: Heating, ventilating and air conditioning equipment as listed herein shall be programmed to start and stop at pre-determined times for optimal operation of the building. Provide the ability for individual start/stop of the following equipment.
 - a. All air handling units, fan coil units and heating and ventilating units.
 - b. All exhaust and ventilating fans. Fans interlocked with air handling units.
 2. Smoke Detectors: Air handling units and fans shall be provided with smoke detectors furnished and installed under Division 16. Air handling units, supply air ventilation fans, exhaust air fans, and relief air fans (except smoke exhaust fans) 2000 CFM and greater will have smoke detectors installed in the discharge supply air ductwork. In general, each air handling unit and fan shall be stopped by the fire alarm system whenever its fire alarm zone is activated. Refer to Division 16, FIRE ALARM AND COMMUNICATION SYSTEM for requirements.

3. High Limit Thermostats: Provide a high limit thermostat for every air handling unit, supply fan, and exhaust fan, which is not otherwise protected by a smoke detector (refer to Division 16) and as required by code. Smoke exhaust fans shall not have a high limit thermostat.
4. Automatic Dampers: Provide automatic dampers where indicated on the Drawings. These dampers shall be interlocked with their respective fan units. On a fan unit start signal, the automatic dampers shall open. Duct systems, dampers, and fans shall be protected from fan starting against closed systems. In general, after a time delay of 15 seconds (adjustable) for dampers to fully open, the fan shall start. In lieu of a time delay, certain sequences require the dampers to be proven open by actuation of a damper blade end switch before the fan is allowed to start.
5. Automatic Outside Air Intake Dampers: On a start signal, the outside air intake dampers shall open. On a stop signal, the fan shall stop and the dampers shall close. Dampers shall close on loss of control signal, on loss of electrical power, and whenever the air handling unit fan motor stops for any reason.
6. Fire Safety Sequences: The operation of certain exhaust and ventilating fans, combination fire, smoke and automatic dampers, control sequences, etc., will be governed by the fire alarm systems. Refer to Division 16, FIRE ALARM AND COMMUNICATION SYSTEM for operation of these systems under special conditions. The fire safety, fire alarm, and fireman's manual override sequences shall take precedence over all other manual, safety, or automatic functions.
7. Variable Speed (Frequency) Drives (VSD Operation): In the normal (auto) mode, when the sequence description requires a motor to be operated automatically through the facility management system, motor controls shall be through the VSD. VSD's shall be provided with manual bypass for override of auto sequences. Fire alarm and/or safety devices/circuits shall override all automatic sequences.
8. Hand-Off-Auto Switch Operation: Where the use of VSD's are not indicated, each motor controller shall be provided with a 120 volt control power transformer and a HAND-OFF-AUTO selector switch. When the sequence description requires a motor to be operated by an automatic device such as outside temperature, Building Control and

Automation System (BCAS), etc., this sequence shall occur only when the selector switch is in the "AUTO" position. The "HAND" position may be used to operate the motor at any time, regardless of the functioning of the automatic device or circuit. All automatic functions such as damper opening, valve actuation, interlocks, etc., shall occur as described whether the motor is started and stopped in the "AUTO" position or manually by use of the "HAND" and "OFF" positions. Safety devices and circuits such as low limit thermostats, high limit thermostats, fire alarm contacts, etc., however, shall operate as described regardless of the position of the H-O-A switch.

9. Control Power Source: In general, all control circuits whenever possible shall originate from respective motor controller control power transformers. Confirm that each control power transformer and control fuse is adequately sized for all relays, coils, etc., connected to the circuit. Provide all necessary interlock and circuit isolation relays required to perform the sequence of operation specified. Coordinate all requirements with the Contractor for Division 26.
 10. Smoke Block Dampers: All air handling unit system smoke block dampers shall close upon a signal from the fire alarm system and shall open upon removal of the signal.
- D. Control Type A1: Draw Through Variable Volume Air Handling Units
1. General: The unit shall consist of a variable volume horizontal draw-through type air handling unit, chilled water cooling coil, variable frequency drive, filters, fan, and related control system.
 2. Start/Stop Control: The unit fan shall be program started and stopped from an ASC or stand-alone DDC panel when its VSD is in the "Auto" position. In the "Bypass" position, the VSD shall allow local manual starting. After the start signal is given, the unit fan shall delay starting for 30 seconds (adjustable) to allow interlocked dampers to modulate to their normal position.
 3. Cooling Coil Control: An extended element averaging temperature sensor located in the cooling coil air discharge shall provide an input to an ASC or stand-alone DDC panel which outputs a signal to modulate an electrically actuated control valve on the cooling coil as required to maintain the discharge air temperature as scheduled (adjustable). The control valve shall close when the unit fan is

- off, and shall fail open upon loss of control signal. The averaging element shall be located in the coil discharge as recommended by the air handling unit manufacturer. The temperature transmitter shall be calibrated from the air temperature sensing point in the unit recommended by the air handling unit manufacturer. The averaging element shall be installed in a zig-zag fashion across the entire face of the cooling coil discharge and shall be mounted on insulated clips at each change in direction. The distance between changes in direction (and clips) shall not exceed two feet measured along the length of the averaging element. Temperature transmitter shall be calibrated to maintain no more than a $\pm 1^{\circ}\text{F}$ variation in leaving air temperature from set point from full flow to minimum flow when measured at the point indicated above.
4. Discharge Duct Pressure Control: A duct mounted static pressure transducer located two thirds the distance down the longest primary duct system served by the air handling unit shall provide an input signal to an ASC or stand-alone DDC panel which, shall through a PI control algorithm, output a signal to a variable frequency drive (CFD) to modulate the fan motor speed as required to maintain duct static pressure set point (adjustable). A separate static pressure switch sensing air handling unit discharge pressure shall stop the air handling unit whenever its limit set point is exceeded. Set point shall be set below the ductwork pressure class designation to protect the ductwork system. Unit fan shall always start unloaded and increase static pressure gradually to set point.
 5. VFD Drive Status: Monitor a contact closure in the VFD drive failure to the BCAS.
 6. Fan Status: Fan status shall be indicated to the BCAS by a differential pressure air flow switch or current sensing relay.
 7. Filter Monitor: Provide an electric differential pressure switch for each filter bank (pre-filter and final filter). Switch shall provide an output signal to the BCAS to indicate dirty filters need replacement. Provide means for visual readout of differential pressure at each filter in each unit.
 8. An air measurement station Ebtron #GTx116-PC [high accuracy (2%), located in the outside air ductwork (not the mixed air stream) as shown on the plans, shall provide a signal to control the motorized outside air damper to maintain a constant volume of outside air at a

- pre-set (adjustable) level, regardless of any changes in the total system delivery volume.
9. Air Handling unit shall run as dictated by owner schedule. Coordinate with visor clinic operating schedules.
 10. Discharge Temperature Reset: If all terminal units are at their respective minimum airflow set points, the discharge air temperature shall be raised from 55°F to 75°F at a rate of 1°F per 5 minutes (adj) until a single zone calls for cooling. Discharge Temperature Reset shall be disabled if enthalpy of outside air is greater than 23.5 Btu/lb. An enthalpy sensor shall be located in the outside air ductwork.
 11. Warm-Up Mode: A morning warmup cycle shall be implemented as required. The air handling unit supply fan shall turn on, outside air damper shall be closed and steam heating valve shall modulate fully open. Unit shall remain in this mode until each zone reaches the morning warmup set point (adjustable). Upon reaching this set point, the air handling unit enters its normal occupied mode of operation.
- E. Control Type B1: Variable Volume Terminal Unit (VAV) w/ Electric Heat
1. General: Each of these units consist of a variable volume unit (VAV), primary cold air inlet damper, inlet airflow sensor, electric reheat coil, and shall be provided with related control systems.
 2. Zone Control: A wall mounted space temperature sensor shall provide an input to an ASC which outputs a signal to modulate the primary inlet damper from maximum CFM set point to minimum CFM set point and shall modulate the SCR heating control on the heating coil in sequence as required to maintain space temperature set point. The heating coil shall not be energized until the primary air inlet damper has closed to its minimum CFM set point.
 3. Pressure Independent Operation: A flow cross/flow ring multipoint sensor in the primary air inlet shall through a pressure transducer and the ASC reset the control loop for terminal unit pressure independent operation. System shall employ a three-mode control algorithm to eliminate offset.
 4. Primary Damper:

- a. From full cooling to full heating, the primary air inlet damper shall modulate closed to its minimum set point in response to the room temperature sensor.
 - b. The primary air inlet damper shall close when the unit fan is off.
- F. Control Type C1: Variable Volume Terminal Unit (VAV) (No Heat)
 1. General: Each of these units consists of a variable volume unit (VAV), primary cold air inlet damper, inlet airflow sensor, and shall be provided with related control systems.
 2. Zone Control: A wall mounted space temperature sensor shall provide an input to an ASC which outputs a signal to modulate the primary inlet damper from maximum CFM set point to minimum CFM set point to maintain space temperature set point.
 3. Pressure Independent Operation: A flow cross/flow ring multipoint sensor in the primary air inlet shall through a pressure transducer and the ASC reset the control loop for terminal unit pressure independent operation. System shall employ a three-mode control algorithm to eliminate offset
 4. Primary Damper: From full cooling to full heating, the primary air inlet damper shall modulate closed to its minimum set point in response to the room temperature sensor.
- G. Control Type D1: General Exhaust Fans
 1. Start/Stop Control: Each general exhaust fan shall be program started and stopped from an ASC or stand-alone DDC panel when its HOA switch is in the "Auto" position. In the "Hand" position, the HOA switch shall allow local manual starting.
 2. Fan status: Fan status shall be indicated to the BCAS by a differential pressure air flow switch or current sensitive relay.
- H. Control Type E1: Interlocked Fans
 1. General: Each of these fans are to be hardware interlocked with other air handling units or systems as indicated in the Schedule of Air Handling Unit Equipment.
 2. Start/Stop Control: Each fan shall be hardware interlock started and stopped along with its associated primary equipment when its HOA switch is in the "Auto" position. In the "Hand" position, the HOA switch shall allow local manual starting.

3. Fan shall run as dictated by owner schedule. Coordinate with owner for fitness center and visor clinic operating schedules.

I. Control Type F1: Air Cooled Condensing Unit

1. General: Monitor a relay contact in the condensing unit to indicate status.

3.3 SYSTEM VALIDATION AND DEMONSTRATION

- A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the contractor is to perform a complete validation of all aspects of the controls and instrumentation system.

B. Validation

1. Prepare and submit for approval a validation test plan including test procedures for the performance verification tests. Test Plan shall address all specified functions of the ECC and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a test check list to be used by the Installer's agent to check and initial that each test has been successfully completed. Deliver test plan documentation for the performance verification tests to the owner's representative 30 days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
2. After approval of the validation test plan, installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List.

C. Demonstration

1. System operation and calibration to be demonstrated by the installer in the presence of the Architect or VA's representative on random samples of equipment as dictated by the Architect or VA's representative. Should random sampling indicate improper

- commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no addition cost to the VA.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
 3. Make accessible, personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
 4. The following witnessed demonstrations of field control equipment shall be included:
 - a. Observe HVAC systems in shut down condition. Check dampers and valves for normal position.
 - b. Test application software for its ability to communicate with digital controllers, operator workstation, and uploading and downloading of control programs.
 - c. Demonstrate the software ability to edit the control program off-line.
 - d. Demonstrate reporting of alarm conditions for each alarm and ensure that these alarms are received at the assigned location, including operator workstations.
 - e. Demonstrate ability of software program to function for the intended applications-trend reports, change in status etc.
 - f. Demonstrate via graphed trends to show the sequence of operation is executed in correct manner, and that the HVAC systems operate properly through the complete sequence of operation, e.g., seasonal change, occupied/unoccupied mode, and warm-up condition.
 - g. Demonstrate hardware interlocks and safeties functions, and that the control systems perform the correct sequence of operation after power loss and resumption of power loss.
 - h. Prepare and deliver to the VA graphed trends of all control loops to demonstrate that each control loop is stable and the set points are maintained.
 - i. Demonstrate that each control loop responds to set point adjustment and stabilizes within one (1) minute. Control loop trend data shall be instantaneous and the time between data points shall not be greater than one (1) minute.
 5. Witnessed demonstration of ECC functions shall consist of:
 - a. Running each specified report.
 - b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.

- c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
- d. Execute digital and analog commands in graphic mode.
- e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs (6 loops minimum).
- f. Demonstrate EMS performance via trend logs and command trace.
- g. Demonstrate scan, update, and alarm responsiveness.
- h. Demonstrate spreadsheet/curve plot software, and its integration with database.
- i. Demonstrate on-line user guide, and help function and mail facility.
- j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
- k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
- l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Water piping to connect HVAC equipment, including the following:
 - 1. Chilled water, condenser water, heating hot water and drain piping.
 - 2. Extension of domestic water make-up piping.
 - 3. Glycol-water piping.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. 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.
- C. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION: Piping insulation.
- D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Temperature and pressure sensors and valve operators.

1.3 QUALITY ASSURANCE

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION, which includes welding qualifications.
- B. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Pipe and equipment supports.
 - 2. Pipe and tubing, with specification, class or type, and schedule.
 - 3. Pipe fittings, including miscellaneous adapters and special fittings.

- ## 1.5 APPLICABLE PUBLICATIONS

- 23 21 13-2

- C. American National Standards Institute, Inc./Fluid Controls Institute
(ANSI/FCI):
70-2-2006.....Control Valve Seat Leakage
- D. American Society of Mechanical Engineers (ASME):
B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
B16.3-2006.....Malleable Iron Threaded Fittings: Class 150 and
300
B16.4-2006.....Gray Iron Threaded Fittings: (Class 125 and
250)
B16.5-2003.....Pipe Flanges and Flanged Fittings: NPS ½
through NPS 24 Metric/Inch Standard
B16.9-07.....Factory Made Wrought Butt Welding Fittings
B16.11-05.....Forged Fittings, Socket Welding and Threaded
B16.18-01.....Cast Copper Alloy Solder Joint Pressure
Fittings
B16.22-01.....Wrought Copper and Bronze Solder Joint Pressure
Fittings.
B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged
Fittings
B16.39-06.....Malleable Iron Threaded Pipe Unions
B16.42-06.....Ductile Iron Pipe Flanges and Flanged Fittings
B31.1-08.....Power Piping
- E. American Society for Testing and Materials (ASTM):
A47/A47M-99 (2004).....Ferritic Malleable Iron Castings
A53/A53M-07.....Standard Specification for Pipe, Steel, Black
and Hot-Dipped, Zinc-Coated, Welded and
Seamless
A106/A106M-08.....Standard Specification for Seamless Carbon
Steel Pipe for High-Temperature Service
A126-04.....Standard Specification for Gray Iron Castings
for Valves, Flanges, and Pipe Fittings
A183-03 Standard Specification for Carbon Steel Track
Bolts and Nuts
A216/A216M-08 Standard Specification for Steel Castings,
Carbon, Suitable for Fusion Welding, for High
Temperature Service

A234/A234M-07 Piping Fittings of Wrought Carbon Steel and
Alloy Steel for Moderate and High Temperature
Service

A307-07 Standard Specification for Carbon Steel Bolts
and Studs, 60,000 PSI Tensile Strength

A536-84 (2004) Standard Specification for Ductile Iron Castings

A615/A615M-08 Deformed and Plain Carbon Steel Bars for
Concrete Reinforcement

A653/A 653M-08 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-
Iron Alloy Coated (Galvannealed) By the Hot-Dip
Process

B32-08 Standard Specification for Solder Metal

B62-02 Standard Specification for Composition Bronze or
Ounce Metal Castings

B88-03 Standard Specification for Seamless Copper Water
Tube

B209-07 Aluminum and Aluminum Alloy Sheet and Plate

C177-04 Standard Test Method for Steady State Heat Flux
Measurements and Thermal Transmission Properties
by Means of the Guarded Hot Plate Apparatus

C478-09 Precast Reinforced Concrete Manhole Sections

C533-07 Calcium Silicate Block and Pipe Thermal
Insulation

C552-07 Cellular Glass Thermal Insulation

D3350-08 Polyethylene Plastics Pipe and Fittings
Materials

C591-08 Unfaced Preformed Rigid Cellular
Polyisocyanurate Thermal Insulation

D1784-08 Rigid Poly (Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly (Vinyl Chloride) (CPVC)
Compound

D1785-06 Poly (Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80 and 120

D2241-05 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe
(SDR Series)

F439-06 Standard Specification for Chlorinated Poly
(Vinyl Chloride) (CPVC) Plastic Pipe Fittings,
Schedule 80

- F441/F441M-02 Standard Specification for Chlorinated Poly
(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules
40 and 80
- F477-08 Elastomeric Seals Gaskets) for Joining Plastic
Pipe
- F. American Water Works Association (AWWA):
- C110-08.....Ductile Iron and Grey Iron Fittings for Water
- C203-02.....Coal Tar Protective Coatings and Linings for
Steel Water Pipe Lines Enamel and Tape Hot
Applied
- G. American Welding Society (AWS):
- B2.1-02.....Standard Welding Procedure Specification
- H. Copper Development Association, Inc. (CDA):
- CDA A4015-06.....Copper Tube Handbook
- I. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003.....Expansion Joint Manufacturer's Association
Standards, Ninth Edition
- J. Manufacturers Standardization Society (MSS) of the Valve and Fitting
Industry, Inc.:
- SP-67-02a.....Butterfly Valves
- SP-70-06.....Gray Iron Gate Valves, Flanged and Threaded
Ends
- SP-71-05.....Gray Iron Swing Check Valves, Flanged and
Threaded Ends
- SP-80-08.....Bronze Gate, Globe, Angle and Check Valves
- SP-85-02.....Cast Iron Globe and Angle Valves, Flanged and
Threaded Ends
- SP-110-96.....Ball Valves Threaded, Socket-Welding, Solder
Joint, Grooved and Flared Ends
- SP-125-00.....Gray Iron and Ductile Iron In-line, Spring
Loaded, Center-Guided Check Valves
- K. National Sanitation Foundation/American National Standards Institute,
Inc. (NSF/ANSI):
- 14-06.....Plastic Piping System Components and Related
Materials
- 50-2009a.....Equipment for Swimming Pools, Spas, Hot Tubs
and other Recreational Water Facilities -
Evaluation criteria for materials, components,

products, equipment and systems for use at
recreational water facilities

61-2008.....Drinking Water System Components - Health
Effects

L. Tubular Exchanger Manufacturers Association: TEMA 9th Edition, 2007

1.6 SPARE PARTS

A. For mechanical pressed sealed fittings provide tools required for each
pipe size used at the facility.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

A. Provide in accordance with Section 23 05 11, COMMON WORK RESULTS FOR
HVAC and STEAM GENERATION.

2.2 PIPE AND TUBING

A. Chilled Water:

1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
2. Copper water tube option: ASTM B88, Type K or L, hard drawn

B. Cooling Coil Condensate Drain Piping:

1. From air handling units: Copper water tube, ASTM B88, Type M, or
schedule 40 PVC plastic piping.
2. From fan coil or other terminal units: Copper water tube, ASTM B88,
Type L for runouts and Type M for mains.

C. Pipe supports, including insulation shields, for above ground piping:
Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

2.3 FITTINGS FOR STEEL PIPE

A. 50 mm (2 inches) and Smaller: Screwed or welded joints.

1. Butt welding: ASME B16.9 with same wall thickness as connecting
piping.
2. Forged steel, socket welding or threaded: ASME B16.11.
3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron,
ASME B16.4, may be used in lieu of malleable iron. Bushing reduction
of a single pipe size, or use of close nipples, is not acceptable.
4. Unions: ASME B16.39.
5. Water hose connection adapter: Brass, pipe thread to 20 mm (3/4
inch) garden hose thread, with hose cap nut.

B. 65 mm (2-1/2 inches) and Larger: Welded or flanged joints. Contractor's
option: Grooved mechanical couplings and fittings are optional.

1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
2. Welding flanges and bolting: ASME B16.5:
 - a. Water service: Weld neck or slip-on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
 - 1) Contractor's option: Convoluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
 - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.
- D. Grooved Mechanical Pipe Couplings and Fittings (Contractor's Option): Grooved Mechanical Pipe Couplings and Fittings may be used, with cut or roll grooved pipe, in water service up to 110 degrees C (230 degrees F) in lieu of welded, screwed or flanged connections. All joints must be rigid type.
 1. Grooved mechanical couplings: Malleable iron, ASTM A47 or ductile iron, ASTM A536, fabricated in two or more parts, securely held together by two or more track-head, square, or oval-neck bolts, ASTM A449 and A183.
 2. Gaskets: Rubber product recommended by the coupling manufacturer for the intended service.
 3. Grooved end fittings: Malleable iron, ASTM A47; ductile iron, ASTM A536; or steel, ASTM A53 or A106, designed to accept grooved mechanical couplings. Tap-in type branch connections are acceptable.

2.4 FITTINGS FOR COPPER TUBING

- A. Joints:
 1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
 2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall.

Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.

- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

2.5 FITTINGS FOR PLASTIC PIPING

- A. Schedule 40, socket type for solvent welding.
- B. Schedule 40 PVC drain piping: Drainage pattern.
- C. Chemical feed piping for condenser water treatment: Chlorinated polyvinyl chloride (CPVC), Schedule 80, ASTM F439.

2.6 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- C. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 99 degrees C (210 degrees F).
- E. Contractor's option: On pipe sizes 2" and smaller, screwed end brass ball valves or dielectric nipples may be used in lieu of dielectric unions.

2.7 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.8 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- D. Shut-Off Valves
 - 1. Ball Valves (Pipe sizes 2" and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.

2. Butterfly Valves (Pipe Sizes 2-1/2" and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS-SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Not permitted for direct buried pipe applications.

- a. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65-45-12 electro-plated.
- b. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
- c. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
 - 1) Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
 - 2) Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.
 - 3) 3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):
 - a) 50 mm (2 inches) and smaller: MSS-SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
 - b) 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS-SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

E. Globe and Angle Valves

1. Globe Valves

- a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.

- b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for globe valves.
 - 2. Angle Valves:
 - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
 - b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-85 for angle.
- F. Check Valves
 - 1. Swing Check Valves:
 - a. 50 mm (2 inches) and smaller: MSS-SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
 - b. 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS-SP-71 for check valves.
 - 2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
 - a. Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
 - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- G. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
 - 1. Globe style valve.
 - 2. A dual purpose flow balancing valve and adjustable flow meter, with bronze or cast iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
 - 3. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
- H. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of at least 10 times the minimum required for control. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:

1. Gray iron (ASTM A126) or brass body rated 1205 kPa (175 psig) at 93 degrees C (200 degrees F), with stainless steel piston and spring.
 2. Brass or ferrous body designed for 2067 kPa (300 psig) service at 121 degrees C (250 degrees F), with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
 3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
 4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
- I. Manual Radiator/Convactor Valves: Brass, packless, with position indicator.

2.9 STRAINERS

A. Y Type.

1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter perforations for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

B. Suction Diffusers: Specified in Section 23 21 23, HYDRONIC PUMPS.

2.10 FLEXIBLE CONNECTORS FOR WATER SERVICE

A. Flanged Spool Connector:

1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
2. Working pressures and temperatures shall be as follows:
 - a. Connector sizes 50 mm to 100 mm (2 inches to 4 inches), 1137 kPa (165psig) at 121 degrees C (250 degrees F).
 - b. Connector sizes 125 mm to 300 mm (5 inches to 12 inches), 965 kPa (140 psig) at 121 degrees C (250 degrees F).
3. Provide ductile iron retaining rings and control units.

B. Mechanical Pipe Couplings:

See other fittings specified under Part 2, PRODUCTS.

2.11 EXPANSION JOINTS

- A. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
- B. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association Standards.
- C. Bellows - Internally Pressurized Type:
 - 1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
 - 2. Internal stainless steel sleeve entire length of bellows.
 - 3. External cast iron equalizing rings for services exceeding 340 kPa (50 psig).
 - 4. Welded ends.
 - 5. Design shall conform to standards of EJMA and ASME B31.1.
 - 6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
 - 7. Integral external cover.
- D. Bellows - Externally Pressurized Type:
 - 1. Multiple corrugations of Type 304 stainless steel.
 - 2. Internal and external guide integral with joint.
 - 3. Design for external pressurization of bellows to eliminate squirm.
 - 4. Welded ends.
 - 5. Conform to the standards of EJMA and ASME B31.1.
 - 6. Threaded connection at bottom, 25 mm (one inch) minimum, for drain or drip point.
 - 7. Integral external cover and internal sleeve.
- E. Expansion Compensators:
 - 1. Corrugated bellows, externally pressurized, stainless steel or bronze.
 - 2. Internal guides and anti-torque devices.
 - 3. Threaded ends.
 - 4. External shroud.
 - 5. Conform to standards of EJMA.
- F. Expansion Joint (Contractor's Option): 2415 kPa (350 psig) maximum working pressure, steel pipe fitting consisting of telescoping body and

slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with grooved ends, suitable for axial end movement to 75 mm (3 inch).

- G. Expansion Joint Identification: Provide stamped brass or stainless steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
- H. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
- I. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.

2.12 HYDRONIC SYSTEM COMPONENTS

- A. Automatic Air Vent Valves (where shown): Cast iron or semi-steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

2.13 WATER FILTERS AND POT CHEMICAL FEEDERS

See section 23 25 00, HVAC WATER TREATMENT, Article 2.2, CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS.

2.14 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 115 mm (4-1/2 inches) in diameter, 6 mm (1/4 inch) NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.
- C. Range of Gages: Provide range equal to at least 130 percent of normal operating range.

1. For condenser water suction (compound): Minus 100 kPa (30 inches Hg) to plus 700 kPa (100 psig).

2.15 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.
- B. Provide one each of the following test items to the Resident Engineer:
 1. 6 mm (1/4 inch) FPT by 3 mm (1/8 inch) diameter stainless steel pressure gage adapter probe for extra long test plug. PETE'S 500 XL is an example.
 2. 90 mm (3-1/2 inch) diameter, one percent accuracy, compound gage, -- 100 kPa (30 inches) Hg to 700 kPa (100 psig) range.
 3. 0 - 104 degrees C (220 degrees F) pocket thermometer one-half degree accuracy, 25 mm (one inch) dial, 125 mm (5 inch) long stainless steel stem, plastic case.

2.16 THERMOMETERS

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 150 mm (6 inch) brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 225 mm (9 inches), range as described below, two degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges:
 1. Chilled Water and Glycol-Water: 0-38 degrees C (32-100 degrees F).
 2. Hot Water and Glycol-Water: -1 - 116 degrees C (30-240 degrees F).

2.17 FIRESTOPPING MATERIAL

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

PART 3 - EXECUTION

3.1 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to

the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- E. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
- G. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:

1. Water treatment pot feeders and condenser water treatment systems.
 2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- J. Thermometer Wells: In pipes 65 mm (2-1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.
- K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.
- L. Where copper piping is connected to steel piping, provide dielectric connections.

3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. Mechanical Joint: Pipe grooving shall be in accordance with joint manufacturer's specifications. Lubricate gasket exterior including lips, pipe ends and housing interiors to prevent pinching the gasket during installation. Lubricant shall be as recommended by coupling manufacturer.
- D. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- E. Solvent Welded Joints: As recommended by the manufacturer.

3.3 EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- A. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
- B. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.

- C. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
- D. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.

3.4 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.5 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
 - 1. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various

- type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Resident Engineer.
2. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow-down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
 3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.6 OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- A. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Adjust red set hand on pressure gages to normal working pressure.

- - - E N D - - -

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Ductwork and accessories for HVAC including the following:
 - 1. Supply air, return air, outside air, exhaust, make-up air, and relief systems.
- B. Definitions:
 - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
 - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2 RELATED WORK

- A. Fire Stopping Material: Section 07 84 00, FIRESTOPPING.
- B. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- C. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING and EQUIPMENT.
- D. Duct Insulation: Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- B. Fire Safety Code: Comply with NFPA 90A.
- C. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- D. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- E. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Rectangular ducts:
 - a. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access doors.
 - 2. Round and flat oval duct construction details:
 - a. Manufacturer's details for duct fittings.
 - b. Duct liner.
 - c. Sealants and gaskets.
 - d. Access sections.
 - e. Installation instructions.
 - 3. Volume dampers, back draft dampers.
 - 4. Upper hanger attachments.
 - 5. Fire dampers, fire doors, and smoke dampers with installation instructions.
 - 6. Sound attenuators, including pressure drop and acoustic performance.
 - 7. Flexible ducts and clamps, with manufacturer's installation instructions.
 - 8. Flexible connections.
 - 9. Instrument test fittings.
 - 10. Details and design analysis of alternate or optional duct systems.
 - 11. COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11 - Common Work Results for HVAC and Steam Generation.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):
 - ASCE7-05.....Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials (ASTM):

- A167-99(2009).....Standard Specification for Stainless and
Heat-Resisting Chromium-Nickel Steel Plate,
Sheet, and Strip
- A653-09.....Standard Specification for Steel Sheet,
Zinc-Coated (Galvanized) or Zinc-Iron Alloy
coated (Galvannealed) by the Hot-Dip process
- A1011-09a.....Standard Specification for Steel, Sheet and
Strip, Hot rolled, Carbon, structural, High-
Strength Low-Alloy, High Strength Low-Alloy with
Improved Formability, and Ultra-High Strength
- B209-07.....Standard Specification for Aluminum and
Aluminum-Alloy Sheet and Plate
- C1071-05e1.....Standard Specification for Fibrous Glass Duct
Lining Insulation (Thermal and Sound Absorbing
Material)
- E84-09a.....Standard Test Method for Surface Burning
Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):
- 90A-09.....Standard for the Installation of Air
Conditioning and Ventilating Systems
- 96-08.....Standard for Ventilation Control and Fire
Protection of Commercial Cooking Operations
- E. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA):
- 2nd Edition - 2005.....HVAC Duct Construction Standards, Metal and
Flexible
- 1st Edition - 1985.....HVAC Air Duct Leakage Test Manual
- 6th Edition - 2003.....Fibrous Glass Duct Construction Standards
- F. Underwriters Laboratories, Inc. (UL):
- 181-08.....Factory-Made Air Ducts and Air Connectors
- 555-06Standard for Fire Dampers
- 555S-06Standard for Smoke Dampers

PART 2 - PRODUCTS

2.1 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts,
casings, and accessories of galvanized sheet steel, ASTM A653, coating
G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003 or 5052.
- B. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167,
Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts

and Finish No. 2B for concealed duct or ducts located in mechanical rooms.

C. Optional Duct Materials:

D. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.

1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
3. Gaskets in Flanged Joints: Soft neoprene.

E. Approved factory made joints may be used.

2.2 DUCT CONSTRUCTION AND INSTALLATION

A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate and seal the ductwork in accordance with the following pressure classifications:

B. Duct Pressure Classification:

- 0 to 50 mm (2 inch)
- > 50 mm to 75 mm (2 inch to 3 inch)
- > 75 mm to 100 mm (3 inch to 4 inch)

Show pressure classifications on the floor plans.

C. Seal Class: All ductwork shall receive Class A Seal

D. Wet Air Exhaust Ducts and Accessories: Ducts for dishwashers, scullery hood, cart washers, manual cart washers, cage washers, steam sterilizer hoods and orthotics hoods shall be 1.3 mm (18 gage) stainless steel made liquid tight with continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self draining back to the equipment, provide low point drain pocket with copper drain pipe to sanitary sewer. Provide access door in side of duct at drain pockets.

E. Duct for Negative Pressure Up to 750 Pa (3 inch W.G.): Provide for exhaust duct between HEPA filters and exhaust fan inlet including systems for Autopsy Suite exhaust.

1. Round Duct: Galvanized steel, spiral lock seam construction with standard slip joints.

2. Rectangular Duct: Galvanized steel, minimum 1.0 mm (20 gage), Pittsburgh lock seam, companion angle joints 32 mm by 3.2 mm (1-1/4 by 1/8 inch) minimum at not more than 2.4 m (8 feet) spacing. Approved pre-manufactured joints are acceptable in lieu of companion angles.
- F. Round and Flat Oval Ducts: Furnish duct and fittings made by the same manufacturer to insure good fit of slip joints. When submitted and approved in advance, round and flat oval duct, with size converted on the basis of equal pressure drop, may be furnished in lieu of rectangular duct design shown on the drawings.
1. Elbows: Diameters 80 through 200 mm (3 through 8 inches) shall be two sections die stamped, all others shall be gored construction, maximum 18 degree angle, with all seams continuously welded or standing seam. Coat galvanized areas of fittings damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.
 2. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA HVAC Duct Construction Standards.
 3. Ribbed Duct Option: Lighter gage round/oval duct and fittings may be furnished provided certified tests indicating that the rigidity and performance is equivalent to SMACNA standard gage ducts are submitted.
 - a. Ducts: Manufacturer's published standard gage, G90 coating, spiral lock seam construction with an intermediate standing rib.
 - b. Fittings: May be manufacturer's standard as shown in published catalogs, fabricated by spot welding and bonding with neoprene base cement or machine formed seam in lieu of continuous welded seams.
 4. Provide flat side reinforcement of oval ducts as recommended by the manufacturer and SMACNA HVAC Duct Construction Standard S3.13. Because of high pressure loss, do not use internal tie-rod reinforcement unless approved by the Resident Engineer.
- G. Casings and Plenums: Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 - 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.

- H. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- I. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.
- J. Ductwork in excess of 620 cm² (96 square inches) shall be protected unless the duct has one dimension less than 150 mm (6 inches) if it passes through the areas listed below. Refer to the Mission Critical Physical Design Manual for VA Facilities. This applies to the following:
 - 1. Agent cashier spaces
 - 2. Perimeter partitions of caches
 - 3. Perimeter partitions of computer rooms
 - 4. Perimeter of a COOP sites
 - 5. Perimeter partitions of Entrances
 - 6. Security control centers (SCC)

2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
 - 1. Each duct mounted coil and humidifier.
 - 2. Each fire damper (for link service), smoke damper and automatic control damper.
 - 3. Each duct mounted smoke detector.
 - 4. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 6 m (20 feet) intervals and at each change in duct direction.
- B. Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12 inch) minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
 - 1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
 - 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

2.4 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

- B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- C. Minimum requirements for fire dampers:
 - 1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
 - 2. Submit manufacturer's installation instructions conforming to UL rating test.

2.5 SMOKE DAMPERS

- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.13 inch W.G.).
- B. Maximum air leakage, closed damper: 0.32 cubic meters /min/square meter (4.0 CFM per square foot) at 750 Pa (3 inch W.G.) differential pressure.
- C. Minimum requirements for dampers:
 - 1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
 - 2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
 - 3. Blades: Galvanized steel, parallel type preferably, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
 - 4. Shafts: Galvanized steel.
 - 5. Bearings: Nylon, bronze sleeve or ball type.
 - 6. Hardware: Zinc plated.
 - 7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

2.7 FIRE DOORS

Galvanized steel, interlocking blade type, UL listing and label, 71 degrees C (160 degrees F) fusible link, 3 hour rating and approved for openings in Class A fire walls with rating up to 4 hours, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

2.8 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 m (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.
- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).
- D. Application Criteria:
 - 1. Temperature range: -18 to 93 degrees C (0 to 200 degrees F) internal.
 - 2. Maximum working velocity: 1200 m/min (4000 feet per minute).
 - 3. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.
- E. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

2.9 FLEXIBLE DUCT CONNECTIONS

Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with

stainless steel or zinc-coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack to insure that no vibration is transmitted.

2.10 AIR FLOW CONTROL VALVES (AFCV)

Refer to Section 23 36 00 / 23 82 00, AIR TERMINAL UNITS / CONVECTION HEATING and COOLING UNITS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
 - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the government. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
 - 2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
 - 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
 - 4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

- D. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the Resident Engineer. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Resident Engineer.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 1.5 m (5 feet) long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.
- G. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- H. Control Damper Installation:
 - 1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 - 2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 - 3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
 - 4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- I. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.

- J. Low Pressure Duct Liner: Install in accordance with SMACNA, Duct Liner Application Standard.
- K. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
- B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections. Based upon satisfactory initial duct leakage test results, the scope of the testing may be reduced by the Resident Engineer on ductwork constructed to the 500 Pa (2" WG) duct pressure classification. In no case shall the leakage testing of ductwork constructed above the 500 Pa (2" WG) duct pressure classification or ductwork located in shafts or other inaccessible areas be eliminated.
- C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. All tests shall be performed in the presence of the Resident Engineer and the Test and Balance agency. The Test and Balance agency shall measure and record duct leakage and report to the Resident Engineer and identify leakage source with excessive leakage.
- F. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Resident Engineer.
- G. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- H. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

3.3 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, and BALANCING FOR HVAC.

3.4 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM
GENERATION

- - - E N D - - -

SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Fans for heating, ventilating and air conditioning.
- B. Product Definitions: AMCA Publication 99, Standard 1-66.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- D. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- E. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- F. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- G. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- I. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- J. Section 23 82 16, AIR COILS.
- K. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC 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.
 - 4. Power roof and wall ventilators.
- C. Certified Sound power levels for each fan.
- D. Motor ratings types, electrical characteristics and accessories.
- E. Roof curbs.
- F. Belt guards.
- G. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- H. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Movement and Control Association International, Inc. (AMCA):

- 99-86.....Standards Handbook
- 210-06.....Laboratory Methods of Testing Fans for
Aerodynamic Performance Rating
- 261-09.....Directory of Products Licensed to bear the AMCA
Certified Ratings Seal - Published Annually
- 300-08.....Reverberant Room Method for Sound Testing of
Fans
- C. American Society for Testing and Materials (ASTM):
- B117-07a.....Standard Practice for Operating Salt Spray (Fog)
Apparatus
- D1735-08.....Standard Practice for Testing Water Resistance
of Coatings Using Water Fog Apparatus
- D3359-08.....Standard Test Methods for Measuring Adhesion by
Tape Test
- G152-06.....Standard Practice for Operating Open Flame
Carbon Arc Light Apparatus for Exposure of Non-
Metallic Materials
- G153-04.....Standard Practice for Operating Enclosed Carbon
Arc Light Apparatus for Exposure of Non-Metallic
Materials
- D. National Fire Protection Association (NFPA):
- NFPA 96-08.....Standard for Ventilation Control and Fire
Protection of Commercial Cooking Operations
- E. National Sanitation Foundation (NSF):
- 37-07.....Air Curtains for Entrance Ways in Food and Food
Service Establishments
- F. Underwriters Laboratories, Inc. (UL):
- 181-2005.....Factory Made Air Ducts and Air Connectors

1.6 EXTRA MATERIALS

- A. Provide one additional set of belts for all belt-driven fans.

PART 2 - PRODUCTS

2.1 FAN SECTION (CABINET FAN)

Refer to specification Section 23 73 00, INDOOR CENTRAL-STATION AIR-
HANDLING UNITS.

2.2 POWER ROOF VENTILATOR

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY
ASSURANCE.
- B. Type: Centrifugal fan, backward inclined blades. Provide down-blast or
up-blast type as indicated.

- C. Construction: Steel or aluminum, completely weatherproof, for curb mounting, exhaust cowl or entire drive assembly readily removable for servicing, aluminum bird screen on discharge, UL approved safety disconnect switch, conduit for wiring, vibration isolators for wheel, motor and drive assembly. Provide self acting back draft damper. Provide electric motor operated damper where indicated.
- D. Motor and Drive: Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Bearings shall be pillow block ball type with a minimum L-50 life of 200,000 hours. Motor shall be located out of air stream.
- E. Prefabricated Roof Curb: As specified in paragraph 2.3 of this section.
- F. Up-blast Type: Top discharge exhaust, motor out of air stream. For kitchen hood exhaust applications, provide grease trough on base and threaded drain. The mounting height of the kitchen up-blast exhaust fan shall be in compliance with NFPA 96. (Provide vented curb extension if required to maintain required clearances.)

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.

Department of Veteran Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC Houston, TX

- - - E N D - - -

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

Air terminal units, air flow control valves.

1.2 RELATED WORK

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Noise requirements.
- D. Section 23 31 00, HVAC DUCTS AND CASINGS: Ducts and flexible connectors.
- E. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Valve operators.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Flow rates adjusting and balancing.
- G. Section 23 82 16, AIR COILS: Heating and Cooling Coils pressure ratings.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Air Terminal Units: Submit test data.
 - 2. Air flow control valves.
- 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. Air Conditioning and Refrigeration Institute (AHRI)/(ARI):
880-08.....Air Terminals Addendum to ARI 888-98
incorporated into standard posted 15th December
2002
- C. National Fire Protection Association (NFPA):
90A-09.....Standard for the Installation of Air
Conditioning and Ventilating Systems
- D. Underwriters Laboratories, Inc. (UL):
181-08.....Standard for Factory-Made Air Ducts and Air
Connectors
- E. American Society for Testing and Materials (ASTM):
C 665-06.....Standard Specification for Mineral-Fiber
Blanket Thermal Insulation for Light Frame
Construction and Manufactured Housing

1.6 GUARANTY

In accordance with the GENERAL CONDITIONS

PART 2 - PRODUCTS

2.1 GENERAL

- A. Coils:
1. Water Heating Coils:
 - a. ARI certified, continuous plate or spiral fin type, leak tested at 2070 kPa (300 PSI).
 - b. Capacity: As indicated, based on scheduled entering water temperature.
 - c. Headers: Copper or Brass.
 - d. Fins: Aluminum, maximum 315 fins per meter (8 fins per inch).
 - e. Tubes: Copper, arrange for counter-flow of heating water.
 - f. Water Flow Rate: Minimum 0.032 Liters/second (0.5 GPM).
 - g. Provide vent and drain connection at high and low point, respectively of each coil.
 - h. Coils shall be guaranteed to drain.
 4. Electric Heating Coils:
 - a. ARI certified, spiral fin type.

- b. Capacity: As indicated, based on scheduled data.
- c. Coil: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings will not be allowed.
- B. Labeling: Control box shall be clearly marked with an identification label that lists such information as nominal CFM, maximum and minimum factory-set airflow limits, coil type and coil connection orientation, where applicable.
- C. Factory calibrate air terminal units to air flow rate indicated. All settings including maximum and minimum air flow shall be field adjustable.
- D. Dampers with internal air volume control: See section 23 31 00 HVAC DUCTS and CASINGS.
- E. Terminal Sound Attenuators: See Section 23 31 00 (HVAC DUCTS AND CASINGS).

2.2 AIR TERMINAL UNITS (BOXES)

- A. General: Factory built, pressure independent units, factory set-field adjustable air flow rate, suitable for single duct applications. Use of dual-duct air terminal units is not permitted. Clearly show on each unit the unit number and factory set air volumes corresponding to the contract drawings. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC work assumes factory set air volumes. Coordinate flow controller sequence and damper operation details with the drawings and Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. All air terminal units shall be brand new products of the same manufacturer.
- B. Capacity and Performance: The Maximum Capacity of a single terminal unit shall not exceed 566 Liters/second (1,200 CFM) with the exception of operating rooms and Cystoscopy rooms, which shall be served by a single air terminal unit at a maximum of 1,250 Liters/second (3,000 CFM).
- C. Sound Power Levels:
Acoustic performance of the air terminal units shall be based on the design noise levels for the spaces stipulated in Section 23 05 41 (Noise and Vibration Control for HVAC Piping and Equipment). Equipment schedule (...) shall show the sound power levels in all octave bands.

Terminal sound attenuators shall be provided, as required, to meet the intent of the design.

- D. Casing: Unit casing shall be constructed of galvanized steel no lighter than 0.85 mm (22 Gauge). Air terminal units serving the operating rooms and Cystoscopy rooms shall be fabricated without lining. Provide hanger brackets for attachment of supports.
1. Lining material: Suitable to provide required acoustic performance, thermal insulation and prevent sweating. Meet the requirements of NFPA 90A and comply with UL 181 for erosion as well as ASTM C 665 antimicrobial requirements. Insulation shall consist of 13 mm (1/2 IN) thick non-porous foil faced rigid fiberglass insulation of 4-lb/cu.ft, secured by full length galvanized steel z-strips which enclose and seal all edges. Tape and adhesives shall not be used. Materials shall be non-friable and with surfaces, including all edges, fully encapsulated and faced with perforated metal or coated so that the air stream will not detach material. No lining material is permitted in the boxes serving operating rooms and Cystoscopy rooms.
 2. Access panels (or doors): Provide panels large enough for inspection, adjustment and maintenance without disconnecting ducts, and for cleaning heating coils attached to unit, even if there are no moving parts. Panels shall be insulated to same standards as the rest of the casing and shall be secured and gasketed airtight. It shall require no tool other than a screwdriver to remove.
 3. Total leakage from casing: Not to exceed 2 percent of the nominal capacity of the unit when subjected to a static pressure of 750 Pa (3 inch WG), with all outlets sealed shut and inlets fully open.
 4. Octopus connector: Factory installed, lined air distribution terminal. Provide where flexible duct connections are shown on the drawings connected directly to terminals. Provide butterfly-balancing damper, with locking means in connectors with more than one outlet. Octopus connectors and flexible connectors are not permitted in the Surgical Suite.
- E. Construct dampers and other internal devices of corrosion resisting materials which do not require lubrication or other periodic maintenance.

1. Damper Leakage: Not greater than 2 percent of maximum rated capacity, when closed against inlet static pressure of 1 kPa (4 inch WG) .
- F. Provide multi-point velocity pressure sensors with external pressure taps.
1. Provide direct reading air flow rate table pasted to box.
- G. Provide static pressure tubes.
- H. Externally powered DDC variable air volume controller and damper actuator to be furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for factory mounting on air terminal units. The DDC controller shall be electrically actuated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.
- B. Handle and install units in accordance with manufacturer's written instructions.
- C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.
- D. Locate air terminal units to provide a straight section of inlet duct for proper functioning of volume controls. See VA Standard Detail.

3.2 OPERATIONAL TEST

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Roof Curbs
- B. Air Outlets and Inlets: Diffusers, Registers, and Grilles.

1.2 RELATED WORK

- A. Outdoor and Exhaust Louvers: Section 08 90 00, LOUVERS AND VENTS.
- B. Kitchen Hoods: Section 23 38 13, COMMERCIAL-KITCHEN HOODS.
- C. Fume Hoods: Section 11 53 13, LABORATORY FUME HOODS.
- D. Seismic Reinforcing: Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- E. General Mechanical Requirements: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- F. Noise Level Requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- G. Testing and Balancing of Air Flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

- A. Refer to article, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Fire Safety Code: Comply with NFPA 90A.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Air intake/exhaust hoods.
 - 2. Diffusers, registers, grilles and accessories.
- C. Coordination Drawings: Refer to article, SUBMITTALS, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Diffusion Council Test Code:
1062 GRD-84.....Certification, Rating, and Test Manual 4th
Edition
- C. American Society of Civil Engineers (ASCE):

ASCE7-05.....Minimum Design Loads for Buildings and Other
Structures

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

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

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

E. National Fire Protection Association (NFPA):

90A-09.....Standard for the Installation of Air
Conditioning and Ventilating Systems

F. Underwriters Laboratories, Inc. (UL):

181-08.....UL Standard for Safety Factory-Made Air Ducts
and Connectors

PART 2 - PRODUCTS

2.1 GRAVITY INTAKE/EXHAUST VENTILATORS (ROOF MOUNTED)

A. Aluminum, ASTM B209, louvered, spun, or fabricated using panel sections with roll-formed edges, 13 mm (1/2 inch) mesh aluminum welded wire bird screen, with gravity or motorized dampers where shown, accessible interior, designed for wind velocity specified in Paragraph 3.3.

1. Spun Intake/Exhaust Ventilators: Spun aluminum structural components shall be constructed of minimum 1.3 mm (16 Gauge) marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength.
2. Louvered Intake/Exhaust Hoods: Louvered hood constructed from 0.081 Gauge extruded aluminum tiers welded to a minimum 3.3 mm (8 Gauge) aluminum support structure. The aluminum hood shall be constructed of a minimum 0.064 marine alloy aluminum and provided with a layer of anti-condensate coating. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.
3. Low Silhouette Intake/Exhaust Ventilator: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 1.60 mm (14 Gauge) marine alloy aluminum, bolted to a minimum 3.25 mm (8 Gauge) aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 13 mm (1/2 inch) mesh shall be mounted across the relief opening.

- B. See ventilator schedule on the drawings. Sizes shown on the drawings designate throat size. Area of ventilator perimeter opening shall be not less than the throat area.
- C. Dampers for Gravity Ventilators without Duct Connection: Construct damper of the same material as the ventilator and of the design to completely close opening or remain wide open. Hold damper in closed position by a brass chain and catch. Extend chains 300 mm (12 inches) below and engage catch when damper is closed.
- D. Provide Roof Curb by unit manufacturer. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION for additional requirements.

2.2 EQUIPMENT SUPPORTS

Refer to Section 21 05 11, COMMON WORK RESULTS FOR FIRE SUPPRESSION, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.

2.3 AIR OUTLETS AND INLETS

- A. Materials:
 - 1. Steel or aluminum Provide manufacturer's standard gasket.
 - 2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
 - 3. Contractor shall review all ceiling drawings and details and provide all ceiling mounted devices with appropriate dimensions and trim for the specific locations.
- B. Performance Test Data: In accordance with Air Diffusion Council Code 1062GRD. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT for NC criteria.
- C. Air Supply Outlets:
 - 1. Ceiling Diffusers: Suitable for surface mounting, exposed T-bar or special tile ceilings, off-white finish, square or round neck connection as shown on the drawings. Provide plaster frame for units in plaster ceilings.
 - a. Square, louver, fully adjustable pattern: Round neck, surface mounting unless shown otherwise on the drawings. Provide equalizing or control grid and volume control damper.
 - b. Louver face type: Square or rectangular, removable core for 1, 2, 3, or 4 way directional pattern. Provide equalizing or control grid and opposed blade damper.
 - c. Perforated face type: Manual adjustment for one-, two-, three-, or four-way horizontal air distribution pattern without change of air

- volume or pressure. Provide equalizing or control grid and opposed blade over overlapping blade damper. Perforated face diffusers for VAV systems shall have the pattern controller on the inner face, rather than in the neck and designed to discharge air horizontally at the ceiling maintaining a Coanda effect.
4. Supply Registers: Double deflection type with horizontal face bars and opposed blade damper with removable key operator.
 - a. Margin: Flat, 30 mm (1-1/4 inches) wide.
 - b. Bar spacing: 20 mm (3/4 inch) maximum.
 - c. Finish: Off white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded with manufacturer's standard finish.
 5. Supply Grilles: Same as registers but without the opposed blade damper.
- D. Return and Exhaust Registers and Grilles: Provide opposed blade damper without removable key operator for registers.
1. Finish: Off-white baked enamel for ceiling mounted units. Wall units shall have a prime coat for field painting, or shall be extruded aluminum with manufacturer's standard aluminum finish.
 2. Standard Type: Fixed horizontal face bars set at 30 to 45 degrees, approximately 30 mm (1-1/4 inch) margin.
 3. Perforated Face Type: To match supply units.
 4. Grid Core Type: 13 mm by 13 mm (1/2 inch by 1/2 inch) core with 30 mm (1-1/4 inch) margin.
 5. Linear Type: To match supply units.
 6. Door Grilles: Are furnished with the doors.
 7. Egg Crate Grilles: Aluminum or Painted Steel 1/2 by 1/2 by 1/2 inch grid providing 90% free area.
 - a. Heavy extruded aluminum frame shall have countersunk screw mounting. Unless otherwise indicated, register blades and frame shall have factory applied white finish.
 - b. Grille shall be suitable for duct or surface mounting as indicated on drawings. All necessary appurtenances shall be provided to allow for mounting.
- E. Supply Registers in Psychiatric Rooms: Supply air registers shall be security type, steel with perforated faceplate, flat surface margin, extension sleeve, opposed blade damper and back mounting flanges. Faceplate shall be 5 mm (3/16 inch) (minimum) with 5x5 mm holes on 7 mm (3/16 by 3/16 inch holes on 9/32 inch) spacing and a minimum free

area of 45 percent. Wall sleeve shall be 5 mm (3/16 inch) thick (minimum).

F. Air Inlet Registers in Psychiatric Rooms: Return, exhaust, transfer and relief air registers shall be security type, steel with perforated faceplate, flat surface margin, wall sleeve, opposed blade damper and back mounting flanges. Faceplate shall be 5 mm (3/16 inch) (minimum) with 5x5 mm holes on 7 mm (3/16 by 3/16 inch holes on 9/32 inch) spacing and a minimum free area of 45 percent. Wall sleeve shall be 5 mm (3/16 inch) thick (minimum).

G. Acoustic Transfer Grille: Aluminum, suitable for partition or wall mounting.

2.4 WIRE MESH GRILLE

A. Fabricate grille with 2 x 2 mesh 13 mm (1/2 inch) galvanized steel or aluminum hardware cloth in a spot welded galvanized steel frame with approximately 40 mm (1-1/2 inch) margin.

B. Use grilles where shown in unfinished areas such as mechanical rooms.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, particularly regarding coordination with other trades and work in existing buildings.

B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.2 TESTING, ADJUSTING AND BALANCING (TAB)

Refer to Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.3 OPERATING AND PERFORMANCE TESTS

Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION

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SECTION 23 73 00
INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Air handling units including integral components specified herein.
- B. Definitions: Air Handling Unit (AHU): A factory fabricated and tested assembly of modular sections consisting of housed-centrifugal fan with direct-drive, coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, dehumidifying, and mixing of air. Design capacities of units shall be as scheduled on the drawings.

1.2 RELATED WORK

- A. General mechanical requirements and items, which are common to more than one section of Division 23: Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Sound and vibration requirements: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- C. Piping and duct insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- D. Piping and valves: Section 23 21 13 / 23 22 13, HYDRONIC PIPING / STEAM AND CONDENSATE HEATING PIPING.
- E. Heating and cooling coils and pressure requirements: Section 23 82 16, AIR COILS.
- F. Return and exhaust fans: Section 23 34 00, HVAC FANS.
- G. Requirements for flexible duct connectors, sound attenuators and sound absorbing duct lining, and air leakage: Section 23 31 00, HVAC DUCTS and CASINGS.
- H. Air filters and filters' efficiency: Section 23 40 00, HVAC AIR CLEANING DEVICES.
- I. HVAC controls: Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- J. Testing, adjusting and balancing of air and water flows: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- K. Types of motors: Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- L. Types of motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- M. General Commissioning: Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS
- N. HVAC Commissioning: Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS

1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Air Handling Units Certification
 - 1. Air Handling Units with Housed Centrifugal Fans: The air handling units shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
 - 2. Air Handling Units with Plenum Fans:
 - a. Air Handling Units with a single Plenum Fan shall be certified in accordance with AHRI 430 and tested/rated in accordance with AHRI 260.
 - b. Air handling Units with Multiple Fans in an Array shall be tested and rated in accordance with AHRI 430 and AHRI 260.
- C. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.
- D. Performance Criteria:
 - 1. The fan BHP shall include all system effects for all fans and v-belt drive losses for housed centrifugal fans.
 - 2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
 - 3. Select the fan operating point as follows:
 - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point.
 - b. Air Foil, Backward Inclined, or Tubular Fans Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
 - 4. Operating Limits: AMCA 99 and Manufacturer's Recommendations.
- E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least five (5) years.

1.4. SUBMITTALS:

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for all air handling units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:
 - 1. Submittals for AHUs shall include fans, drives, motors, coils, mixing box with outside/return air dampers, filter housings,, and all other related accessories. The contractor shall provide custom drawings

- showing total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc).
2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version used by the VA at the time of submission.
 3. Submit sound power levels in each octave band for the inlet and discharge of the fan and at entrance and discharge of AHUs at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
 4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute).
 5. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.
- E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.
1. Units shall be shipped in one (1) piece where possible and in shrink wrapping to protect the unit from dirt, moisture and/or road salt.

2. If not shipped in one (1) piece, provide manufacturer approved shipping splits where required for installation or to meet shipping and/or job site rigging requirements in modular sections. Indicate clearly that the shipping splits shown in the submittals have been verified to accommodate the construction constraints for rigging as required to complete installation and removal of any section for replacement through available access without adversely affecting other sections.
3. If shipping splits are provided, each component shall be individually shrink wrapped to protect the unit and all necessary hardware (e.g. bolts, gaskets etc.) will be included to assemble unit on site (see section 2.1.A4).
4. Lifting lugs will be provided to facilitate rigging on shipping splits and joining of segments. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI)/(ARI):
410-01.....Standard for Forced-Circulation Air-Heating and
Air-Cooling Coils
430-09.....Central Station Air Handling Units
- C. Air Movement and Control Association International, Inc. (AMCA):
210-07.....Laboratory Methods of Testing Fans for Rating
- D. American Society of Heating, Refrigerating and Air-conditioning
Engineers, Inc. (ASHRAE):
170-2008.....Ventilation of Health Care Facilities
- E. American Society for Testing and Materials (ASTM):
ASTM B117-07a.....Standard Practice for Operating Salt Spray (Fog)
Apparatus
ASTM D1654-08.....Standard Test Method for Evaluation of Painted
or Coated Specimens Subjected to Corrosive
Environments
ASTM D1735-08.....Standard Practice for Testing Water Resistance
of Coatings Using Water Fog Apparatus
ASTM D3359-08.....Standard Test Methods for Measuring Adhesion by
Tape Test

F. Military Specifications (Mil. Spec.):

MIL-P-21035B-2003.....Paint, High Zinc Dust Content, Galvanizing
Repair (Metric)

G. National Fire Protection Association (NFPA):

NFPA 90A.....Standard for Installation of Air Conditioning
and Ventilating Systems, 2009

H. Energy Policy Act of 2005 (P.L.109-58)

PART 2 - PRODUCTS

2.1 AIR HANDLING UNITS

A. Manufacturers:

1. Daikin (McQuay)
2. Johnson Controls (York Solution)
3. Approved Equal

B. General:

1. AHUs shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Casing shall be fabricated as specified in section 2.1.C.2. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units, subject to VA approval, may be used in place of galvanized steel. The unit manufacturer shall provide published documentation confirming that the structural rigidity of aluminum air-handling units is equal or greater than the specified galvanized steel.
2. The contractor and the AHU manufacturer shall be responsible for ensuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the government.
3. AHUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested, and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site.

- Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.
4. The AHU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a factory-trained and qualified local representative at the job site to supervise the assembly and to assure that the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation to the Contracting Officer that the local representative has provided services of similar magnitude and complexity on jobs of comparable size. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
 5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
 6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 1991 PA (8 inch WG) or higher.

C. Base:

1. Provide a heavy duty steel base for supporting all major AHU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 125 mm (5 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap and steam coil condensate return trap as shown on drawings.
2. AHUs shall be completely self supporting for installation on concrete housekeeping pad, steel support pedestals, or suspended as shown on drawings.
3. The AHU bases not constructed of galvanized steel shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

D. Casing (including wall, floor and roof):

1. General: AHU casing shall be constructed as solid double wall, galvanized steel insulated panels without any perforations, integral of or attached to a structural frame. The thickness of insulation, mode of application and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU located in the non-conditioned spaces.
2. Casing Construction:

Table 2.1.C.2

Outer Panel	0.8 mm (22 Gage) Minimum
Inner Panel	0.8 mm (22 Gage) Minimum
Insulation	Foam
Thickness	50 mm (2 inch) Minimum
Density	48 kg/m ³ (3.0 lb/ft ³) Minimum
Total R Value	2.3 m ² .K/W (13.0 ft ² .°F.hr/Btu) Minimum

3. Casing Construction (Contractor's Option):

Table 2.1.C.3

Outer Panel	1.3 mm (18 Gage) Minimum
Inner Panel	1.0 mm (20 Gage) Minimum
Insulation	Fiberglass
Thickness	50 mm (2 inch) Minimum
Density	24 kg/m ³ (1.5 lb/ft ³) Minimum
Total R Value	1.4 m ² .K/W (8.0 ft ² .°F.hr/Btu) Minimum

4. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
5. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications. Welded exterior panels are not acceptable.
6. Access Doors: Provide in each access section and where shown on drawings. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inch) thick with same double wall construction as the unit casing.

Doors shall be a minimum of 600 mm (24 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors for fan section, mixing box, coil section shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.

- a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 lb) weight hung on latch side of door.
 - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inch WG).
 - c. Gaskets: Neoprene, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
7. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

E. Floor:

1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 lbs per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation.

- Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.
2. Where indicated, furnish and install floor drains, flush with the floor, with nonferrous grate cover and stub through floor for external connection.
- E. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double-wall, double sloping type, and fabricated from stainless (304) with at least 50 mm (2 inch) thick insulation sandwiched between the inner and outer surfaces. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.
1. An intermediate, stainless-steel (304) condensate drip pan with copper downspouts shall be provided on stacked cooling coils. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
 2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
 3. Installation, including frame, shall be designed and sealed to prevent blow-by.
- F. Housed Centrifugal Fan Sections:
1. Fans shall be minimum Class II construction, double width, double inlet centrifugal, air type as indicated on drawings, factory balanced and rated in accordance with AMCA 210 or ASHRAE 51. Provide self-aligning, pillow block, regreasable ball-type bearings selected for a B (10) life of not less than 50,000 hours and an L (50) average fatigue life of 200,000 hours per AFBMA Standard 9. Extend bearing grease lines to motor and drive side of fan section. Fan shall be located in airstream to assure proper air flow.
 2. Provide internally vibration isolated fan, motor and drive, mounted on a common integral bolted or welded structural steel base with adjustable motor slide rail with locking device. Provide vibration isolators and flexible duct connections at fan discharge to completely isolate fan assembly. Refer to Section 23 05 41, NOISE AND

VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.

3. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).

G. Fan Motor, Drive, and Mounting Assembly (Housed Centrifugal Fans):

1. Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12 (General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications on AHUs where this type of drive is indicated. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
2. Fan drive and belts shall be factory mounted with final alignment and belt adjustment to be made by the Contractor after installation. Drive and belts shall be as specified in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION. Provide additional drive(s) if required during balancing, to achieve desired airflow.

H. Plenum Fans - Single and/or Multiple Fans in an Array:

1. General: Fans shall be Class II (minimum) construction with single inlet, aluminum wheel and stamped air-foil aluminum bladed. The fan wheel shall be mounted on the directly-driven motor shaft in AMCA Arrangement 4. Fans shall be dynamically balanced and internally isolated to minimize the vibrations. Provide a steel inlet cone for each wheel to match with the fan inlet. Locate fan in the air stream

- to assure proper flow. The fan performance shall be rated in accordance with AMCA 210 or ASHRAE 51.
2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 axial).
 3. The plenum fans shall be driven by variable speed drives with at least one back-up drive as shown in the design documents. Use of a drive with bypass is not permitted.
 4. Multiple fans shall be installed in a pre-engineered structural frame to facilitate fan stacking. All fans shall modulate in unison, above or below the synchronous speed within the limits specified by the manufacturer, by a common control sequence. Staging of the fans is not permitted. Redundancy requirement shall be met by all operating fans in an array and without the provision of an idle standby fan.
 5. Fan Accessories
 - a. Fan Airflow Measurement: Provide an airflow measuring device integral to the fan to measure air volume within +/- 5 percent accuracy. The probing device shall not be placed in the airflow path to stay clear of turbulence and avoid loss of performance.
- I. Fan Motor, Drive, and Mounting Assembly (Plenum Fans):
- Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12 (General Motor Requirements For HVAC and Steam Equipment), on drawings and suitable for use in variable frequency drive applications. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS

- J. Multi-zone damper blades shall be galvanized steel or aluminum type. Dampers shall have metal compressible jamb seals and extruded vinyl or metal blade edge seals. Dampers shall rotate on stainless steel bearings or bronze bushings. Leakage rate shall not exceed 2.5 cubic meters/minute/square meter (8 CFM per sq. foot) at 250 Pa (1 inch WG). Dampers and operators shall be furnished and factory installed by AHU manufacturer. Damper operators shall be of the same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- K. Mixing Boxes: Mixing box shall consist of casing and outdoor air and return air dampers in opposed blade arrangement with damper linkage for automatic operation. Coordinate damper operator with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC. Dampers shall be of ultra-low leak design with metal compressible bronze jamb seals and extruded vinyl edge seals on all blades. Blades shall rotate on stainless steel sleeve bearings or bronze bushings. Leakage rate shall not exceed 1.6 cubic meters/min/square meter (5 CFM per square foot) at 250 Pa (1 inch WG) and 2.8 cubic meters/min/square meter (9 CFM per square foot) at 995 Pa (4 inch WG) Electronic operators shall be furnished and mounted in an accessible and easily serviceable location by the air handling unit manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- L. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.
1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters and after-filters, as shown on drawings) required for AHU testing.
 2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service or holding frame housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.
- M. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement thru the access doors or removable panels. Each coil shall be removable without disturbing

adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections. All coils in the high humidity areas, shall be epoxy-coated as shown below. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air handling unit in conformance with ARI 435.
- B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.
- C. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class (C_L) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- D. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.

3.2 STARTUP SERVICES

- A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.
- C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Owner/Operator training, etc.

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection,

start up, and contractor testing required above and required by the
System Readiness Checklist provided by the Commissioning Agent.

- B. Components provided under this section of the specification will be
tested as part of a larger system. Refer to Section 23 08 00 -
COMMISSIONING OF HVAC SYSTEMS and related sections for contractor
responsibilities for system commissioning.

- - - E N D - - -

SECTION 26 05 11
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that

- maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
 3. Certified: Materials and equipment which:
 - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
 - b. Are periodically inspected by a NRTL.
 - c. Bear a label, tag, or other record of certification.
 4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
- B. Product Qualification:
 1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
 2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- 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 Resident Engineer 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 Resident Engineer 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 Resident Engineer.
 - 4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
 - 5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J - General Environmental Controls, OSHA Part 1910 subpart K - Medical and First Aid, and OSHA Part 1910 subpart S - Electrical, in addition to other references required by contract.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
 - 1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the Resident Engineer and Medical Center staff. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Resident Engineer.
- D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.
- C. Inaccessible Equipment:
 1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

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 panelboards, motor controllers, fused and non-fused safety switches, separately enclosed circuit breakers,

individual breakers and controllers in switchboards, 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/cm²), 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 Resident Engineer in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".

2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 3. Submit each section separately.
- E. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
 2. Submittals are required for all equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion, etc.) associated with equipment or piping so that the proposed installation can be properly reviewed. Include sufficient fabrication information so that appropriate mounting and securing provisions may be designed and attached to the equipment.
 3. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 4. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
- F. Maintenance and Operation Manuals:
1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
 2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
 3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
 4. The manuals shall include:

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b. A control sequence describing start-up, operation, and shutdown.
 - c. Description of the function of each principal item of equipment.
 - d. Installation instructions.
 - e. Safety precautions for operation and maintenance.
 - f. Diagrams and illustrations.
 - g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
 - h. Performance data.
 - i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
 - j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.
- G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
- H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
- 1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
 - 2. Each type of conduit coupling, bushing, and termination fitting.
 - 3. Conduit hangers, clamps, and supports.
 - 4. Duct sealing compound.
 - 5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.14 POLYCHLORINATED BIPHENYL (PCB) EQUIPMENT

- A. This project requires the removal, transport, and disposal of electrical equipment containing Polychlorinated Biphenyls (PCB) in accordance with the Federal Toxic Substances Control Act (TSCA).
- B. The equipment to be removed is shown on the drawings.
- C. The selective demolition shall be in accordance with Section 02 41 00, DEMOLITION.

1.15 ACCEPTANCE CHECKS AND TESTS

- A. The Contractor shall furnish the instruments, materials, and labor for tests.
- B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
- C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.16 WARRANTY

- A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.17 INSTRUCTION

- A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
- B. Furnish the services of competent 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 Resident Engineer at least 30 days prior to the planned training.

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Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC Houston, TX

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: Stranded.
 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be use for isolation power units.
- E. Color Code:
1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
 2. No. 8 AWG and larger: Color-coded using one of the following methods:
 - a. Solid color insulation or solid color coating.
 - b. Stripes, bands, or hash marks of color specified.
 - c. Color using 19 mm (0.75 inches) wide tape.
 4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
 5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

6. Lighting circuit "switch legs", and 3-way and 4-way switch "traveling wires," shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the Resident Engineer.
7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

- A. Splices shall be in accordance with NEC and UL.
- B. Above Ground Splices for No. 10 AWG and Smaller:
 - 1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
 - 2. The integral insulator shall have a skirt to completely cover the stripped conductors.
 - 3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
- C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
 - 1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
 - 4. All bolts, nuts, and washers used with splices shall be cadmium-plated steel.
- D. Above Ground Splices for 250 kcmil and Larger:
 - 1. Long barrel "butt-splice" or "sleeve" type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
 - 2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
 - 3. Splice and insulation shall be product of the same manufacturer.
- G. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

2.3 CONNECTORS AND TERMINATIONS

- A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
- B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.

- C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be cadmium-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
- D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
- E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.
- G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
- H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
- I. Conductor and Cable Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
 - 2. Use nonmetallic pull ropes.

3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
 4. All conductors in a single conduit shall be pulled simultaneously.
 5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- J. No more than three branch circuits shall be installed in any one conduit.
- K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.3 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.

3.10 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests: Inspect physical condition.
 - 2. Electrical tests:
 - a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
 - b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
 - c. Perform phase rotation test on all three-phase circuits.

---END---

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:
Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:
Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- H. Section 26 22 00, LOW-VOLTAGE TRANSFORMERS: Low-voltage transformers.
- J. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.
- K. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
 - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
 - 2. Test Reports:

- a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Resident Engineer.

3. Certifications:

- a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
 - B1-07.....Standard Specification for Hard-Drawn Copper Wire
 - B3-07.....Standard Specification for Soft or Annealed Copper Wire
 - B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 81-83.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
 - 70-11.....National Electrical Code (NEC)
 - 70E-12.....National Electrical Safety Code
 - 99-12.....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
 - 44-10Thermoset-Insulated Wires and Cables
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 467-07Grounding 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.

2.4 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 cadmium-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 cadmium-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 cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

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 cadmium-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.
- D. For patient care area electrical power system grounding, conform to NFPA 99 and NEC.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- C. Panelboards and other electrical equipment:
 - 1. Connect the equipment grounding conductors to the ground bus.
 - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
- D. Transformers:
 - 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.
- I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.7 CORROSION INHIBITORS

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.8 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- 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.

3.12 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.

3.14 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.
- C. Below-grade connections shall be visually inspected by the Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 48 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.
- I. Section 31 20 00, EARTH MOVING: Bedding of conduits.

1.3 QUALITY ASSURANCE

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 Resident Engineer:
 - 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 3/4" unless otherwise shown. Where permitted by the NEC, a minimum 3/4" flexible conduit may 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.
 - 8. No BX conduit shall be allowed in the facility.
- C. All conduit Fittings shall be compression unless noted otherwise.
- 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 should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Resident Engineer prior to drilling through structural elements.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except where permitted by the Resident Engineer 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.
- 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 may be used for slight offsets and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.
 2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the Resident Engineer.

3.3 CONCEALED WORK INSTALLATION

- A. In Concrete:
1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
 2. Align and run conduit in direct lines.
 3. Install conduit through concrete beams only:
 - a. Where shown on the structural drawings.

- b. As approved by the Resident Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- 4. Installation of conduit in concrete that is less than 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 will 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 above 600 V: Rigid steel. Mixing different types of conduits indiscriminately in the same system is prohibited.
 - 2. Conduit for conductors 600 V and below: Rigid steel, IMC, or EMT. Mixing different types of conduits 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 6 ft [1.8 M] of flexible metal conduit extending from a junction box to the fixture.
 - 5. 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

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.
- 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 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.

E. Hollow Masonry: Toggle bolts.

F. Bolts supported only by plaster or gypsum wallboard are not acceptable.

G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

J. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.

K. 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 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the overcurrent protective device coordination study, indicated as the study in this section.
- B. A short-circuit and selective coordination study shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time-current analysis of each overcurrent protective device from the individual device up to the main overcurrent protecting device of the panelboard/switchboard/MCC serving all the individual devices. Overcurrent protective devices shall be coordinated in a manner that an individual device will not trip other individual devices or the main.

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 23 00, LOW-VOLTAGE SWITCHGEAR: Low-voltage switchgear.
- C. Section 26 24 13, DISTRIBUTION SWITCHBOARDS: Low-voltage distribution switchboards.
- D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.
- E. Section 26 24 19, MOTOR CONTROL CENTERS: Motor control centers.

1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- B. The study shall be prepared by the equipment manufacturer.

1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
 - 1. Product data on the software program to be used for the study. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
 - 2. Complete study as described in paragraph 1.6. Submittal of the study shall be well-coordinated with submittals of the shop drawings for equipment in related specification sections.

3. Certifications: Two weeks prior to final inspection, submit the following.

- a. Certification by the Contractor that the overcurrent protective devices have been set in accordance with the approved study.

1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 242-01.....Protection and Coordination of Industrial and Commercial Power Systems
 - 399-97.....Industrial and Commercial Power Systems Analysis
 - 1584a-04.....Guide for Performing Arc-Flash Hazard Calculations

1.6 STUDY REQUIREMENTS

- A. The study shall include one line diagram, short-circuit and ground fault analysis, and protective coordination plots for all overcurrent protective devices.
- B. One Line Diagram:
 - 1. Show all electrical equipment and wiring to be protected by the overcurrent devices.
 - 2. Show the following specific information:
 - a. Calculated fault impedance, X/R ratios, and short-circuit values at each feeder and branch circuit bus.
 - b. Relay, circuit breaker, and fuse ratings.
 - c. Generator kW/kVA and transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 - d. Voltage at each bus.
 - e. Identification of each bus, matching the identification on the drawings.
 - f. Conduit, conductor, and busway material, size, length, and X/R ratios.
- C. Short-Circuit Study:
 - 1. The study shall be performed using computer software designed for this purpose. Pertinent data and the rationale employed in

developing the calculations shall be described in the introductory remarks of the study.

2. Calculate the fault impedance to determine the available short-circuit and ground fault currents at each bus. Incorporate applicable motor and/or generator contribution in determining the momentary and interrupting ratings of the overcurrent protective devices.
3. Present the results of the short-circuit study in a table. Include the following:
 - a. Device identification.
 - b. Operating voltage.
 - c. Overcurrent protective device type and rating.
 - d. Calculated short-circuit current.

D. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of overcurrent protective devices to demonstrate selective coordination. Graphically illustrate on log-log paper that adequate time separation exists between devices, including the utility company upstream device if applicable. Plot the specific time-current characteristics of each overcurrent protective device in such a manner that all devices are clearly depicted.
2. The following specific information shall also be shown on the coordination curves:
 - a. Device identification.
 - b. Potential transformer and current transformer ratios.
 - c. Three-phase and single-phase ANSI damage points or curves for each cable, transformer, or generator.
 - d. Applicable circuit breaker or protective relay characteristic curves.
 - e. No-damage, melting, and clearing curves for fuses.
 - f. Transformer in-rush points.
3. Develop a table to summarize the settings selected for the overcurrent protective devices. Include the following in the table:
 - a. Device identification.
 - b. Protective relay or circuit breaker potential and current transformer ratios, sensor rating, and available and suggested pickup and delay settings for each available trip characteristic.
 - c. Fuse rating and type.

1.7 ANALYSIS

- A. Analyze the short-circuit calculations, and highlight any equipment determined to be underrated as specified. Propose solutions to effectively protect the underrated equipment.

1.8 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS

- A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost to the Government.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

---END---

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the furnishing, installation and connection of the lighting controls.

1.2 RELATED WORK

- 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

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 Resident Engineer.
- D. Certifications:

1. Two weeks prior to final inspection, submit four copies of the following certifications to the Resident Engineer:
 - 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-48Guide 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
773ANonindustrial Photoelectric Switches for Lighting Control
98.....Enclosed and Dead-Front Switches
917.....Clock Operated Switches

PART 2 - PRODUCTS

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.
- 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.

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 10 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.
- F. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized technician who will verify all adjustments and sensor placements.

3.3 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting control devices are in good operating condition and properly performing the intended function.

- - - E N D - - -

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 6-08Wiring 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 gray in color for normal power and red in color for emergency power.
 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 gray 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 brown nylon.

- C. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
- D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 TOGGLE SWITCHES

- A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be gray in color for normal power and red in color for emergency power.
 - 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 fluorescent electronic dimming ballasts and approved by the ballast manufacturer and LED dimming driver and be approved by the manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
- C. Provide single-pole or three-way, as shown on the drawings.
- D. Manual dimming control and faceplates shall be ivory in color unless otherwise specified.

2.4 WALL PLATES

- A. Wall plates for switches and receptacles shall be type 302 stainless steel. Oversize plates are not acceptable.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

- D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.
- E. Duplex Receptacles on Emergency Circuit: Wall plates shall be red nylon with the word "EMERGENCY" engraved in 6 mm (1/4 inch) white letters. Wall plates shall be type 302 stainless steel, with the word "EMERGENCY" engraved in 6 mm (1/4 inch) red letters. Receptacles shall be red in color.

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 may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
- M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Inspect physical and electrical condition.
 - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
 - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable

receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

d. Test GFCI receptacles.

2. Healthcare Occupancy Tests:

a. Test hospital grade receptacles for retention force per NFPA 99.

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SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms "lighting fixture," "fixture," and "luminaire" are used interchangeably.

1.2 RELATED WORK

- A. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT: Disposal of lamps.
- B. Section 02 41 00, DEMOLITION: Removal and disposal of lamps and ballasts.
- C. Section 10 25 13, PATIENT BED SERVICE WALLS: Power and controls for wall-mounted fluorescent bedlight fixtures.
- D. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
- G. 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, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

G. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

I. Light Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.

J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures.

2.2 BALLASTS

- A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic, instant-start, programmed-start, rapid-start type, designed for type and quantity of lamps indicated. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:
1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.

4. Total Harmonic Distortion (THD): 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.87 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. EMR/RFI Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 11. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
 12. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
 13. Dimming ballasts shall be as per above, except dimmable from 100% to 2% of rated lamp lumens. Dimming ballasts shall be fully compatible with the dimming controls.
- B. Low-Frequency Linear T8 Fluorescent Lamp Ballasts (allowed for Critical Care Units): Multi-voltage (120 - 277V), hybrid electronic-electromagnetic rapid-start type, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output. Ballasts shall include the following features:
1. Automatic lamp starting after lamp replacement.
 2. Sound Rating: Class A.
 3. Total Harmonic Distortion (THD): 20 percent or less.
 4. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 5. Operating Frequency: 60 Hz.

6. Lamp Current Crest Factor: 1.7 or less.
 7. Ballast Factor: 0.85 or higher unless otherwise indicated.
 8. Power Factor: 0.90 or higher.
 9. Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
 10. To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
 11. Where three-lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two-lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave-lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single-lamp ballast for operation of the center lamp.
- C. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 - 277V), electronic programmed rapid-start type, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated. Ballasts shall include the following features:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion (THD): 10 percent or less.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. Ballast Factor: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.98 or higher.
 10. Interference: Comply with CFR Title 47 Part 18 for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

11. Dimming ballasts shall be as per above, except dimmable from 100% to 2% of rated lamp lumens. Dimming ballasts shall be fully compatible with the dimming controls.
- D. Ballasts for HID fixtures: Multi-tap voltage (120 - 480V) electromagnetic ballast for high intensity discharge lamps. Include the following features unless otherwise indicated:
 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

2.3 FLUORESCENT EMERGENCY BALLAST

- A. Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture housing and compatible with ballast.
 1. Emergency Connection: Operate two fluorescent lamp(s) continuously at an output of 1400 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 5. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.4 EMERGENCY LIGHTING UNIT

- A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.
1. Enclosure: Shall be cast aluminum. Enclosure shall be suitable for the environmental conditions in which installed.
 2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
 3. Lamps: Shall be sealed-beam MR-16 halogen, rated not less than 12 watts at the specified DC voltage.
 4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
 5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
 6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.5 LAMPS

- A. Linear and U-shaped T5 and T8 Fluorescent Lamps:
1. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500° and 4100°K, a Color Rendering Index (CRI) equal or greater than 80, average rated life equal to or greater than 24,000 hours when used with an instant start ballast and 30,000 hours when used with a programmed or rapid start ballast (based on 3 hour starts), and be suitable for use with dimming ballasts, unless otherwise indicated.
 - a. Over the beds in Intensive Care, Coronary Care, Recovery, Life Support, and Observation and Treatment areas; Electromyographic, Autopsy (Necropsy), Surgery, and certain dental rooms (Examination, Oral Hygiene, Oral Surgery, Recovery, Labs, Treatment, and X-Ray) use color corrected lamps having a CRI of 85 or above and a correlated color temperature between 5000 and 6000°K, as shown on the drawings.
 - b. Other areas as shown on the drawings.
 2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.

B. Compact Fluorescent Lamps:

1. T4, CRI 80 (minimum), color temperature 3500°K, average rated life equal to or greater than 12,000 hours (based on 3 hour starts), and suitable for use with dimming ballasts, unless otherwise indicated.
2. Lamps shall comply with EPA Toxicity Characteristic Leachate Procedure (TCLP) requirements.

2.6 WALL MOUNTED FLUORESCENT BEDLIGHT FIXTURES

- A. Fixtures shall be lensed.
- B. Fixtures shall be rated for 120 Volt operation, and be powered through the patient wall unit per Section 10 25 13, PATIENT BED SERVICE WALLS.
- C. Provide 4-position, pull cord switch to control the upward and downward portion of the light separately and simultaneously. Include an off position, except in single bed rooms where the switch shall energize and de-energize the downward light only. In the single bed rooms, provide a 2-position pull cord switch for "on-off" control of the downward lamps.
- D. Provide low-voltage relays and switching integration with patient bed controls.

2.7 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).

2.8 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: $\leq 20\%$.
 - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in 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 may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
 2. Shall maintain the fixture positions after cleaning and relamping.
 3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
 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 may extend over the inside of the flange of the channel (or spline) that faces away from the fixture, in a manner that prevents any fixture movement.
 - c. In addition to the above, the following is required for fixtures exceeding 9 kg (20 pounds) in weight.
 - 1) Where fixtures mounted in ASTM Standard C635 "Intermediate Duty" and "Heavy Duty" ceilings and weigh between 9 kg and 25 kg (20 pounds and 56 pounds), provide two 12 gauge safety hangers hung slack between diagonal corners of the fixture and the building structure.
 - 2) Where fixtures weigh over 25 kg (56 pounds), they shall be independently supported from the building structure by

approved hangers. Two-way angular bracing of hangers shall be provided to prevent lateral motion.

- d. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
7. Surface mounted lighting fixtures:
 - a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
 - b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
 - c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
 - 1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
 - 2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
 - 3) The outlet box is supported vertically from the building structure.
 - d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
8. Single or double pendant-mounted lighting fixtures:
 - a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.

9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
- E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
- F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
- G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
- H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Government.
- I. Dispose of lamps per requirements of Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT, and Section 02 41 00, DEMOLITION.

3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform the following:
 1. Visual Inspection:
 - a. Verify proper operation by operating the lighting controls.
 - b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.
 2. Electrical tests:
 - a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Resident Engineer. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Government.
 - b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Government. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless

specifically recommended otherwise by the lamp manufacturer.

Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

---END---

SECTION 27 05 11
REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, 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 will 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 Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.5 EQUIPMENT REQUIREMENTS

Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

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 Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
3. Painted surfaces shall be protected with factory installed removable heavy 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 will 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 will not be considered for approval.
1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 3. Submit each section separately.
- E. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 3. 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.

4. 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 will be based on complete submission of manuals together with shop drawings.
- H. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:
 - 1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
 - 2. Each type of conduit and pathway coupling, bushing and termination fitting.
 - 3. Raceway and pathway hangers, clamps and supports.
 - 4. Duct sealing compound.

1.11 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

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 Resident Engineer at least 30 days prior to the planned training.

- - - E N D - - -

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 15 00, COMMUNICATIONS HORIZONTAL CABLING

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 Resident Engineer:
 - 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):
 - 44-2005Thermoset-Insulated Wires and Cables
 - 83-2003Thermoplastic-Insulated Wires and Cables
 - 467-2004Grounding and Bonding Equipment
 - 486A-486B-2003Wire 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 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (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 50mm² (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

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. Room Signal Grounding: 300 mm x 100 mm (12 inches x 4 inch).
 - 2. 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.
- A. 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

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

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

Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 16 mm² (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

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.
- F. 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.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- H. 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.
- J. 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.
- M. Raised Floors: Provide bonding of all raised floor components.

3.4 CORROSION INHIBITORS

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 Resident Engineer 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 mm² (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 mm² (6 AWG) bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
2. Use 16 mm² (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 mm² (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
3. Provide a 16 mm² (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 mm² (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 mm² (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 CABLE TRAY SYSTEMS:

- A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout this cable tray systems as follows:
1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Subcontractor shall verify this loss by testing across one splice plate connection in the presence of the Contractor.
 2. Install a 16 mm² (6 AWG) bonding jumper across each cable tray splice or junction where splice plates cannot be used.
 3. When cable tray terminations to cable rack, install 16 mm² (6 AWG) bonding jumper between cable tray and cable rack pan.

3.10 COMMUNICATIONS RACEWAY GROUNDING

- A. Conduit: Use insulated 16 mm² (6 AWG) bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 16 mm² (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 mm² (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).

3.11 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 may be used to meet the required resistance, but the specified number of electrodes must 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 Resident Engineer prior to backfilling. The Contractor shall notify the Resident Engineer 24 hours before the connections are ready for inspection.

3.12 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.

- - - E N D - - -

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

- 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.
- B. Certification: Prior to final inspection, deliver to the // Resident Engineer // COTR // four copies of the certification that the material is in accordance with the drawings and specifications and has been properly installed.

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 the basic designation only.
- B. National Fire Protection Association (NFPA):
70-05.....National Electrical Code (NEC)
- C. Underwriters Laboratories, Inc. (UL):

- 1-03.....Flexible Metal Conduit
- 5-01.....Surface Metal Raceway and Fittings
- 6-03.....Rigid Metal Conduit
- 50-03.....Enclosures for Electrical Equipment
- 360-03.....Liquid-Tight Flexible Steel Conduit
- 467-01.....Grounding and Bonding Equipment
- 514A-01.....Metallic Outlet Boxes
- 514B-02.....Fittings for Cable and Conduit
- 514C-05.....Nonmetallic Outlet Boxes, Flush-Device Boxes and
Covers
- 651-02.....Schedule 40 and 80 Rigid PVC Conduit
- 651A-03.....Type EB and A Rigid PVC Conduit and HDPE Conduit
- 797-03.....Electrical Metallic Tubing
- 1242-00.....Intermediate Metal Conduit
- D. National Electrical Manufacturers Association (NEMA):
 - TC-3-04.....PVC Fittings for Use with Rigid PVC Conduit and
Tubing
 - FB1-03.....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 13 mm
(1/2 inch) unless otherwise shown. Where permitted by the NEC, 13 mm
(1/2 inch) flexible conduit may be used for tap connections to recessed
lighting fixtures.
- B. Conduit:
 - 1. Rigid galvanized steel: Shall Conform to UL 6, ANSI C80.1.
 - 2. Rigid aluminum: Shall Conform to UL 6A, ANSI C80.5.
 - 3. Rigid intermediate steel conduit (IMC): Shall Conform to UL 1242,
ANSI C80.6.
 - 4. 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.
 - 5. Flexible galvanized steel conduit: Shall Conform to UL 1.
 - 6. Liquid-tight flexible metal conduit: Shall Conform to UL 360.
 - 7. Direct burial plastic conduit: Shall conform to UL 651 and UL 651A,
heavy wall PVC or high density polyethylene (PE).
 - 8. 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 ANSI/ NEMA FB1.
- a. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
- b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
- c. 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.
- d. 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.
- e. 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. Rigid aluminum conduit fittings:

- a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
- b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
- c. Set screw fittings: Not permitted for use with aluminum conduit.

3. Electrical metallic tubing fittings:

- a. 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.
- 4. Flexible steel conduit fittings:
 - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
 - b. Clamp type, with insulated throat.
- 5. Liquid-tight flexible metal conduit fittings:
 - a. Fittings shall meet the requirements of UL 514B and ANSI/ NEMA FB1.
 - b. Only steel or malleable iron materials are acceptable.
 - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
- 6. Direct burial plastic conduit fittings:
 - a. Fittings shall meet the requirements of UL 514C and NEMA TC3.
 - b. As recommended by the conduit manufacturer.
- 7. Surface metal raceway fittings: As recommended by the raceway manufacturer.
- 8. 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.

PART 3 - EXECUTION

3.1 PENETRATIONS

- A. Cutting or Holes:
1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Resident Engineer prior to drilling through structural sections.
 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Resident Engineer 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.

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. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
 12. Do not use aluminum conduits in wet locations.
 13. Unless otherwise indicated on the drawings or specified herein, all conduits shall be installed concealed within finished walls, floors and ceilings.
- B. Conduit Bends:
1. Make bends with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 3. Bending of conduits with a pipe tee or vise is prohibited.
- C. Layout and Homeruns:
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted approved by the // Resident Engineer // COTR //.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run conduit in direct lines.

3. Install conduit through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the // Resident Engineer // COTR // prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
 4. Installation of conduit in concrete that is less than 75 mm (3 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 will be a minimum of 19 mm (3/4 inch) of concrete around the conduits.
 5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.
- B. Furred or Suspended Ceilings and in Walls:
1. Conduit for conductors above 600 volts:
 - a. Rigid steel or rigid aluminum.
 - b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
 2. Conduit for conductors 600 volts and below:
 - a. Rigid steel, IMC, rigid aluminum, or EMT. Different type conduits mixed indiscriminately in the same system is prohibited.
 3. Align and run conduit parallel or perpendicular to the building lines.
 4. Connect recessed lighting fixtures to conduit runs with maximum 1800 mm (six 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 above 600 volts:
1. Rigid steel or rigid aluminum.
 2. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.

- C. Conduit for Conductors 600 volts and below:
 - 1. Rigid steel, IMC, rigid aluminum, or EMT. Different type of conduits mixed indiscriminately in the system is prohibited.
- 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 2400 mm (eight foot) 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 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.

3.6 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".

3.11 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 06 10 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).

- - - E N D - - -

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 27.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

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

1.3 SUMMARY

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

1.4 DEFINITIONS

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

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 27 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 27, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

1.6 SUBMITTALS

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

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

3.2 PRE-FUNCTIONAL CHECKLISTS

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

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

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 27 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

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

3.5 TRAINING OF VA PERSONNEL

- A. Training of the VA operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 19 00. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 27 Sections for additional Contractor training requirements.

Department of Veteran Affairs, Renovate Medical Media for
Geriatrics/Wound Care Clinic

Project Number 580-17-100

MEDVAMC Houston, TX

----- END -----

SECTION 27 51 16
PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. Work covered by this document includes design, engineering, labor, material and products, equipment warranty and system warranty, training and services for, and incidental to, the complete installation of new and fully operating National Fire Protection Association (NFPA) - Life Safety Code 101.3-2 (a) Labeled and (b) Listed Emergency Service Public Address System (PAS) and associated equipment (here-in-after referred to as the System) in approved locations indicated on the contract drawings. These items shall be tested and certified capable of receiving, distributing, interconnecting and supporting PAS communications signals generated local and remotely as detailed herein.
- B. Work shall be complete, Occupational Safety and Health Administration (OSHA), National Recognized Testing Laboratory (NRTL - i.e. Underwriters Laboratory [UL]) Listed and Labeled; and VA Central Office (VACO), Telecommunications Voice Engineering (TVE 005OP3B) tested, certified and ready for operation.
- C. The System shall be delivered free of engineering, manufacturing, installation, and functional defects. It shall be designed, engineered and installed for ease of operation, maintenance, and testing.
- D. The term "provide", as used herein, shall be defined as: designed, engineered, furnished, installed, certified, and tested, by the Contractor.
- E. Specification Order of Precedence: In the event of a conflict between the text of this document and the Project's Contract Drawings outlined and/or cited herein; **THE TEXT OF THIS DOCUMENT TAKES PRECEDENCE.** *HOWEVER, NOTHING IN THIS DOCUMENT WILL SUPERSEDE APPLICABLE EMERGENCY LAWS AND REGULATIONS, SPECIFICALLY NATIONAL AND/OR LOCAL LIFE AND PUBLIC SAFETY CODES.* The Local Fire Marshall and/or VA Public Safety Officer are the only authorities that may modify this document's EMERGENCY CODE COMPLIANCE REQUIREMENTS, on a case by case basis, in writing and confirmed by VA's PM, RE and TVE-005OP3B. The VA PM is the only approving authority for other amendments to this document that may be granted, on a case by case basis, in writhing with technical concurrencies by VA's RE, TVE-005OP3B and identified Facility Project Personnel.

F. The Original Equipment Manufacturer (OEM) and Contractor shall ensure that all management, sales, engineering and installation personnel have read and understand the requirements of this specification before the system is designed, engineered, delivered and provided. The Contractor shall furnish a written statement attesting this requirement as a part of the technical submittal that includes each name and certification, including the OEMs.

1.2 RELATED SECTIONS

- A. 01 33 23 - Shop Drawings, Product Data and Samples.
- B. 07 84 00 - Firestopping.
- E. 27 05 11 - Requirements for Communications Installations.
- F. 27 05 26 - Grounding and Bonding for Communications Systems.
- G. 27 05 33 - Raceways and Boxes for Communications Systems.
- J. 27 15 00 - Horizontal and Vertical Communications Cabling Equipment and 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 Technical Review, for National and VA communications and security, codes, frequency licensing, standards, guidelines compliance:
 - Office of Telecommunications
 - Special Communications Team (0050P2B)
 - 1335 East West Highway - 3rd Floor
 - Silver Spring, Maryland 20910
 - (O) 301-734-0350, (F) 301-734-0360

H. Contractor: Radio 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 Federal Law:

a. Departments of:

- 1) Commerce, Consolidated Federal Regulations (CFR), Title 15 -
Under the Information Technology Management Reform Act (Public
Law 104-106), the Secretary of Commerce approves standards and
guidelines that are developed by the:
 - a) Chapter II, National Institute of Standards Technology
(NIST - formerly the National Bureau of Standards). Under
Section 5131 of the Information Technology Management
Reform Act of 1996 and the Federal Information Security
Management Act of 2002 (Public Law 107-347), NIST develops
- Federal Information Processing Standards Publication
(FIPS) 140-2-Security Requirements for Cryptographic
Modules.
 - b) Chapter XXIII, National Telecommunications and Information
Administration (NTIA - aka 'Red Book') Chapter 7.8 / 9;
CFR, Title 47 Federal communications Commission (FCC) Part
15, Radio Frequency Restriction of Use and Compliance in
"Safety of Life" Functions & Locations
- 2) FCC - Communications Act of 1934, as amended, CFR, Title 47 -
Telecommunications, in addition to Part 15 - Restrictions of
use for Part 15 listed Radio Equipment in Safety of Life /
Emergency Functions / Equipment/ Locations (also see CFR,
Title 15 - Department of Commerce, Chapter XXIII - NTIA):
 - a) Part 15 - Restrictions of use for Part 15 listed Radio
Equipment in Safety of Life / Emergency Functions /
Equipment/Locations.
 - b) Part 58 - Television Broadcast Service.
 - c) Part 90 - Rules and Regulations, Appendix C.
 - d) Form 854 - Antenna Structure Registration.
- 3) Health, (Public Law 96-88), CFR, Title 42, Chapter IV Health &
Human Services, CFR, Title 46, Subpart 1395(a)(b) JCAHO "a
hospital that meets JCAHO accreditation is deemed to meet the
Medicare conditions of Participation by meeting Federal
Directives:"
 - a) All guidelines for Life, Personal and Public Safety; and,
Essential and Emergency Communications.

4) Labor, CFR, Title 29, Part 1910, Chapter XVII - Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standard:

a) Subpart 7 - Definition and requirements (for a NRTL - 15 c's, for complete list, contact

[\(\[http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html\]\(http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html\)\)](http://www.osha.gov/dts/otpca/nrtl/faq_nrtl.html) :

1) UL:

- a) 44-02 - Standard for Thermoset-Insulated Wires and Cables.
- b) 65 - Standard for Wired Cabinets.
- c) 83-03 - Standard for Thermoplastic-Insulated Wires and Cables.
- d) 467-01 - Standard for Electrical Grounding and Bonding Equipment
- e) 468 - Standard for Grounding and Bonding Equipment.
- f) 486A-01 - Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors
- g) 486C-02 - Standard for Splicing Wire Connectors.
- h) 486D-02 - Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
- i) 486E-00 - Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
- j) 493-01 - Standard for Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable.
- k) 514B-02 - Standard for Fittings for Cable and Conduit.
- l) 1069 - Hospital Signaling and Nurse Call Equipment.
- m) 1333 - Vertical (Riser) Fire Rating.
- n) 1449 - Standard for Transient Voltage Surge Suppressors.
- o) 1479-03 - Standard for Fire Tests of Through-Penetration Fire Stops.
- p) 1863 - Standard for Safety, Communications Circuits Accessories.
- q) 2024 - Standard for Optical Fiber Raceways.
- r) 60950-1/2 - Information Technology Equipment - Safety.

- 2) Canadian Standards Association (CSA): same tests as for UL.
- 3) Communications Certifications Laboratory (CCL): same tests as for UL.
- 4) Intertek Testing Services NA, Inc. (ITSNA formerly Edison Testing Laboratory [ETL]): same tests as for UL.
- b) Subpart 35 - Compliance with NFPA 101 - Life Safety Code.
- c) Subpart 36 - Design and construction requirements for exit routes.
- d) Subpart 268 - Telecommunications.
- e) Subpart 305 - Wiring methods, components, and equipment for general use.
- 5) Department of Transportation, CFR, Title 49 (Public Law 89-670), Part 1, Subpart C - Federal Aviation Administration (FAA):
 - a) Standards AC 110/460-ID & AC 707 / 460-2E - Advisory Circulars for Construction of Antenna Towers.
 - b) Forms 7450 and 7460-2 - Antenna Construction Registration.
- 6) Veterans Affairs (Public Law No. 100-527), CFR, Title 38, Volumes I & II:
 - a) Office of Telecommunications:
 - 1) Handbook 6100 - Telecommunications.
 - a) Spectrum Management FCC & NTIA Radio Frequency Compliance and Licensing Program.
 - b) Special Communications Proof of Performance Testing, VACO Compliance and Life Safety Certification(s).
 - b) Office of Cyber and Information Security (OCIS):
 - 1) Handbook 6500 - Information Security Program.
 - 2) Wireless and Handheld Device Security Guideline Version 3.2, August 15, 2005.
 - c) VA's National Center for Patient Safety - Veterans Health Administration Warning System, Failure of Medical Alarm Systems using Paging Technology to Notify Clinical Staff, July 2004.
 - d) VA's Center for Engineering Occupational Safety and Health, concurrence with warning identified in VA Directive 7700.
 - e) Office of Construction and Facilities Management (CFM):
 - 1) Master Construction Specifications (PG-18-1).

- 2) Standard Detail and CAD Standards (PG-18-4).
- 3) Equipment Guide List (PG-18-5.
- 4) Electrical Design Manual for VA Facilities (PG 18-10),
Articles 7 & 8.
- 5) Minimum Requirements of A/E Submissions (PG 18-15):
 - a) Volume B, Major New Facilities, Major Additions; and
Major Renovations, Article VI, Paragraph B.
 - b) Volume C - Minor and NRM Projects, Article III,
Paragraph S.
 - c) Volume E - Request for Proposals Design/Build
Projects, Article II, Paragraph F.
- 6) Mission Critical Facilities Design Manual (Final Draft -
2007).
- 7) Life Safety Protected Design Manual (Final Draft -
2007).
- 8) Solicitation for Offerors (SFO) for Lease Based Clinics
- (05-2009).
- b. Federal Specifications (Fed. Specs.):
 - 1) A-A-59544-00 - Cable and Wire, Electrical (Power, Fixed
Installation).
2. United States National Codes:
 - a. American Institute of Architects (AIA): Guidelines for Healthcare
Facilities.
 - b. American National Standards Institute/Electronic Industries
Association/Telecommunications Industry Association
(ANSI/EIA/TIA):
 - 1) 568-B - Commercial Building Telecommunications Wiring
Standards:
 - a) B-1 - General Requirements.
 - b) B-2 - Balanced twisted-pair cable systems.
 - c) B-3 - Fiber optic cable systems.
 - 2) 569 - Commercial Building Standard for Telecommunications
Pathways and Spaces.
 - 3) 606 - Administration Standard for the Telecommunications
Infrastructure of Communications Buildings.
 - 4) 607 - Commercial Building Grounding and Bonding Requirements
for Telecommunications.
 - 5) REC 127-49 - Power Supplies.

- 6) RS 160-51 - Sound systems.
 - 7) RS 270 - Tools, Crimping, Solderless Wiring Devices,
Recommended Procedures for User Certification.
 - 8) SE 101-A49 - Amplifier for Sound Equipment
 - 9) SE 103-49 - Speakers for Sound Equipment
 - c. American Society of Mechanical Engineers (ASME):
 - 1) Standard 17.4 - Guide for Emergency Personnel.
 - 2) Standard 17.5 - Elevator & Escalator Equipment (prohibition of
installing non-elevator equipment in Elevator Equipment Room /
Mechanical Penthouse).
 - d. American Society of Testing Material (ASTM):
 - 1) D2301-04 - Standard Specification for Vinyl Chloride Plastic
Pressure Sensitive Electrical Insulating Tape.
 - e. Building Industries Communications Services Installation (BICSI):
 - 1) All standards for smart building wiring, connections and
devices for commercial and medical facilities.
 - 2) Structured Building Cable Topologies.
 - 3) In consort with ANSI/EIA/TIA.
 - f. Institute of Electrical and Electronics Engineers (IEEE):
 - 1) SO/TR 21730:2007 - Use of mobile wireless communication and
computing technology in healthcare facilities -
Recommendations for electromagnetic compatibility (management
of unintentional electromagnetic interference) with medical
devices.
 - 2) 0739-5175/08/©2008 IEEE - Medical Grade - Mission Critical -
Wireless Networks.
 - 3) C62.41 - Surge Voltages in Low-Voltage AC Power Circuits.
 - g. NFPA:
 - 1) 70 - National Electrical Code (current date of issue) -
Articles 517, 645 & 800.
 - 2) 75 - Standard for Protection of Electronic Computer Data-
Processing Equipment.
 - 3) 77 - Recommended Practice on Static Electricity.
 - 4) 99 - Healthcare Facilities.
 - 5) 101 - Life Safety Code.
 - 6) 1600 - Disaster Management, Chapter 5.9 - Communications and
Warning
3. State Hospital Code(s).

4. Local Town, City and/or County Codes.

5. Accreditation Organization(s):

- a. Joint Commission on Accreditation of Hospitals Organization
(JCAHO) - Section VI, Part 3a - Operating Features.

1.5 QUALIFICATIONS

- A. The OEM shall have had experience with three (3) or more installations of systems of comparable size and complexity with regards to type and design as specified herein. Each of these installations shall have performed satisfactorily for at least one (1) year after final acceptance by the user. Include the names, locations and point of contact for these installations as a part of the submittal.
- B. The Contractor shall submit certified documentation that they have been an authorized distributor and service organization for the OEM for a minimum of three (3) years. The Contractor shall be authorized by the OEM to pass thru the OEM's warranty of the installed equipment to VA. In addition, the OEM and Contractor shall accept complete responsibility for the design, installation, certification, operation, and physical support for the System. This documentation, along with the System Contractor and OEM certifications must be provided in writing as part of the Contractor's Technical submittal.
- C. The Contractor's Communications Technicians assigned to the System shall be fully trained, qualified, and certified by the OEM on the engineering, installation, operation, and testing of the System. The Contractor shall provide formal written evidence of current OEM certification(s) for the installer(s) as a part of the submittal or to the RE before being allowed to commence work on the System.
- D. The Contractor shall display all applicable national, state and local licenses.
- E. The Contractor shall submit copy (s) of Certificate of successful completion of OEM's installation/training school for installing technicians of the System's PA equipment being proposed.

1.6 CODES AND PERMITS

- A. Provide all necessary permits and schedule all inspections as identified in the contract's milestone chart, so that the system is proof of performance tested and ready for operation on a date directed by the Owner.
- B. The contractor is responsible to adhere to all codes described herein and associated contractual, state and local codes.

- C. The Contractor shall display all applicable national, state and local licenses and permits.

1.7 SCHEDULING

- A. After the award of contract, the Contractor shall prepare a detailed schedule (aka milestone chart) using "Microsoft Project" software or equivalent. The Contractor Project Schedule (CPS) shall indicate detailed activities for the projected life of the project. The CPS shall consist of detailed activities and their restraining relationships. It will also detail manpower usage throughout the project.
- B. It is the responsibility of the Contractor to coordinate all work with the other trades for scheduling, rough-in, and finishing all work specified. The owner will not be liable for any additional costs due to missed dates or poor coordination of the supplying contractor with other trades.

1.8 REVIEW OF CONTRACT DRAWINGS AND EQUIPMENT DATA SUBMITTALS

(Note: The Contractor is encouraged, but not required, to submit separate technical submittal(s) outlining alternate technical approach(s) to the system requirements stated here-in as long as each alternate technical document(s) is complete, separate, and submitted in precisely the same manner as outlined herein. VA will review and rate each received alternate submittal, which follows this requirement, in exactly the same procedure as outlined herein. Partial, add-on, or addenda type alternates will not be accepted or reviewed.)

- A. Submit at one time within 10 days of contract awarding, drawings and product data on all proposed equipment and system. Check for compliance with contract documents and certify compliance with Contractor's "APPROVED" stamp and signature.
- B. Support all submittals with descriptive materials, i.e., catalog sheets, product data sheets, diagrams, and charts published by the manufacturer. These materials shall show conformance to specification and drawing requirements.
- C. Where multiple products are listed on a single cut-sheet, circle or highlight the one that you propose to use. Provide a complete and through equipment list of equipment expected to be installed in the system, with spares, as a part of the submittal. Special Communications (TVE-005OP3B) will not review any submittal that does not have this list.

- D. Provide four (4) copies to the PM for technical review. The PM will provide a copy to the offices identified in Paragraph 1.3.C & D, at a minimum for compliance review as described herein where each responsible individual(s) shall respond to the PM within 10 days of receipt of their acceptance or rejection of the submittal(s).
- E. Provide interconnection methods, conduit (where not already installed), junction boxes (J-Boxes), cable, interface fixtures and equipment lists for the: ENR(s) (aka DMARC), TER, TCR, MCR, MCOR, PCR, ECR, Stacked Telecommunications Rooms (STR), Nurses Stations (NS), Head End Room (HER), Head End Cabinet (HEC), Head End Interface Cabinet (HEIC) and approved TCO locations Telecommunications Infrastructure Plant (TIP) interface distribution layout drawing, as they are to be installed and interconnected to teach other (REFER TO APPENDIX B - SUGGESTED TELECOMMUNI-CAITONS ONE LINE TOPOLOGY pull-out drawing).
- F. Headend and each interface distribution cabinet layout drawing, as they are expected to be installed.
- G. Equipment OEM technical literature detailing the electrical and technical characteristics of each item of equipment to be furnished.
- H. Engineering drawings of the System, showing calculated of expected signal levels at the headend input and output, each input and output distribution point, and signal level at each telecommunications outlet.
- I. Surveys Required as a Part of The Technical Submittal:
 - 1. The Contractor shall provide the following System survey(s) that depict various system features and capacities required in addition to the on-site survey requirements described herein. Each survey shall be in writing and contain the following information (the formats are suggestions and may be used for the initial Technical Submittal Survey requirements), as a minimum:
 - a. PA Cable System Design Plan:
 - 1) An OEM and contractor designed functioning PA System cable plan to populate the entire TIP empty conduit/pathway distribution systems provided as a part of Specification 27 11 00 shall be provided as a part of the technical proposal. A specific functioning PA: cable, interfaces, J-boxes and back boxes shall coincide with the total growth items as described herein. It is the Contractor's responsibility to provide the Systems' entire PA cable and accessory requirements and

engineer a functioning PA distribution system and equipment
requirement plan of the following paragraph(s), at a minimum:

2) The required PA Equipment Locations:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Master Control Stations		
Telephone Operators Room		
Police Control Room		
Other		
Zone Amplifiers		
All Call (complete Zone 1)		
Admissions (Zone 2)		
Entrance (Zone 2a)		
Pharmacy Dispensing (Zone 2a)		
Agent Cashier (Zone 2a)		
Other (Zone 2a)		
Labs (Zone 3)		
Blood (Zone 3a)		
Dissecting (Zone 3a)		
Other (Zone 3a)		
Clinics (Zone 4)		
Dental (Zone 4a)		
Radiology (Zone 4a)		
Oncology (Zone 4a)		
Other (Zone 4a)		
Supervisory Panel(s)		
Trouble Panel(s)		
Locations		
Speakers		
Overhead		
Locations		
Other		
Other		
Outside		
Locations		
Other		

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Horn		
Locations		
Other		
Power Supply(s)		
Location		
Other		
UPS(s)		
Location		
Other		
Radio Paging Access (when pre-approved by TVE-0050P3B)		
Wireless Access (when pre-approved by TVE-0050P3B)		
Maintenance/Programming Console		
Location(s)		
Other		

3) The required PA Cable Plant/Connections:

The Contractor shall clearly and fully indicate this category for each item identified herein as a part of the technical submittal. For this purpose, the following definitions and sample connections are provided to detail the system's capability:

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Central Control Cabinet/Equipment		
Location		
Power Supply(s)		
UPS(s)		
Essential Electrical Power Panel(s)		
Other		
Cable Plant		
Supply to Locations Identified herein		
Speaker Locations		

<u>EQUIPPED ITEM</u>	<u>CAPACITY</u>	<u>GROWTH</u>
Remote Locations		
Telephone Operator Room		
Police Control Room		
Other		
Maintenance/Program Console		
Location(s)		
Other		
LAN (Local Facility) Access/Equipment/Location (when pre- approved by TVE-0050P3B)		
Wireless Access/Equipment/Location (when pre-approved by TVE-0050P3B)		
Other		

1.9 PROJECT RECORD DOCUMENTS (AS BUILTS)

- A. Throughout progress of the Work, maintain an accurate record of changes in Contract Documents. Upon completion of Work, transfer recorded changes to a set of Project Record Documents.
- B. The floor plans shall be marked in pen to include the following:
 1. All device locations with UL labels affixed.
 2. Conduit locations.
 3. Head-end equipment and specific location.
 4. Each interface and equipment specific location.
 5. Facility Entrance (aka DEMARC) Room(s) interface equipment and location(s).
 6. Telephone Equipment Room (TER) interface equipment and specific location.
 7. Main Computer Room (MCR) interface equipment and specific location.
 8. Police Control Room (PCR) interface equipment and specific location.
 9. Engineering Control Room (ECR) interface equipment and specific location
 10. Telecommunication Outlet (s -TCO) equipment and specific location
 11. TIP Wiring diagram(s).
 12. Warranty certificate.
 13. System test results.
 14. System Completion Document(s) or MOU.

1.10 WARRANTIES / GUARANTY

- A. The Contractor shall warrant the installation to be free from defect in material and workmanship for a period of two (2) years from the date of acceptance of the project by the owner. The Contractor shall agree to remedy covered defects within four (4) hours of notification of major failures or within twenty-four (24) hours of notification for individual station related problems.
- B. The Contractor shall agree to grantee the system according to the guidelines outlined in Article 4 herein.

1.11 USE OF THE SITE

- A. Use of the site shall be at the GC's direction.
- B. Coordinate with the GC for lay-down areas for product storage and administration areas.
- C. Coordinate work with the GC and their sub-contractors.
- D. Access to buildings wherein the work is performed shall be directed by the GC.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft.
- B. Store products in original containers.
- C. Coordinate with the GC for product storage. There may be little or no storage space available on site. Plan to potentially store materials off site.
- D. Do not install damaged products. Remove damaged products from the site and replaced with new product at no cost to the Owner.

1.13 PROJECT CLOSE-OUT

- A. Prior to final inspection and acceptance of the work, remove all debris, rubbish, waste material, tools, construction equipment, machinery and surplus materials from the project site and thoroughly clean your work area.
- B. Before the project closeout date, the Contractor shall submit:
 - 1. Warranty certificate.
 - 2. Evidence of compliance with requirements of governing authorities such as the Low Voltage Certificate of Inspection.
 - 3. Project record documents.
 - 4. Instruction manuals and software that is a part of the system.
- C. Contractor shall submit written notice that:
 - 1. Contract Documents have been reviewed.

2. Project has been inspected for compliance with contract.

3. Work has been completed in accordance with the contract.

PART 2 - PRODUCTS / FUNCTIONAL REQUIREMENTS

2.1 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

2.2 SYSTEM DESCRIPTION

- E. System hardware shall consist of a **standalone (separate)** PA communications network comprised of amplifiers, mixers, speakers, volume controls, test sets, telephone private branch exchange (PBX) interface equipment, equipment cabinets/racks, wiring and other options such as, sub zoning in addition to "all call" functions, computer interfaces, printer interfaces and wireless network interfaces, (**when specifically approved by 005OP3B and VA Headquarters Spectrum Management 005OP2B - herein after referred to as 005OP2B**) as shown on drawings. All necessary equipment required to meet the intent of these specifications, whether or not enumerated within these specifications, shall be supplied and installed to provide a complete and operating nurse/patient communications network.
- F. Systems firmware shall be the product of a reputable firmware OEM of record with a proven history of product reliability and sole control over all source code. Manufacturer shall provide, free of charge, product firmware/software upgrades for a period of two (2) years from date of acceptance by VA for any product feature enhancements. System configuration programming changes shall not require any exchange of parts and shall be capable of being executed remotely via a modem connection (when specifically approved first by 005OP3B).
- G. The PA Head End Equipment shall be located in Room 111. The PA shall cover B108. The PA shall provide zoned, one-way voice paging through distributed, ceiling mounted loudspeakers. Voice input into the PA shall be by zone using the telephone system. **The Nurse Call / Code Blue System may interface the PA system when specifically approved by VA Headquarters 005OP3B during the project approval process prior to contract bidding.**
- H. The System shall utilize microprocessor components for all signaling and programming circuits and functions. Self contained or on board system program memory shall be non-volatile and protected from erasure from power outages for a minimum of 24 hours.
- I. Provide a backup battery or a UPS for the System (including each distribution cabinet/point, CRT, LCD and Monitor) to allow normal

operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of two (2) Hours.

- K. The System shall interface with the Facility's existing PAS so that a global page (aka "all call" page) is communicated to the existing PAS and the new System of this project. Arrangements for interconnection of the System and the telephone system(s) shall be coordinated with the owner and the PBX provider.
- L. The system shall be designed to provide continuous electrical supervision of the complete and entire system (i.e. light bulbs, wires, contact switch connections, master control stations, wall stations, circuit boards, data, audio, and communication busses, main and UPS power, etc.). All alarm initiating and signaling circuits shall be supervised for open circuits, short circuits, and system grounds. Main and UPS power circuits shall be supervised for a change in state (i.e. primary to backup, low battery, UPS on line, etc.). When an open, short or ground occurs in any system circuit, an audible and visual fault alarm signal shall be initiated at the main supervisory panel, nurse control station and all remote amplifier locations.
- M. When the System is approved to connect to a separate communications system (i.e. LAN, WAN, Telephone, Nurse Call, radio raging, wireless systems, etc) the connection point shall be at one location and shall meet the following minimum requirements for each hard wired connection (note each wireless system connection MUST BE APPROVED PRIOR TO CONTRACT BID BY VA HEADQUARTERS 0050P3B AND 0050P2B):
 - 1. UL 60950-1/2.
 - 2. FIPS 142.
 - 3. FCC Part 15 Listed Radio Equipment is not allowed.
- N. All passive distribution equipment shall meet or exceed -80 dB radiation shielding (aka RFI) shielding specifications and be provided with screw type audio connectors.
- O. All equipment face plates utilized in the system shall be stainless steel, anodized aluminum or UL approved cycolac plastic for the areas where provided.
- P. All trunk, branch, and interconnecting cables and unused equipment ports or taps shall be terminated with proper terminating resistors designed for RF, audio and digital cable systems without adapters.

- Q. Noise filters and surge protectors shall be provided for each equipment interface cabinet, headend cabinet, control console and local and remote amplifier locations to insure protection from input primary AC power surges and to insure noise glitches are not induced into low voltage data circuits.
- R. Plug-in connectors shall be provided to connect all equipment, except coaxial cables and RF transmission line interface points. Coaxial cable distribution points and RF transmission lines shall use coaxial cable connections recommended by the cable OEM and approved by the system OEM. Base band cable systems shall utilize barrier terminal screw type connectors, at a minimum. As an alternate, crimp type connectors installed with a ratchet type installation tool are acceptable provided the cable dress, pairs, shielding, grounding, connections and labeling are the same as the barrier terminal strip connectors. Tape of any type, wire nuts or solder type connections are unacceptable and will not be approved.
- S. Audio Level Processing: The control equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each sub-zone in the system and distribute them into the System's RF interfacing distribution trunks and amplification circuits. It is acceptable to use identified Telephone System cable pairs designated for Two-Way Radio interface and control use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor. The use of telephone cable to distribute RF signals, carrying system or sub-system AC or DC voltage is not acceptable and will not be approved. Additionally, each control location shall be provided with the equipment required to insure the system can produce its designed audio channel capacity at each speaker identified on the contract drawings. The Contractor shall provide: a spare set of telephone paging modules as recommended by the OEM (as a minimum provide one spare module for each installed module); one spare audio power amplifier, one spare audio mixer, one spare audio volume limiter and/or compressor, and one spare audio automatic gain adjusting device, and minimum RF equipment recommended by the OEM.
- T. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. Unless

otherwise noted in this Part, equipment quantities shall be as indicated on the drawings.

2.3 SYSTEM PERFORMANCE:

- A. At a minimum, each distribution, interconnection, interface, terminating point and TCO shall be capable of supporting the Facility's PA system voice and data service as follows:
1. Shall be compliant with and not degrade the operating parameters of the Public Switched Telephone Network (PSTN) and the Federal Telecommunications System (FTS) at each PSTN and FTS interface, interconnection and terminating locations in the TERs.
 2. Audio Input: The signal level of each audio input channel at each input point shall be a MINIMUM of zero decibels measured (dBm), +0.10 dBm across 150 Ohms, balanced.
 3. Audio Output: The audio signal level at each speaker shall be a MINIMUM of +0.25 Watt (W) and a maximum of +20 W, 600 Ohms balanced impedance, on a 70.7 V audio distribution line Contractor to determine and set each speaker's proper audio signal level (top) based on speaker location and the ambient noise level in speaker coverage area.
 4. The system shall meet the following MINIMUM parameters at each speaker:
 - a. Cross Modulation: -46 dB
 - b. Hum Modulation: -55 dB
 - c. Isolation (outlet-outlet): 24 dB
 - d. Impedance:
 - 1) Distribution: 600 Ohm balanced @ 70.7 V audio line level.
 - 2) Speaker: Selectable, as required.
 - e. Audio Gain: 10 dB minimum @ mid-range measured with a sound pressure level meter (SPL)
 - f. Signal to noise (S/N) ratio: 35 dB, minimum
- B. Audio Level Processing: The head-end equipment shall consist of audio mixer(s), volume limiter(s) and/or compressor(s), and power amplifier(s) to process, adjust, equalize, isolate, filter, and amplify each audio channel for each zone or sub-zone in the system and distribute them into the system's distribution trunks. It is acceptable to use identified telephone system cable pairs designated for PA use or identified as spare telephone cable pairs by the Facility's Telephone System Contractor.

1. THE USE OF TELEPHONE CABLE TO DISTRIBUTE PA SIGNALS CARRYING AC OR DC VOLTAGE IS NOT ACCEPTABLE AND WILL NOT BE APPROVED.
2. Additionally, each remote location shall be provided with the equipment required to ensure the system supervision and designed audio channel capacity at each speaker identified on the contract drawings.

2.4 MANUFACTURERS

- A. The products specified shall be new, FCC and UL Listed, labeled and produced by OEM of record. An OEM of record shall be defined as a company whose main occupation is the manufacture for sale of the items of equipment supplied and which:
 1. Maintains a stock of replacement parts for the item submitted,
 2. Maintains engineering drawings, specifications, and operating manuals for the items submitted, and
 3. Has published and distributed descriptive literature and equipment specifications on the items of equipment submitted at least 30 days prior to the Invitation for Bid (IFB).
- B. Specifications contained herein as set forth in this document detail the salient operating and performance characteristics of equipment in order for VA to distinguish acceptable items of equipment from unacceptable items of equipment. When an item of equipment is offered or furnished for which there is a specification contained herein, the item of equipment offered or furnished shall meet or exceed the specification for that item of equipment.
- C. Equipment Standards and Testing:
 1. The System has been defined herein as connected to systems identified as an Emergency performing Public Safety Support Functions. Therefore, at a minimum, the system shall conform to all aforementioned National and/or Local Public and Life Safety Codes (which ever are the more stringent), NFPA, NEC, this specification, JCAHCO Life Safety Accreditation requirements, and the OEM recommendations, instructions, and guidelines.
 2. All supplies and materials shall be listed, labeled or certified by UL or a nationally recognized testing laboratory (NRTL) where such standards have been established for the supplies, materials or equipment.
 3. The provided equipment required by the System design and approved technical submittal must conform with each UL standard in effect for

- the equipment, as of the date of the technical submittal (or the date when the RE approved system equipment necessary to be replaced) was technically reviewed and approved by VA. Where a UL standard is in existence for equipment to be used in completion of this contract, the equipment must bear the approved UL seal.
4. Each item of electronic equipment to be provided under this contract must bear the approved UL seal or the seal of the testing laboratory that warrants the equipment has been tested in accordance with, and conforms to the specified standards. The placement of the UL Seal shall be a permanent part of the electronic equipment that is not capable of being transportable from one equipment item to another.

2.5 PRODUCTS

A. General.

1. Contractor is responsible for pricing all accessories and miscellaneous equipment required to form a complete and operating system. The equipment quantities provided herein shall be as indicated on the drawings with the exception of the indicated spare equipment.
2. Each cabinet shall be provided with internal and external items to maintain a neat and orderly system of equipment, wire, cable and conduit connections and routing.
3. Contractor Furnished Equipment List (CFEs):
 - a. The Contractor is required to provide a list of the CFE equipment to be furnished. The quantity, make and model number of each item is required. Select the required equipment items quantities that will satisfy the needs of the system as described herein and with the OEM's concurrence applied to the list(s), in writing.
 - b. The following equipment items are the minimum requirements of VA to provide an acceptable system described herein:

"as required" column and delete the
remaining system items.

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>
1.	//As required//	Interface Panel(s)
1.a	//As required//	Electrical Supervision
		Trouble Enunciator
1.a.1.	//As required//	Equipment Back Box(s)
1.a.2.	//As required//	Telephone Access Equipment
1.a.3.	//As required//	Radio Paging Access Equipment
1.a.3.a.	//As required//	Radio Pager Equipment
1.a.4.	//As required//	Wireless Access Equipment
1.a.5.	//As required//	Personal Communicator
		Equipment
2.	//As required//	Lightning Arrestor
3.	//As required//	Head End Equipment Locations
3.a	//As required//	Cabinet(s)
3.a.1.	//As required//	AC Power Conditioner & Filter
3.a.2.	//As required//	AC Power Strip
3.a.3.	//As required//	UPS
3.a.3.a	//As required//	Main Power Amplifiers
3.a.3.b	//As required//	Remote Power Amplifiers
3.a.3.c	//As required//	Distributed Amplifiers (When Approved)
3.a.4.	//As required//	Interconnecting wire Cable(s)
3.a.4.a	//As required//	Wire Cable Connector(s)
3.a.4.b	//As required//	Wire Cable Terminator(s)
3.a.4.c	//As required//	Wire Management System
3.b.	//As required//	Head End Function(s)
4.	//As required//	Distribution System(s)
4.a	//As required//	Equipment Back Box(s)
4.a.1.	//As required//	Speakers
4.a.1.a	//As required//	Overhead
4.a.1.b	//As required//	Horn
4.a.1.c	//As required//	Outside
4.a.1.d	//As required//	Speaker w/ Microphone
5.	2 (MIN)	Remote Station(s)
5.a.	//As required//	Spare Items
6.	//As required//	Mental Health Unit
6.a.	//As required//	Interface Panel(s)
6.b.	//As required//	Electrical Supervision
		Trouble Enunciator
6.c.	//As required//	Equipment Back Box(s)
6.d.	//As required//	Telephone Access Equipment
6.e.	//As required//	Radio Paging Access Equipment
6.e.1.	//As required//	Radio Pager Equipment
6.f.	//As required//	Wireless Access Equipment
6.g.	//As required//	Personal Communicator
		Equipment
6.h.	//As required//	Lightning Arrestor
6.i.	//As required//	Head End Equipment
		Location(s)
6.i.1.	//As required//	Cabinets
6.i.2.	//As required//	AC Power Conditioner & Filter
6.i.3.	//As required//	AC Power Strip
6.i.4.	//As required//	UPS
6.i.5.	//As required//	Main Power Amplifiers

6.j.	//As required//	Remote Power Amplifiers
6.k.	//As required//	Distributed Amplifiers (When Approved)
6.l.	//As required//	Interconnecting Wire Cable(s)
6.l.1.	//As required//	Wire Cable Connector(s)
6.l.2.	//As required//	Wire Cable Terminator(s)
6.l.3.	//As required//	Wire Management System
6.m.	//As required//	Head End Function(s)
6.n.	//As required//	Distribution System(s)
6.n.1	//As required//	Equipment Back Box(S)
6.n.2	//As required//	Speakers
6.n.2(a)	//As required//	Overhead
6.n.2(b)	//As required//	Horn
6.n.2(c)	//As required//	Outside
6.n.2(d)	//As required//	Speaker w/ Microphone
6.o	2 (MIN)	Remote Station(s)
6.p.	//As required//	Spare Items
//7.	//As required//	Blind Rehabilitation Unit//
7.a	//As required//	Interface Panel(s)
7.b	//As required//	Electrical Supervision
		Trouble Enunciator
7.c	//As required//	Equipment Back Box(s)
7.d.	//As required//	Telephone Access Equipment
7.e.	//As required//	Radio Paging Access Equipment
7.e.1.	//As required//	Radio Pager Equipment
7.f.	//As required//	Wireless Access Equipment
7.g.	//As required//	Personal. Communicator
		Equipment
7.h.	//As required//	Lightning Arrestor
7.i.	//As required//	Head End Equipment
		Location(s)
7.i.1.	//As required//	Cabinets
7.i.2.	//As required//	AC Power Conditioner & Filter
7.i.3.	//As required//	AC Power Strip
7.i.4.	//As required//	UPS
7.i.5.	//As required//	Main Power Amplifiers
7.j.	//As required//	Remote Power Amplifiers
7.k.	//As required//	Distributed Amplifiers (When Approved)
7.l.	//As required//	Interconnecting Wire Cable(s)
7.l.1.	//As required//	Wire Cable Connector(s)
7.l.2.	//As required//	Wire Cable Terminator(s)
7.l.3.	//As required//	Wire Management System
7.k.	//As required//	Head End Function(s)
7.m.	//As required//	Distribution System(s)
7.m.1.	//As required//	Equipment Back Box(s)
7.m.2.	//As required//	Speakers
7.m.2(a)	//As required//	Overhead
7.m.2(b)	//As required//	Horn
7.m.2(c)	//As required//	Outside
7.m.2(d)	//As required//	Speaker w/ Microphone
7.n.	2 (MIN)	Remote Station(s)
7.o.	//As required//	Spare Items
//8.	//As required//	Oncology, Radiology,
		Dialysis, Units (These units are treated the same as Blind

B. ENT (aka DEMARC) Room(s):

Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

C. TER, TCR, TR, SCC, PCR, STR, HER Rooms and Equipment:

Refer to CFM Physical Security Manual (07-2007) for VA Facilities, Chapters 9.3 & 1) and PG 18-10, EDM, Chapters 7- Table 7-1, 8 & Appendix B, Telecommunications One Line Topology for specific Room and TIP Connection Requirements.

1. Interface Equipment:

a. TER:

1) Paging adaptor:

- a) The Contractor shall coordinate the installation of the paging adapter(s) designed for use with the Facility's telephone system with the Facility Telephone Contractor or local telephone company.
- b) The Contractor shall provide and install a paging adapter(s) for each zone and sub zone. The paging adapter(s) shall be accessible by dialing a telephone number provided by the Facility's Telephone Contractor.
The Paging Adapter shall:
 - 1) Monitor each audio input and output on the unit.
 - 2) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms.
 - 3) Be provided as part of the head end equipment and shall be located in the Telephone Switch Room
 - 4) Be provided with Executive (aka emergency) Paging Override of all routine paging calls in progress or being accessed to allow system "all call" (aka global)

and radio paging calls designated as (Code One Blue) functions.

- 5) Be capable of internal time out capability.
- 6) Function completely with the interface module.
- 7) Provide one spare adapter.
- c) Time Out Device: A time out device/capability shall be provided to prevent system "hang-up" due to an off-hook telephone. The device shall be able to be preset from 30 seconds to two (2) minutes. Its function shall not interfere with or override the required "all call" (aka global) operational capability.
 - 1) Central Processor Module:
 - 2) Controls system operations and holds all programmed parameters.
 - 3) Data link connection to additional CPU modules.
- d) Power Module: Provides 12V DC @ 800mA to Central Processor Module.
- e) Minimum three (3) Zone Module:
 - 1) Provides a minimum of three (3) paging zone outputs at 70V audio sound level.
 - 2) Background Music inhibit switch for each zone.
- 2) Audio Monitor Panel:
 - a) The panel shall be EIA/TIA standard for 483 mm (19") cabinet mounting.
 - b) It shall be provided in the upper portion of the head-end equipment cabinet.
 - c) Provide one (1) spare panel.
- 3) Trouble Annunciator Panel:
 - a) A trouble annunciator panel shall be provided in the head-end cabinet, and at locations as designated on the contract drawings. The panel(s) shall be compatible with or generate electrical and/or electronic supervising signals to continuously monitor the operating condition for the System head-end audio power amplifier(s), remote power amplifier(s), microphone consoles and interconnecting trunks. The panels shall generate an audible and visual signal when the System's supervising system detects an amplifier or trunk-line is malfunctioning.

- b) Provide one (1) spare panel.
- 4) Head-End Equipment
 - a) Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed herein. Head-end components may be rack mounted or wall mounted in a metal enclosure.
 - b) Provide the head end equipment in the closed telecommunications closet where the PA system is installed to include the minimum equipment listed herein.
 - c) Provide minimum of 30 minute battery back-up to system components.
- 5) Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions
 - a) Vertical Equipment Rack, Wall Mounted (to be included inside of the Equipment Cabinet):
 - b) 74" (48RU) rack space, Welded Steel construction, Minimum 20" usable depth, Adjustable front mounting rails.
 - 1) Install the following products in rack provided by same manufacturer or as specified:
 - 2) Security screws w/ nylon isolation bushings.
 - 3) Textured blank panels.
 - 4) Custom mounts for components without rack mount kits.
 - 5) Security covers.
 - 6) Copper Bus Bar.
 - 7) Power Sequencer rack mounted power conditioner and (provide as needed) delayed sequencer(s) with two (2) inswitched outlets each and contact closure control inputs.
 - 8) Rack mounting: Provide rack mount kit.
- 6) Amplifier Equipment:
 - a) Paging (aka zone):
 - 1) Inputs for 600-ohm balanced telephone line, LO-Z balanced microphone, and background music.

- 2) Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations speaker microphones, or handset transmitters
- 3) Automatic Level Control (ALC) for pages, adjustable background music muting level during page, wall or rack mountable.
- 4) 16-ohm, 25V, 25V center tapped (CT), and 70V outputs. Amplifier quantity and size (output power) as needed. Continuous amplifier power rating shall exceed loudspeaker load on amplifier by at least 25%.
- 5) Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
- 6) Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- 7) Minimum Signal-to-Noise Ratio: 45 dB, at rated output.
- 8) Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.
- b) Output Regulation: Maintains output level within 2 dB from full to no load.
- c) Amplifier Protection: Prevents damage from shorted or open output.
- d) Be provided with electronic supervision function(s).
- e) Provide onespare amplifier.

b. TCR:

- 1) Microphone Paging Console:
 - a) A console shall be provided in the TCR and PCR's as shown on the drawings.
 - b) The console shall contain visual enunciators for each connection to the telephone system's Public Address Paging Adapter. The visual enunciators shall display all the System connections to the telephone system being used.
 - c) The console shall be fully independent of the Facility's telephone system so if the telephone system has a

catastrophic failure (aka partial, multiple or total system failure) the microphone console will function normally as if the Facility's telephone system was operating normally. The restoration of the Facility's telephone system shall not affect the System.

d) Each microphone console shall:

- 1) Be Mounted: Flush unless otherwise indicated, and suitable for mounting conditions indicated.
- 2) Have a Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.
- 3) Have a system interface Back Box: Minimum Two-gang galvanized steel with 2-1/2 inch minimum depth.
- 4) Have an Internal Speaker: 3 inches, 2.3 oz. minimum; permanent magnet.
- 5) Have a Call Switch: Mount on faceplate. Permits calls to The system.
- 6) When approved - in lieu of a standalone microphone, provide a Handset with Hook Switch: Have a Handset with Hook Switch: Telephone type with 24-inch-long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.
- 7) Be provided with an electrical supervision panel to provide both audio and visual trouble alarms to the Nurse Call /Code Blue electrical supervision system.
- 8) Be capable of internal time out capability.
- 0) Be completely compatible with the Telephone Interface unit(s)

2) Electrical Supervision Trouble Annunciator Panel:

- a) The Electrical Supervision Trouble Annunciation Panel shall be located in the TCR and PCR's SCC.
- b) The panel(s) shall be compatible with the generated electrical and/or electronic supervising signals to continuously monitor the operating condition for the PA system head-end processing equipment, local/remote control consoles, audio power amplifier(s), UPS, power supplies, dome lights and interconnecting trunks. The panels shall generate an audible and visual signal when the System's

supervising system detects a system trouble or trunk-line is malfunctioning.

- c) TRs: Locate the PA floor distribution equipment within each TR as required by system design and OEM direction. Provide secured and lockable cabinet/rack(s) as required.
 - 1) General Equipment: Provide all required power supplies, communications hubs, network switches, intelligent controllers and other devices necessary to form a complete system listed herein. Equipment components may be rack mounted or wall mounted in a metal enclosure.

2) Amplifiers:

- a) Panging Amplifier Equipment:
- b) Refer to the Amplifier characteristics described herein Paragraph 2.4.G.f.
- c) Provide one (1) spare amplifier in addition to the spare Head End Amplifier.

3) Distributed Amplifier:

- a) Provide the type and number of the amplifier(S) required to meet the system design. Provide this unit as complete and separate technical submittal during the IFB review portion of the project.
- b) Provide one spare amplifier for each 20% (or portion thereof) of amplifiers used in the system.

4) Provide the equipment in the nearest TER where the System is installed to include the minimum equipment listed herein.

5) Provide minimum of 30 minute battery (UPS) back-up to system components.

6) Equipment Cabinet: Comply with cabinet requirements as aforementioned.

7) Trouble Annunciator Panel: Comply with the panel characteristics identified herein.

d. SCC, PCR, STR, HER: Refer to PG-18-10, Article 7 for specific required equipment and use minimum aforementioned specifications for population.

D. TIP DISTRIBUTION SYSTEM:

1. System Speakers:

a. Ceiling Cone-Type:

1) Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.

- 2) Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
 - 3) Minimum Dispersion Angle: 100 degrees.
 - 4) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
 - 5) Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
 - 6) Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish. Completely fill the baffle with fiberglass.
 - 7) Vandal-Proof, High-Strength Baffle: For flush-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.
 - 8) Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
 - 9) Have a minimum of two (2) safety wires installed to a solid surface or use a flexible conduit from ceiling / wall back box to the speaker back box.
 - 10) The speakers and mounting shall be self contained and wall mounted with flush back box at a minimum of 10 meter intervals and shall match (or contrast with, at the direction of the RE) the color of the adjacent surfaces.
 - 11) Provide one spare speaker, mount, and back box for each 50 speakers or portion thereof.
- b. Wall Mounted Horne-Type:
- 1) Each horn speaker shall be provided with a means of adjusting the output level over the rated horn speaker range to an appropriate audio level in the area installed.
 - 2) Provide horn speakers in equipment rooms, mechanical room, supply warehouse areas, loading dock, entrance and exit areas, and at other areas as indicated on the drawings.

- 3) Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.
 - 4) Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
 - 5) Minimum Power Rating of Driver: 15 W, continuous.
 - 6) Minimum Dispersion Angle: 110 degrees.
 - 7) Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.
 - 8) Provide one spare speaker, mount, and back box for each 20 speakers or portion thereof.
- c. System Cables: In addition to the TIP provided under Specification Section 27 15 00 - TIP Horizontal and Vertical Communications Cabling, provide the following additional TIP installation and testing requirements, provide the following minimum System TIP cables & interconnections:
- 1) Line Level Audio and Microphone Cable:
 - a) Line level audio and microphone cable for inside racks and conduit.
 - b) Shielded, twisted pair Minimum 22 American Wire Gauge (AWG), stranded conductors and 24 AWG drain wire with overall jacket.
 - 2) Speaker Level (Audio 70.7Volt [V]) Cable, Riser Rated:
 - a) For use with 70.7 V audio speaker circuits.
 - b) 18 AWG stranded pair, minimum.
 - c) UL-1333 listed.
 - 3) Speaker Level Audio Cable, Plenum Rated (70.7V):
 - a) For use with 70.7 V audio speaker circuits.
 - b) 18 AWG stranded pair, minimum.
 - 4) All cabling shall be riser rated.
 - 5) Provide one (1) spare 1,000 foot roll of approved System (not microphone) cable only.
2. Raceways, Back Boxes and conduit:
- a. Raceways:
- 1) In addition to the Raceways, Equipment Room Fittings provided under Specification Sections 27 15 00 TIP Communication Room Fittings and 27 15 00 - TIP Communications Horizontal and Vertical Cabling, provide the following additional TIP raceway and fittings:

- 2) Each raceway that is open top, shall be: UL certified for telecommunications systems, partitioned with metal partitions in order to comply with NEC Parts 517 & 800 to "mechanically separate telecommunications systems of different service, protect the installed cables from falling out when vertically mounted and allow junction boxes to be attached to the side to interface "drop" type conduit cable feeds.
- 3) Intercommunication System cable infrastructure: EMT or in J-hooks above accessible ceilings, 24 inches on center.
- 4) Junction boxes shall be not less than 2-1/2 inches deep and 6 inches wide by 6 inches long.
- 5) Flexible metal conduit is prohibited unless specifically approved by 005OP3B.

b. System Conduit:

- 1) The PA system is NFPA listed as Emergency / Public Safety Communication System which requires the entire system to be installed in a separate conduit system.
- 2) The use of centralized mechanically partitioned wireways may be used to augment main distribution conduit on a case by case basis when specifically approved by VA Headquarters (005OP3B).
- 3) Conduit Sleeves:
 - a) The AE has made a good effort to identify where conduit sleeves through full-height and fire rated walls on the drawings, and has instructed the electrician to provide the sleeves as shown on the drawings.
 - b) While the sleeves shown on the drawings will be provided by others, the contractor is responsible for installing conduit sleeves and fire-proofing where necessary. It is often the case, that due to field conditions, the nurse-call cable may have to be installed through an alternate route. Any conduit sleeves required due to field conditions or those omitted by the engineer shall be provided by the cabling contractor.

3. Device Back Boxes:

- a. Furnish to the electrical contractor all back boxes required for the PA system devices.

- b. The electrical contractor shall install the back boxes as well as the system conduit. Coordinate the delivery of the back boxes with the construction schedule.
4. Telecommunication Outlets (TCO): Populate each TCO that is required to perform system operations in the locations that were provided and cabled as a part of Specifications Sections 27 11 00 and 27 15 00. Provide additional TCO equipment, interfaces and connections as required by System design. Provide secured pathway(s) and TCOs as required.
5. UPS:
 - a. Provide a backup battery or a UPS for the System to allow normal operation and function (as if there was no AC power failure) in the event of an AC power failure or during input power fluctuations for a minimum of four (4) hours.
 - b. As an alternate solution, the telephone system UPS may be utilized to meet this requirement at the headend location, as long as this function is specifically approved by the Telephone Contractor and the RE.
 - c. The PA Contractor shall not make any attachments or connection to the telephone system until specifically directed to do so, in writing, by the RE.
 - d. Provide UPS for all active system components including but not limited to:
 - 1) System Amplifiers.
 - 2) Microphone Consoles.
 - 3) Telephone Interface Units.
 - 4) TER, TR & Headend Equipment Rack(s).

F. Installation Kit:

1. General: The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. Turn over to the RE all unused and partially opened installation kit boxes, coaxial,

- fiberoptic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware. The following are the minimum required installation sub-kits:
2. System Grounding:
 - a. The grounding kit shall include all cable and installation hardware required. All radio equipment shall be connected to earth ground via internal building wiring, according to the NEC.
 - b. This includes, but is not limited to:
 - 1) Coaxial Cable Shields.
 - 2) Control Cable Shields.
 - 3) Data Cable Shields.
 - 4) Equipment Racks.
 - 5) Equipment Cabinets.
 - 6) Conduits.
 - 7) Duct.
 - 8) Cable Trays.
 - 9) Power Panels.
 - 10) Connector Panels.
 - 11) Grounding Blocks.
 3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
 4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
 5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
 6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
 7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to completely and

correctly label each subsystem according to the OEM requirements, as-installed drawings, and this document.

8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to completely and correctly provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Assign a single project manager to this project who will serve as the point of contact for the Owner, the General Contractor, and the Engineer.
- B. The Contractor shall be proactive in scheduling work at the hospital, specifically the Contractor will initiate and maintain discussion with the general contractor regarding the schedule for ceiling cover up and install cables to meet that schedule.
- C. Contact the Office of Telecommunications, Special Communications Team (0050P3B) at (301) 734-0350 to have a VA Certified Telecommunications COTR assigned to the project for telecommunications review, equipment and system approval and co-ordination with VA's Spectrum Management and OCIS Teams.

3.2 COORDINATION WITH OTHER TRADES

- A. Coordinate with the cabling contractor the location of the PA system faceplate and the faceplate opening for the PA system back boxes.
- B. Coordinate with the cabling contractor the location of TIP equipment in the **TER, TCR, PA, PCR, SCC, ECR, STRs, NSs, HER and TCOs in order to connect to the TIP cable network that was installed as a part of Section Specification 27 11 00. Contact the RE immediately, in writing, if additional location(s) are discovered to be activated that was not previously provided.**
- C. Before beginning work, verify the location, quantity, size and access for the following:
 - 1. Isolated ground AC power circuits provided for systems.
 - 2. Junction boxes, wall boxes, wire troughs, conduit stubs and other related infrastructure for the systems.
 - 3. System components installed by others.
 - 4. Overhead supports and rigging hardware installed by others.

- D. Immediately notify the Owner, GC and Consultant(s) in writing of any discrepancies

3.3 NEEDS ASSESSMENT

Provide a one-on-one meeting with the particular manager of each unit affected by the installation of the new PA system. Review the floor plan drawing, educate the nursing manager with the functions of the equipment that is being provided and gather details specific to the individual units; coverage and priorities of calls; staffing patterns; and other pertinent details that will affect system programming and training.

3.4 INSTALLATION

A. General

1. Execute work in accordance with National, State and local codes, regulations and ordinances.
2. Install work neatly, plumb and square and in a manner consistent with standard industry practice. Carefully protect work from dust, paint and moisture as dictated by site conditions. The Contractor will be fully responsible for protection of his work during the construction phase up until final acceptance by the Owner.
3. Install equipment according to OEM's recommendations. Provide any hardware, adaptors, brackets, rack mount kits or other accessories recommended by OEM for correct assembly and installation.
4. Secure equipment firmly in place, including receptacles, speakers, equipment racks, system cables, etc.
 - a. All supports, mounts, fasteners, attachments and attachment points shall support their loads with a safety factor of at least 5:1.
 - b. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems.
 - c. Any suspended equipment or associated hardware must be certified by the OEM for overhead suspension.
 - d. The Contractor is responsible for means and methods in the design, fabrication, installation and certification of any supports, mounts, fasteners and attachments.
5. Locate overhead ceiling-mounted loudspeakers as shown on drawings, with minor changes not to exceed 12" in any direction.

- a. Mount transformers securely to speaker brackets or enclosures using screws. Adjust torsion springs as needed to securely support speaker assembly.
 - b. Speaker back boxes shall be completely filled with fiberglass insulation.
 - c. Seal cone speakers to their enclosures to prevent air passing from one side of the speaker to the other.
6. Finishes for any exposed work such as plates, racks, panels, speakers, etc. shall be approved by the Architect, Owner and 0050P3B.
7. Coordinate cover plates with field conditions. Size and install cover plates as necessary to hide joints between back boxes and surrounding wall. Where cover plates are not fitted with connectors, provide grommets holes in size and quantity required. Do not allow cable to leave or enter boxes without cover plates installed.
8. Active electronic component equipment shall consist of solid state components, be rated for continuous duty service, comply with the requirements of FCC standards for telephone and data equipment, systems, and service.
9. Color code all distribution wiring to conform to the PA Industry Standard, EIA/TIA, and this document, whichever is the more stringent. At a minimum, all equipment, cable duct and/or conduit, enclosures, wiring, terminals, and cables shall be clearly and permanently labeled according to and using the provided record drawings, to facilitate installation and maintenance.
10. Connect the System's primary input AC power to the Facility's Critical Branch of the Emergency AC power distribution system as shown on the plans or if not shown on the plans consult with RE regarding a suitable circuit location prior to bidding.
11. Product Delivery, Storage and Handling:
 - a. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment catalog numbers, model and serial identification numbers. The RE may inventory the cable, patch panels, and related equipment.
 - b. Storage and Handling: Store and protect equipment in a manner, which will preclude damage as directed by the RE.

12. Where TCOs are installed adjacent to each other, install one outlet for each instrument.

13. Equipment installed outdoors shall be weatherproof or installed in weatherproof enclosures with hinged doors and locks with two keys.

B. Equipment Racks:

1. Fill unused equipment mounting spaces with blank panels or vent panels. Match color to equipment racks.
2. Provide security covers for all devices not requiring routine operator control.
3. Provide vent panels and cooling fans as required for the operation of equipment within the OEM' specified temperature limits. Provide adequate ventilation space between equipment for cooling. Follow manufacturer's recommendations regarding ventilation space between amplifiers.
4. Provide insulated connections of the electrical raceway to equipment racks.
5. Provide continuous raceway/conduit with no more than 40% fill between wire troughs and equipment racks for all non-plenum-rated cable. Ensure each system is mechanically separated from each other in the wireway.
6. Ensure a minimum of 36 inches around each cabinet and/or rack to comply with OSHA Safety Standards. Cabinets and/or Racks installed side by side - the 36" rule applies to around the entire assembly

C. Distribution Frames.

1. A new stand-alone (i.e., self supporting, free standing) PA rack/frame may be provided in each TR to interconnect the PA, TER, TCR, PCR, SCC, STRs & ECRs. Rack/frames shall be wired in accordance with industry standards and shall employ "latest state-of-the-art" modular cross-connect devices. The PA riser cable shall be sized to satisfy all voice/digital requirements plus not less than 50% spare (growth) capacity in each TR which includes a fiber optic backbone.
2. The frames/racks shall be connected to the TER/MCR system ground.

D. Wiring Practice - in addition to the MANDATORY infrastructure requirements outlined in VA Construction Specifications 27 10 00 - TIP Structured Communications Cabling, 27 11 00 - TIP Communications Rooms Fittings and 27 15 00 - TIP Horizontal and Vertical Communicators Cabling, the following additional practices shall be adhered too:

1. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Execute all wiring in strict adherence to the National Electrical Code, applicable local building codes and standard industry practices.
3. Wiring shall be classified according to the following low voltage signal types:
 - a. Balanced microphone level audio (below -20dBm) or Balanced line level audio (-20dBm to +30dBm)
 - b. 70V audio speaker level audio.
 - c. Low voltage DC control or power (less than 48VDC)
4. Where raceway is to be EMT (conduit), wiring of differing classifications shall be run in separate conduit. Where raceway is to be an enclosure (rack, tray, wire trough, utility box) wiring of differing classifications which share the same enclosure shall be mechanically partitioned and separated by at least four (4) inches. Where Wiring of differing classifications must cross, they shall cross perpendicular to one another.
5. Do not splice wiring anywhere along the entire length of the run. Make sure cables are fully insulated and shielded from each other and from the raceway for the entire length of the run.
6. Do not pull wire through any enclosure where a change of raceway alignment or direction occurs. Do not bend wires to less than radius recommended by manufacturer.
7. Replace the entire length of the run of any wire or cable that is damaged or 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 to the Facility's signal ground system as indicated by the drawings.
12. Field wiring entering equipment racks shall be terminated as follows:

- a. Provide ample service loops at harness break-outs and at plates, panels and equipment. Loops should be sufficient to allow plates, panels and equipment to be removed for service and inspection.
 - b. Line level and speaker level wiring may be terminated inside the equipment rack using specified terminal blocks (see "Products.") Provide 15% spare terminals inside each rack. Microphone level wiring may only be terminated at the equipment served.
 - c. If specified terminal blocks are not designed for rack mounting, utilize $\frac{3}{4}$ " plywood or 1/8" thick aluminum plates/blank panels as a mounting surface. Do not mount on the bottom of the rack.
 - d. Employ permanent strain relief for any cable with an outside diameter of 1" or greater.
13. Use only balanced audio circuits unless noted otherwise
14. Make all connections as follows:
- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
 - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
 - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
 - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
15. Make all connections as follows:
- a. Make all connections using rosin-core solder or mechanical connectors appropriate to the application.
 - b. For crimp-type connections, use only tools that are specified by the manufacturer for the application.
 - c. Use only insulated spade lugs on screw terminals. Spade lugs shall be sized to fit the wire gauge. Do not exceed two lugs per terminal.
 - d. Wire nuts, electrical tape or "Scotch Lock" connections are not acceptable for any application.
16. Noise filters and surge protectors shall be provided for each equipment interface cabinet, switch equipment cabinet, control console, local, and remote active equipment locations to ensure protection from input primary AC power surges and noise glitches are not induced into low Voltage data circuits.

17. Wires or cables **previously approved** to be installed outside of conduit, cable trays, wireways, cable duct, etc:

- a. Only when specifically authorized as described herein, will wires or cables be identified and approved to be installed outside of conduit. The wire or cable runs shall be UL rated plenum and OEM certified for use in air plenums.
 - b. Wires and cables shall be hidden, protected, fastened and tied at 600 mm (24 in.) intervals, maximum, as described herein to building structure.
 - c. Closer wire or cable fastening intervals may be required to prevent sagging, maintain clearance above suspended ceilings, remove unsightly wiring and cabling from view and discourage tampering and vandalism. Wire or cable runs, not provided in conduit, that penetrate outside building walls, supporting walls, and two hour fire barriers shall be sleeved and sealed with an approved fire retardant sealant.
 - d. Wire or cable runs to system components installed in walls (i.e.: volume attenuators, circuit controllers, signal, or data outlets, etc.) may, when specifically authorized by the RE, be fished through hollow spaces in walls and shall be certified for use in air plenum areas.
 - e. Completely test all of the cables after installation and replace any defective cables.
 - f. Wires or cables that are installed outside of buildings shall be in conduit, secured to solid building structures. If specifically approved, on a case by case basis, to be run outside of conduit, the wires or cables shall be installed, as described herein. The bundled wires or cables must: Be tied at not less than 460 mm (18 in.) intervals to a solid building structure; have ultra violet protection and be totally waterproof (including all connections). The laying of wires or cables directly on roof tops, ladders, drooping down walls, walkways, floors, etc. is not allowed and will not be approved.
- E. Cable Installation - In addition to the **MANDATORY** infrastructure requirements outlined in VA Construction Specifications 27 10 00 - Structured TIP Communications Cabling, 27 11 00 - TIP Communications Rooms and Fittings and 27 15 00 - TIP Communications Horizontal and

Vertical Cabling and the following additional practices shall be adhered too:

1. Support cable on maximum 2'-0" centers. Acceptable means of cable support are cable tray, j-hooks, and bridal rings. Velcro wrap cable bundles loosely to the means of support with plenum rated Velcro straps. Plastic tie wraps are not acceptable as a means to bundle cables.
2. Run cables parallel to walls.
3. Install maximum of 10 cables in a single row of J-hooks. Provide necessary rows of J-hooks as required by the number of cables.
4. Do not lay cables on top of light fixtures, ceiling tiles, mechanical equipment, or ductwork. Maintain at least 2'-0" clearance from all shielded electrical apparatus.
5. All cables shall be tested after the total installation is fully complete. All test results are to be documented. All cables shall pass acceptable test requirements and levels. Contractor shall remedy any cabling problems or defects in order to pass or comply with testing. This includes the re-pull of new cable as required at no additional cost to the Owner.
6. Ends of cables shall be properly terminated on both ends per industry and OEM's recommendations.
7. Provide proper temporary protection of cable after pulling is complete before final dressing and terminations are complete. Do not leave cable lying on floor. Bundle and tie wrap up off of the floor until you are ready to terminate.
8. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
9. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
10. Bundle, lace, and train conductors to terminal points without exceeding OEM's limitations on bending radii. Install lacing bars and distribution spools.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.
12. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

13. Separation of Wires: (REFER TO RACEWAY INSTALLATION) Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

14. Serve all cables as follows:

- a. Cover the end of the overall jacket with a 1" (minimum) length of transparent heat-shrink tubing. Cut unused insulated conductors 2" (minimum) past the heat-shrink, fold back over jacket and secure with cable-tie. Cut unused shield/drain wires 2" (minimum) past the Heatshrink and serve as indicated below.
- b. Cover shield/drain wires with heat-shrink tubing extending back to the overall jacket. Extend tubing ¼" past the end of unused wires, fold back over jacket and secure with cable tie.
- c. For each solder-type connection, cover the bare wire and solder connection with heat-shrink tubing.

F. Labeling: Provide labeling in accordance with ANSI/EIA/TIA-606-A. All lettering for PA circuits shall be stenciled.

1. Cable and Wires (Hereinafter referred to as "Cable"): Cables shall be labeled at both ends in accordance with ANSI/EIA/TIA-606-A. Labels shall be permanent in contrasting colors. Cables shall be identified according to the System "Record Wiring Diagrams."
2. Equipment: System equipment shall be permanently labeled with contrasting plastic laminate or Bakelite material. System equipment shall be labeled on the face of the unit corresponding to its source.
 - a. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles and electronic and other equipment.
 - b. Engrave and paint fill all receptacle panels using 1/8" (minimum) high lettering and contrasting paint.
 - c. For rack-mounted equipment, use engraved Lamacoid labels with white 1/8" (minimum) high lettering on black background. Label the front and back of all rack-mounted equipment.
3. Conduit, Cable Duct, and/or Cable Tray: The Contractor shall label all conduit, duct and tray, including utilized GFE, with permanent

- marking devices or spray painted stenciling a minimum of 3 meters (10 ft.) identifying it as the System. In addition, each enclosure shall be labeled according to this standard.
4. Termination Hardware: The Contractor shall label TCOs and patch panel connections using color coded labels with identifiers in accordance with ANSI/EIA/TIA-606-A and the "Record Wiring Diagrams."
 5. Where multiple pieces of equipment reside in the same rack group, clearly and logically label each indicating to which room, channel, receptacle location, etc. they correspond.
 6. Permanently label cables at each end, including intra-rack connections. Labels shall be covered by the same, transparent heat-shrink tubing covering the end of the overall jacket. Alternatively, computer generated labels of the type which include a clear protective wrap may be used.
 7. Contractor's name shall appear no more than once on each continuous set of racks. The Contractor's name shall not appear on wall plates or portable equipment.
 8. Ensure each OEM supplied item of equipment has appropriate UL Labels / Marks for the service the equipment is performed permanently attached / marked. SYSTEM EQUIPMENT INSTALLED NOT BEARING THESE UL MARKS WILL NOT BE ALLOWED TO BE A PART OF THE SYSTEM. THE CONTRACTOR SHALL BEAR ALL COSTS REQUIRED TO PROVIDE REPLACEMENT EQUIPMENT WITH APPROVED UL MARKS.
- G. Conduit and Signal Ducts: When the Contractor and/or OEM determines additional system conduits and/or signal ducts are required in order to meet the system minimum performance standards outlined herein, the contractor shall provide these items as follows:
1. Conduit:
 - a. The Contractor shall employ the latest installation practices and materials. The Contractor shall provide conduit, junction boxes, connectors, sleeves, weather heads, pitch pockets, and associated sealing materials not specifically identified in this document as GFE. Conduit penetrations of walls, ceilings, floors, interstitial space, fire barriers, etc., shall be sleeved and sealed.
 - b. All cables shall be installed in separate conduit and/or signal ducts (exception from the separate conduit requirement to allow PA cables to be installed in partitioned cable tray with voice

cables may be granted in writing by the RE if requested).

Conduits shall be provided in accordance with Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and NEC Articles 517 for Critical Care and 800 for Communications systems, at a minimum.

- c. When metal, plastic covered, etc., flexible cable protective armor or systems are specifically authorized to be provided for use in the System, their installation guidelines and standards shall be as specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
 - d. When "interduct" flexible cable protective systems is specifically authorized to be provided for use in the System, it's installation guidelines and standards shall be as the specified herein, Section 27 05 33, RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS, and the NEC.
 - e. Conduit fill (including GFE approved to be used in the system) shall not exceed 40%. Each conduit end shall be equipped with a protective insulator or sleeve to cover the conduit end, connection nut or clamp, to protect the wire or cable during installation and remaining in the conduit. Electrical power conduit shall be installed in accordance with the NEC. AC power conduit shall be run separate from signal conduit.
2. Signal Duct, Cable Duct, or Cable Tray:
- a. The Contractor shall use GFE signal duct, cable duct, and/or cable tray, when identified and approved by the RE.
 - b. Approved signal and/or cable duct shall be a minimum size of 100 mm x 100 mm (4 in. X 4 in.) inside diameter with removable tops or sides, as appropriate. Protective sleeves, guides or barriers are required on all sharp corners, openings, anchors, bolts or screw ends, junction, interface and connection points.
 - c. Approved cable tray shall be fully covered, mechanically and physically partitioned for multiple electronic circuit use, and be UL certified and labeled for use with telecommunication circuits and/or systems. The RE shall approve width and height dimensions.
 - d. All cable junctions and taps shall be accessible. Provide an 8" X 8" X 4" (minimum) junction box attached to the cable duct or

raceway for installation of distribution system passive equipment. Ensure all equipment and tap junctions are accessible

3.5 PROTECTION OF NETWORK DEVICES

Contractor shall protect network devices during unpacking and installation by wearing manufacturer approved electrostatic discharge (ESD) wrist straps tied to chassis ground. The wrist strap shall meet OSHA requirements for prevention of electrical shock, should technician come in contact with high voltage.

3.6 CUTTING, CLEANING AND PATCHING

- A. It shall be the responsibility of the contractor to keep their work area clear of debris and clean area daily at completion of work.
- B. It shall be the responsibility of the contractor to patch and paint any wall or surface that has been disturbed by the execution of this work.
- C. The Contractor shall be responsible for providing any additional cutting, drilling, fitting or patching required that is not indicated as provided by others to complete the Work or to make its parts fit together properly.
- D. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate Contractor the Contractor's consent to cutting or otherwise altering the Work.
- E. Where coring of existing (previously installed) concrete is specified or required, including coring indicated under unit prices, the location of such coring shall be clearly identified in the field and the location shall be approved by the Project Manager prior to commencement of coring work.

3.7 FIREPROOFING

- A. Where PA wires, cables and conduit penetrate fire rated walls, floors and ceilings, fireproof the opening.
- B. Provide conduit sleeves (if not already provided by electrical contractor) for cables that penetrate fire rated walls and Telecommunications Rooms floors and ceilings. After the cabling

installation is complete, install fire proofing material in and around all conduit sleeves and openings. Install fire proofing material thoroughly and neatly. Seal all floor and ceiling penetrations.

- C. Use only materials and methods that preserve the integrity of the fire stopping system and its rating.
- D. Install fireproofing where low voltage cables are installed in the same manholes with high voltage cables; also cover the low voltage cables with arc proof and fireproof tape.
- E. Use approved fireproofing tape of the same type as used for the high voltage cables, and apply the tape in a single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 25 mm (one inch) into each duct.
- F. Secure the tape in place by a random wrap of glass cloth tape.

3.8 GROUNDING

- A. Ground PA cable shields and equipment to eliminate shock hazard and to minimize ground loops, commonmode returns, noise pickup, cross talk, and other impairments as specified in CFM Division 27, Section 27 05 26 - Grounding and Bonding for Communications Systems.
- B. Facility Signal Ground Terminal: Locate at main room or area signal ground within the room (i.e. head end and telecommunications rooms) or area(s) and indicate each signal ground location on the drawings.
- C. Extend the signal ground to inside each equipment cabinet and/or rack. Ensure each cabinet and/or rack installed item of equipment is connected to the extended signal ground. Isolate the signal ground from power and major equipment grounding systems.
- D. When required, install grounding electrodes as specified in CFM Division 26, Section 26 05 26 -Grounding and Bonding for Electrical Systems.
- E. Do not use "3rd or 4th" wire internal electrical system conductors for communications signal ground.
- F. Do not connect the signal ground to the building's external lightning protection system.
- G. Do Not "mix grounds" of different systems.
- H. Insure grounds of different systems are installed as to not violate OSHA Safety and NEC installation requirements for protection of personnel.

PART 4 - TESTING / GUARANTY / TRAINING

4.1 SYSTEM LISTING

The PA System is NFPA listed as an "Emergency / Public Safety" Communications system. Where Code Blue signals are transmitted, that listing is elevated to "Life Support/Safety." Therefore, the following testing and guaranty provisions are the minimum to be performed and provided by the contractor and OEM.

4.2 PROOF OF PERFORMANCE TESTING

A. Intermediate Testing:

1. After completion of 25 - 30% the installation of a head end cabinet(s) and equipment, one microphone console, local and remote enunciation stations, two (2) zones, two (2) sub zones prior to any further work, this portion of the system must be pretested, inspected, and certified. Each item of installed equipment shall be checked to ensure appropriate UL Listing and Certification Labels are affixed as required by NFPA -Life Safety Code 101-3.2 (a) & (b) and JCHCO evaluation guidelines, and proper installation practices are followed. The intermediate test shall include a full operational test.
2. All inspections and tests shall be conducted by an OEM-certified contractor representative and witnessed by TVE-0050P3B if there is no local Government Representative that processes OEM and VA approved Credentials to inspect and certify the system. The results of the inspection will be officially recorded by the Government Representative and maintained on file by the RE, until completion of the entire project. The results will be compared to the Acceptance Test results. An identical inspection may be conducted between the 65 - 75% of the system construction phase, at the direction of the RE.

B. Pretesting:

1. Upon completing installation of the PA System, the Contractor shall align, balance, and completely pretest the entire system under full operating conditions.
2. Pretesting Procedure:
 - a. During the System Pretest the Contractor shall verify (utilizing approved test equipment) that the System is fully operational and meets all the System performance requirements of this standard.

- b. The Contractor shall pretest and verify that all PA System functions and specification requirements are met and operational, no unwanted aural effects, such as signal distortion, noise pulses, glitches, audio hum, poling noise, etc. are present. At a minimum, each of the following locations shall be fully pretested:
 - 1) Central Control Cabinets.
 - 2) Local Control Stations.
 - 3) Zone Equipment/Systems.
 - 4) Sub-Zone Equipment/Systems.
 - 5) Remote Control Panels.
 - a.) TCR.
 - b.) PCR/SCC.
 - 6) All Networked locations.
 - 7) System interface locations (i.e. TELCO, two way radio, etc.).
 - 8) System trouble reporting.
 - 9) System Electrical Supervision.
 - 10) UPS operation.
 - 11) STRs.
 - 12) NSs
 - 13) TCOs.
3. The Contractor shall provide four (4) copies of the recorded system pretest measurements and the written certification that the System is ready for the formal acceptance test shall be submitted to the RE.

C. Acceptance Test:

1. After the PA System has been pretested and the Contractor has submitted the pretest results and certification to the RE, then the Contractor shall schedule an acceptance test date and give the RE 30 day's written notice prior to the date the acceptance test is expected to begin. The System shall be tested in the presence of TVE 0050P3B and an OEM certified representatives. The System shall be tested utilizing the approved test equipment to certify proof of performance and Emergency / Public Safety compliance. The tests shall verify that the total System meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

2. The acceptance test shall be performed on a "go-no-go" basis. Only those operator adjustments required to show proof of performance shall be allowed. The test shall demonstrate and verify that the installed System does comply with all requirements of this specification under operating conditions. The System shall be rated as either acceptable or unacceptable at the conclusion of the test. Failure of any part of the System that precludes completion of system testing, and which cannot be repaired in four (4) hours, shall be cause for terminating the acceptance test of the System. Repeated failures that result in a cumulative time of eight (8) hours to affect repairs shall cause the entire System to be declared unacceptable. Retesting of the entire System shall be rescheduled at the convenience of the Government.
3. Retesting of the entire System shall be rescheduled at the convenience of the Government and costs borne by the Contractor at the direction of the SRE.

D. Acceptance Test Procedure:

1. Physical and Mechanical Inspection:

- a. The TVE 0050P3B Representative will tour all areas where the PA system and all sub-systems are completely and properly installed to insure they are operationally ready for proof of performance testing. A system inventory including available spare parts will be taken at this time. Each item of installed equipment shall be checked to ensure appropriate UL certification labels are affixed.
- b. The System diagrams, record drawings, equipment manuals, TIP Auto CAD Disks, intermediate, and pretest results shall be formally inventoried and reviewed.
- c. Failure of the System to meet the installation requirements of this specification shall be grounds for terminating all testing.

2. Operational Test:

- a. After the Physical and Mechanical Inspection, the system head end equipment shall be checked to verify that it meets all performance requirements outlined herein. A spectrum analyzer and sound level meter may be utilized to accomplish this requirement.
- b. Following the head end equipment test, each speaker (or on board speaker) shall be inspected to ensure there are no signal

distortions such as intermodulation, data noise, popping sounds, erratic system functions, on any function.

- c. The distribution system shall be checked at each interface, junction, and distribution point, first, middle, and last speaker in each leg to verify the PA distribution system meets all system performance standards.
 - d. If the RED system is a part of the system, each volume stepper switches shall be checked to insure proper operation of the pillow speaker, the volume stepper and the RED system (if installed).
 - e. Additionally, each installed head end equipment, microphone console; amplifier, mixer, distributed speaker/amplifier, monitor speaker, telephone interface, power supply and remote amplifiers shall be checked insuring they meet the requirements of this specification.
 - f. Once these tests have been completed, each installed sub-system function shall be tested as a unified, functioning and fully operating system. The typical functions are: "all call," three sub-zoned, minimum of 15 minutes of UPS operation, electrical supervision, trouble panel, corridor speakers and audio paging.
 - h. Individual Item Test: The TVE 0050P3B Representative will select individual items of equipment for detailed proof of performance testing until 100% of the System has been tested and found to meet the contents of this specification. Each item shall meet or exceed the minimum requirements of this document.
3. Test Conclusion:
- a. At the conclusion of the Acceptance Test, using the generated punch list (or discrepancy list) the VA and the Contractor shall jointly agree to the results of the test, and reschedule testing on deficiencies and shortages with the RE. Any retesting to comply with these specifications will be done at the Contractor's expense.
 - b. If the System is declared unacceptable without conditions, all rescheduled testing expenses will be borne by the Contractor.
- E. Acceptable Test Equipment: The test equipment shall furnished by the Contractor shall have a calibration tag of an acceptable calibration service dated not more than 12 months prior to the test. As part of the

submittal, a test equipment list shall be furnished that includes the make and model number of the following type of equipment as a minimum:

1. Spectrum Analyzer.
2. Signal Level Meter.
3. Volt-Ohm Meter.
4. Sound Pressure Level (SPL) Meter.
5. Oscilloscope.
6. Random Noise Generator.
7. Audio Amplifier with External Speaker.

4.3 WARRANTY

A. Comply with FAR 52.246-21, except that warranty shall be as follows:

B. Contractor's Responsibility:

1. The Contractor shall warranty that all provided material and equipment will be free from defects, workmanship and will remain so for a period of two (2) years from date of final acceptance of the System by the VA. The Contractor shall provide OEM's equipment warranty documents, to the RE (or Facility Contracting Officer if the Facility has taken possession of the building), that certifies each item of equipment installed conforms to OEM published specifications.
2. The Contractor's maintenance personnel shall have the ability to contact the Contractor and OEM for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the Contractor and OEM at no additional cost to the VA.
3. All Contractor maintenance and supervisor personnel shall be fully qualified by the OEM and must provide two (2) copies of current and qualified OEM training certificates and OEM certification upon request.
4. Additionally, the Contractor shall accomplish the following minimum requirements during the two year guaranty period:
 - a. Response Time During the **Two Year** Guaranty Period:
 - 1) The RE (or Facility Contracting Officer if the system has been turned over to the Facility) is the Contractor's ONLY OFFICIAL reporting and contact official for nurse call system trouble calls, during the guaranty period.

- 2) A standard work week is considered 8:00 A.M. to 5:00 P.M. or as designated by the RE (or Facility Contracting Officer), Monday through Friday exclusive of Federal Holidays.
 - 3) The Contractor shall respond and correct on-site trouble calls, during the standard work week to:
 - a) A routine trouble call within one (1) working day of its report. A routine trouble is considered a trouble which causes a power supply; one (1) master System control station, microphone console or amplifier to be inoperable.
 - b) Routine trouble calls in critical emergency health care facilities (i.e., cardiac arrest, intensive care units, etc.) shall also be deemed as an emergency trouble call. The RE (or Facility Contracting Officer) shall notify the Contractor of this type of trouble call.
 - c) An emergency trouble call within four (4) hours of its report. An emergency trouble is considered a trouble which causes a sub-zone, zone, distribution point, terminal cabinet, or all call system to be inoperable at anytime.
 - 4) If a PA System component failure cannot be corrected within four (4) hours (exclusive of the standard work time limits), the Contractor shall be responsible for providing alternate System equipment. The alternate equipment/system shall be operational within a maximum of 12 hours after the four (4) hour trouble shooting time and restore the effected location operation to meet the System performance standards. If any sub-system or major system trouble cannot be corrected within one working day, the Contractor shall furnish and install compatible substitute equipment returning the System or sub-system to full operational capability, as described herein, until repairs are complete.
- b. Required On-Site Visits During the Two Year Guaranty Period
- 1) The Contractor shall visit, on-site, for a minimum of eight (8) hours, once every 12 weeks, during the guaranty period, to perform system preventive maintenance, equipment cleaning, and operational adjustments to maintain the System according the descriptions identified in this document.

- 2) The Contractor shall arrange all Facility visits with the RE (or Facility Contracting Officer) prior to performing the required maintenance visits.
- 3) Preventive maintenance procedure(s) shall be performed by the Contractor in accordance with the OEM's recommended practice and service intervals during non-busy time agreed to by the RE (or Facility Contracting Officer) and Contractor.
- 4) The preventive maintenance schedule, functions and reports shall be provided to and approved by the RE (or Facility Contracting Officer).
- 5) The Contractor shall provide the RE (or Facility Contracting Officer) a type written report itemizing each deficiency found and the corrective action performed during each required visit or official reported trouble call. The Contractor shall provide the RE with sample copies of these reports for review and approval at the beginning of the Acceptance Test. The following reports are the minimum required:
 - a) The Contractor shall provide a monthly summary all equipment and sub-systems serviced during this warranty period to RE (or Facility Contracting Officer) by the fifth (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 RE (or Facility Contracting Officer) shall convey to the Facility Engineering Officer, two (2) copies of actual reports for evaluation.
 - a) The RE (or Facility Contracting Officer) shall ensure a copy of these reports is entered into the System's official acquisition documents.

b) The Facility Chief Engineer shall ensure a copy of these reports is entered into the System's official technical record documents.

C. Work Not Included: Maintenance and repair service shall not include the performance of any work due to improper use; accidents; other vendor, contractor, or owner tampering or negligence, for which the Contractor is not directly responsible and does not control. The Contractor shall immediately notify the RE or Facility Contracting Officer in writing upon the discovery of these incidents. The RE or Facility Contracting Officer will investigate all reported incidents and render an official opinion in writing concerning the supplied information.

4.4 TRAINING

A. Provide thorough training of all biomed engineering and electronic technical staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.

B. Provide the following minimum training times and durations:

1. 12 hours prior to opening for BME / Electronic Staff (in 8-hour increments) - split evenly over 3 weeks and day and night shifts. Coordinate schedule with Owner.
2. 8 hours during the opening week for Telephone Staff - both day and night shifts.

- - - E N D - - -

SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section, Common Work Results for Electronic Safety and Security (ESS), applies to all sections of Division 28.
- B. Furnish and install fully functional electronic safety and security cabling system(s), equipment and approved accessories in accordance with the specification section(s), drawing(s), and referenced publications. Capacities and ratings of cable and other items and arrangements for the specified items are shown on each system's required Bill of Materials (BOM) and verified on the approved system drawing(s). If there is a conflict between contract's specification(s) and drawings(s), the contract's specification requirements shall prevail.
- C. The Contractor shall provide a fully functional and operating ESS, programmed, configured, documented, and tested as required herein and the respective Safety and Security System Specification(s). The Contractor shall provide calculations and analysis to support design and engineering decisions as specified in submittals. The Contractor shall provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. The Contractor shall secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; the Contractor will comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.
- D. The Contractor shall provide an ESS, installed, programmed, configured, documented, and tested. The security system shall include but not limited to: physical access control, intrusion detection, duress alarms, elevator control interface, video assessment and surveillance, video recording and storage, delayed egress, personal protection system, intercommunication system, fire alarm interface, equipment cabinetry, dedicated photo badging system and associated live camera, report printer, photo badge printer, and uninterruptible power supplies (UPS) interface. Operator training shall not be required as part of the Security Contractors scope and shall be provided by the Owner. The Security Contractor shall still be required to provide necessary maintenance and troubleshooting manuals as well as submittals as

identified herein. The work shall include the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. The Contractor shall provide all associated installation support, including the provision of primary electrical input power circuits.

E. Repair Service Replacement Parts On-site service during the warranty period shall be provided as specified under "Emergency Service". The Contractor shall guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in Part 5 of this Specification. The Contractor shall be responsible for all equipment, software, shipping, transportation charges, and expenses associated with the service of the system for one (1) year. The Contractor shall provide 24-hour telephone support for the software program at no additional charge to the owner. Software support shall include all software updates that occur during the warranty period.

F. Section Includes:

1. Description of Work for Electronic Security Systems,
2. Electronic security equipment coordination with relating Divisions,
3. Submittal Requirements for Electronic Security,
4. Miscellaneous Supporting equipment and materials for Electronic Security,
5. Electronic security installation requirements.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- G. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- K. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- L. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- M. Section 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- P. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.

- Q. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- R. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- S. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for Commissioning.
- T. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). For physical access control integration.
- U. Section 28 13 16 - PHYSICAL ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- V. Section 28 13 53 - SECURITY ACCESS DETECTION. Requirements for screening of personnel and shipments.
- W. Section 28 16 00 - INTRUSION DETECTION SYSTEM (IDS). Requirements for alarm systems.
- X. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- Y. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

1.3 DEFINITIONS

- A. AGC: Automatic Gain Control.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. CCD: Charge-coupled device.
- E. Central Station: A PC with software designated as the main controlling PC of the security access system. Where this term is presented with initial capital letters, this definition applies.
- F. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- G. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- H. CPU: Central processing unit.
- I. Credential: Data assigned to an entity and used to identify that entity.
- J. DGP: Data Gathering Panel - component of the Physical Access Control System capable to communicate, store and process information received from readers, reader modules, input modules, output modules, and Security Management System.

- K. DTS: Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.
- L. EMI: Electromagnetic interference.
- M. EMT: Electric Metallic Tubing.
- N. ESS: Electronic Security System.
- O. File Server: A PC in a network that stores the programs and data files shared by users.
- P. GFI: Ground fault interrupter.
- Q. IDC: Insulation displacement connector.
- R. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- S. I/O: Input/Output.
- T. Intrusion Zone: A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.
- U. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- V. LAN: Local area network.
- W. LCD: Liquid-crystal display.
- X. LED: Light-emitting diode.
- Y. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- Z. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- AA. M-JPEG: Motion - Joint Photographic Experts Group.
- BB. MPEG: Moving picture experts group.
- CC. NEC: National Electric Code
- DD. NEMA: National Electrical Manufacturers Association
- EE. NFPA: National Fire Protection Association
- FF. NTSC: National Television System Committee.
- GG. NRTL: Nationally Recognized Testing Laboratory.

- HH. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- II. PACS: Physical Access Control System; A system comprised of cards, readers, door controllers, servers and software to control the physical ingress and egress of people within a given space
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. RCDD: Registered Communications Distribution Designer.
- NN. RFI: Radio-frequency interference.
- OO. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
- PP. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- QQ. RS-485: An TIA/EIA standard for multipoint communications.
- RR. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- SS. SMS: Security Management System - A SMS is software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- UU. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- VV. UPS: Uninterruptible Power Supply
- XX. UTP: Unshielded Twisted Pair
- YY. Workstation: A PC with software that is configured for specific limited security system functions.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the

equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Contractor Qualification:

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within [60] <insert number> miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to

- verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
 3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- D. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS

- A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the Contractor shall submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.
- B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.6 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. The Government's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
 1. Mark the submittals, "SUBMITTED UNDER SECTION _____".
 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 3. Submit each section separately.
- D. The submittals shall include the following:
 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
- E. Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Government to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted. Additional general provisions are as follows:
 1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - Design Submittal Procedures, which outline basic submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.

2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards CAD Standard Application Guide, and VA BIM Guide. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are necessary to accommodate data; correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential information for communication of proper operation and/or maintenance of the component or system.
 - 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.

- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
 - 1) Maintenance and Operation Manuals: Submit as required for systems and equipment specified in the technical sections. Furnish four copies, bound in hardback binders, (manufacturer's standard binders) or an approved equivalent. Furnish one complete manual as specified in the technical section but in no case later than prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion.
 - 2) Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.
 - 3) The manuals shall include:

- a) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - b) A control sequence describing start-up, operation, and shutdown.
 - c) Description of the function of each principal item of equipment.
 - d) Installation and maintenance instructions.
 - e) Safety precautions.
 - f) Diagrams and illustrations.
 - g) Testing methods.
 - h) Performance data.
 - i) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
 - j) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
- h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
- i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

- j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
 - k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
 - l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
 - m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
 - n. Calculations: Provide a section for circuit and panel calculations.
 - o. Loading Sheets: Provide a section for DGP Loading Sheets.
 - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-

conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.

8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.

9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

F. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:

- a. General - Drawings shall conform to VA CAD Standards Guide. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
- b. Cover Sheet - Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
- c. General Information Sheets - General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
- d. Floor Plans - Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) Security devices by symbol,
 - 2) The associated device point number (derived from the loading sheets),
 - 3) Wire & cable types and counts

- 4) Conduit sizing and routing
- 5) Conduit riser systems
- 6) Device and area detail call outs
- e. Architectural details - Architectural details shall be produced for each device mounting type (door details for EECS and IDS, Intrusion Detection system (motion sensor, vibration, microwave Motion Sensor and Camera mounting,
- f. Riser Diagrams - Contractor shall provide a riser diagram indicating riser architecture and distribution of the SMS throughout the facility (or area in scope).
- g. Block Diagrams - Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., electronic entry control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams - Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - 1) Panel Assembly Detail - For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - 2) Panel Details - Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details - Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - 6) Sensor detection patterns - Each system sensor shall have associated detection patterns.

- 7) Equipment Rack Detail - For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions between equipment racks shall be shown to include use vertical and horizontal latter rack system.
- 8) Security Control Room - The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console - The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.
Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room - Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule - Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule - A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Derived from Loading Sheets)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type & Model Number
 - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
 - 9) Card Reader Type & Model Number
 - 10) Shunting Device Type & Model Number

- 11) Sounder Type & Model Number
 - 12) Manufacturer
 - 13) Misc. devices as required
 - a) Delayed Egress Type & Model Number
 - b) Intercom
 - c) Camera
 - d) Electric Transfer Hinge
 - e) Electric Pass-through device
 - 14) Remarks column indicating special notes or door configurations
2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
- a. Item Number
 - b. Camera Number
 - c. Naming Conventions
 - d. Description of Camera Coverage
 - e. Camera Location
 - f. Floor Plan Sheet Number
 - g. Camera Type
 - h. Mounting Type
 - i. Standard Detail Reference
 - j. Power Input & Draw
 - k. Power Panel Location
 - l. Remarks Column for Camera
3. Section II - Data Gathering Panel Documentation Package
- a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package.

The documentation packages shall be provided in both printed and magnetic form at both review stages.
 - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following

- the format currently utilized by VA. A separate spreadsheet file shall be generated for each DGP and associated field panels.
- c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
 - d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
 - e. The DGP spreadsheet shall include an entry section for the following information:
 - 1) DGP number
 - 2) First Reader Number
 - 3) First Monitor Point Number
 - 4) First Relay Number
 - 5) DGP, input or output Location
 - 6) DGP Chain Number
 - 7) DGP Cabinet Tamper Input Number
 - 8) DGP Power Fail Input Number
 - 9) Number of Monitor Points Reserved For Expansion Boards
 - 10) Number of Control Points (Relays) Reserved For Expansion Boards
 - f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - 1) System Numbers for Card Readers
 - 2) System Numbers for Monitor Point Inputs
 - 3) System Numbers for Control Points (Relays)
 - 4) Next DGP or input module First Monitor Point Number
 - 5) Next DGP or output module First Control Point Number
 - g. The DGP spreadsheet shall provide the following information for each card reader:
 - 1) DGP Reader Number
 - 2) System Reader Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)

- 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - 6) Description Field
 - 7) DGP Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
 - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
- 1) DGP Monitor Point Input Number
 - 2) System Monitor Point Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - 7) DGP or input module Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
 - 11) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
- 1) DGP Control Point (Relay) Number
 - 2) System (Control Point) Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
 - 6) Description Field
 - 7) DGP or OUTPUT MODULE Output Location
 - 8) Date Test
 - 9) Date Passed Cable Type
 - 10) Camera Number (of associated alarm event preset call-ups)
- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:
- 1) Header
 - a) DGP Input and Output Worksheet
 - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.

2) Footer

- a) File Name
- b) Date Printed
- c) Page Number

SPEC WRITER NOTE: Delete following paragraph describing mock-up construction if not required by the project.

- 4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
- 5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
- 6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
 - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
 - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.
 - c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
- 7. Section VI - Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".

G. Group II Technical Data Package

1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
 2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
 - a. Baseline configuration
 - b. Access levels
 - c. Schedules (intrusion detection, physical access control, holidays, etc.)
 - d. Badge database
 - e. System monitoring and reporting (unit level and central control)
 - f. Naming conventions and descriptors
- H. Group III Technical Data Package
1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- I. Group IV Technical Data Package
1. Performance Verification Test
 - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.
 2. Training Documentation

- a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
- b. New Unit Control Room:
 - 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
 - 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.
 - 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
 - 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.

- 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
3. System Configuration and Data Entry:
- a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
 - 1) Physical Access control system components,
 - 2) All intrusion detection system components,
 - 3) Video surveillance, control and recording systems,
 - 4) Intercom systems components,
 - 5) All other security subsystems shown in the contract documents.
 - b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
 - c. Refer to Part 3 for system programming requirements and planning guidelines.
4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent

information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

J. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.

3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.
5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.
 - b. Operating characteristics.

- c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.
 - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.
 - j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office.
- Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings.
- Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents.
- Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".

10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.
11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.

- f. Final inspection and correction procedures.
 - g. Project schedule
13. Record Construction Documents (Record As-Built)
- a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.
 - b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
 - c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security

closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).

K. FIPS 201 Compliance Certificates

1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:

- a. Fingerprint Capture Station
- b. Card Readers
- c. Facial Image Capturing Camera
- d. PIV Middleware
- e. Template Matcher
- f. Electromagnetically Opaque Sleeve
- g. Certificate Management
 - 1) CAK Authentication System
 - 2) PIV Authentication System
 - 3) Certificate Validator
 - 4) Cryptographic Module
- h. <list devices and software>

L. Approvals will be based on complete submission of manuals together with shop drawings.

M. After approval and prior to installation, furnish the Resident Engineer with one sample of each of the following:

1. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
2. Each type of conduit and pathway coupling, bushing and termination fitting.
3. Conduit hangers, clamps and supports.
4. Duct sealing compound.

N. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.7 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Publications listed below apply to all specs in section 28.

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-09Power 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 Manufactures 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-01Security 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

28 05 00 - 33

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 500-101Care and Handling of Computer Magnetic Storage
Media

1.8 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.9 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors,

physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

E. System Inspections

1. These inspections shall include:
 - a. The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics and correct all problems; and resolve any previous outstanding problems.

F. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.

- a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
- b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

G. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

H. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

I. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

J. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Resident Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Resident Engineer. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

K. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software.

All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.10 MINIMUM REQUIREMENTS

- A. References to industry and trade association standards and codes are minimum installation requirement standards.
- B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.11 DELIVERY, STORAGE, & HANDLING

- A. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain:
 1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.
 2. Damaged equipment shall be, as determined by the Resident Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
 3. Painted surfaces shall be protected with factory installed removable heavy craft paper, sheet vinyl or equal.
 4. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.
- B. Central Station, Workstations, and Controllers:
 1. Store in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature

- between 10 to 30 deg C (50 to 85 deg F), and not more than 80 percent relative humidity, non-condensing.
2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
 3. Mark packing list with designations which have been assigned to materials and equipment for recording in the system labeling schedules generated by cable and asset management system.
 4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.12 PROJECT CONDITIONS

- A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.
 2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4X enclosures.
 3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick. NEMA 250, Type 4X enclosures.
 4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
 5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

- B. Security Environment: Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.
- C. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

1.13 EQUIPMENT AND MATERIALS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.14 ELECTRICAL POWER

- A. Electrical power of 120 Volts Alternating Current (VAC) shall be indicated on the Division 26 drawings. Additional locations requiring primary power required by the security system shall be shown as part of

these contract documents. Primary power for the security system shall be configured to switch to emergency backup sources automatically if interrupted without degradation of any critical system function. Alarms shall not be generated as a result of power switching, however, an indication of power switching on (on-line source) shall be provided to the alarm monitor. The Security Contractor shall provide an interface (dry contact closure) between the PACS and the Uninterruptible Power Supply (UPS) system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.

- B. Failure of any on-line battery shall be detected and reported as a fault condition. Battery backed-up power supplies shall be provided sized for [8] <insert hours> hours of operation at actual connected load.

Requirements for additional power or locations shall be included with the contract to support equipment and systems offered. The following minimum requirements shall be provided for power sources and equipment.

1. Emergency Generator

- a. Report Printers: Unit Control Room
- b. Video Monitors: Unit Control Room
- c. Intercom Stations
- d. Radio System
- e. Lights: Unit Control Room, Equipment Rooms, & Security Offices
- f. Outlets: Security Outlets dedicated to security equipment racks or security enclosure assemblies.
- g. Security Device Power Supplies (DGP, VASS, Card Access, Lock Power, etc.) powered from the security closets or remotely: various locations
- h. Telephone/Radio Recording Equipment: Unit Control Room.
- i. VASS Camera Power Supplies: Security Closets
- j. VASS Pan/Tilt Units: Various Locations
- k. VASS Outdoor Housing Heaters and Blowers: Various Sites
- l. Intercom Master Control System
- m. Fiber Optic Receivers/Transmitters
- n. Security office Weapons Storage
- o. Outlets that charge handheld radios

2. Uninterruptible Power Supply (UPS) on Emergency Power

- a. The following 120VAC circuits shall be provided by others. The Security Contractor shall coordinate exact locations with the Electrical Contractor:
 - 1) Security System Monitors and Keyboards: Control Room
 - 2) CPU: Control Equipment Room

- 3) Communications equipment: Control Equipment Room and various sites.
- 4) VASS Matrix Switcher: Control Equipment Room
- 5) VASS: Control Equipment Room
- 6) Digital Video Recorders, encoders & decoders: Control Room
- 7) All equipment Room racked equipment.
- 8) Network switches

1.15 TRANSIENT VOLTAGE SUPPRESSION, POWER SURGE SUPPLESION, & GROUNDING

- A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
1. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 2. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 3. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B.
 4. Operating Temperature and Humidity: -40 to 85 deg C (-40 to 185 deg F), 0 to 95 percent relative humidity.
- B. Grounding and Surge Suppression
1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. To ensure the operation of over current devices, such as fuses, circuit breakers, and relays, under ground-fault conditions.
 2. Security Contractor shall engineer and provide proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards referenced in this document.
 3. Principal grounding components and features. Include main grounding buses and grounding and bonding connections to service equipment.

4. Details of interconnection with other grounding systems. The lightning protection system shall be provided by the Security Contractor.
5. Locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with the best practices of the trade and manufactures installation instructions.
8. Protection should be provided at both ends of cabling.

1.16 COMPONENT ENCLOSURES

A. Construction of Enclosures

1. Consoles, power supply enclosures, detector control and terminal cabinets, control units, wiring gutters, and other component housings, collectively referred to as enclosures, shall be so formed and assembled as to be sturdy and rigid.
2. Thickness of metal in-cast and sheet metal enclosures of all types shall not be less than those in Tables I and II, UL 611. Sheet steel used in fabrication of enclosures shall be not less than 14 gauge. Consoles shall be 16-gauge.
3. Doors and covers shall be flanged. Enclosures shall not have pre-punched knockouts. Where doors are mounted on hinges with exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent removal. Doors having a latch edge length of less than 609.6 mm (24 in) shall be provided with a single construction core. Where the latch edge of a hinged door is more than 609.6 mm (24 in) or more in length, the door shall be provided with a three-point latching device with construction core; or alternatively with two, one located near each end.
4. Any ventilator openings in enclosures and cabinets shall conform to the requirements of UL 611. Unless otherwise indicated, sheet metal enclosures shall be designed for wall mounting with tip holes slotted. Mounting holes shall be in positions that remain accessible when all major operating components are in place and the door is open, but shall be in accessible when the door is closed.
5. Covers of pull and junction boxes provided to facilitate initial installation of the system shall be held in place by tamper proof Torx Center post security screws. Stenciled or painted labels shall be affixed to such boxes indicating they contain no connections.

These labels shall not indicate the box is part of the Electronic Security System (ESS).

B. Consoles & Equipment Racks: All consoles and vertical equipment racks shall include a forced air-cooling system to be provided by others.

1. Vertical Equipment Racks:

- a. The forced air blowers shall be installed in the vented top of each cabinet and shall not reduce usable rack space.
- b. The forced air fan shall consist of one fan rated at 105 CFM per rack bay and noise level shall not exceed 55 decibels.
- c. d. Vertical equipment racks are to be provided with full sized clear plastic locking doors and vented top panels as shown on contract drawings.

2. Console racks:

- a. Forced air fans shall be installed in the top rear of each console bay. The forced air fan shall consist of one fan rated at 105 CFM mounted to a 133mm vented blank panel the noise level of each fan shall not exceed 55 decibels. The fans shall be installed so air is pulled from the bottom of the rack or cabinet and exhausted out the top.
- b. Console racks are to be provided with flush mounted hinged rear doors with recessed locking latch on the bottom and middle sections of the consoles. Provide code access to support wiring for devices located on the work surfaces.

C. Tamper Provisions and Tamper Switches:

1. Enclosures, cabinets, housings, boxes and fittings or every product description having hinged doors or removable covers and which contain circuits, or the integrated security system and its power supplies shall be provided with cover operated, corrosion-resistant tamper switches.
2. Tamper switches shall be arranged to initiate an alarm signal that will report to the monitoring station when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed. It shall take longer than 1 second to depress or defeat the tamper switch after opening or removing the cover. The enclosure and tamper switch shall function together in such a manner as to prohibit direct line of sight to any internal component before the switch activates.
3. Tamper switches shall be inaccessible until the switch is activated. Have mounting hardware concealed so the location of the switch cannot be observed from the exterior of the enclosure. Be connected

- to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 " tolerance. The tamper device or its components shall not be visible or accessing with common tools to bypass when the enclosure is in the secured mode.
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
 5. All enclosures over 305 square mm shall be hinged with an enclosure lock.
 6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
 7. Provide one (1) enclosure tamper switch for each 609 linear mm of enclosure lock side opening evenly spaced.
 8. All security screws shall be Torx-Post Security Screws.
 9. The contractor shall provide the owner with two (2) torx-post screwdrivers.

1.17 ELECTRONIC COMPONENTS

- A. All electronic components of the system shall be of the solid-state type, mounted on printed circuit boards conforming to UL 796. Boards shall be plug-in, quick-disconnect type. Circuitry shall not be so densely placed as to impede maintenance. All power-dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current-carrying capacity.

1.18 SUBSTITUTE MATERIALS & EQUIPMENT

- A. Where variations from the contract requirements are requested in accordance with the GENERAL CONDITIONS and Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

- B. In addition to this Section the Security Contractor shall also reference Section II, Products and associated divisions. The Resident Engineer shall have final authority on the authorization or refusal of substitutions. If there are no proposed substitutions, a statement in writing from the Contractor shall be submitted to the Resident Engineer stating same. In the preparation of a list of substitutions, the following information shall be included, as a minimum:
1. Identity of the material or devices specified for which there is a proposed substitution.
 2. Description of the segment of the specification where the material or devices are referenced.
 3. Identity of the proposed substitute by manufacturer, brand name, catalog or model number and the manufacturer's product name.
 4. A technical statement of all operational characteristic expressing equivalence to items to be substituted and comparison, feature-by-feature, between specification requirements and the material or devices called for in the specification; and Price differential.
- C. Materials Not Listed: Furnish all necessary hardware, software, programming materials, and supporting equipment required to place the specified major subsystems in full operation. Note that some supporting equipment, materials, and hardware may not be described herein. Depending on the manufacturers selected by the COTR, some equipment, materials and hardware may not be contained in either the Contract Documents or these written specifications, but are required by the manufacturer for complete operation according to the intent of the design and these specifications. In such cases, the Resident Engineer shall be given the opportunity to approve the additional equipment, hardware and materials that shall be fully identified in the bid and in the equipment list submittal. The Resident Engineer shall be consulted in the event there is any question about which supporting equipment, materials, or hardware is intended to be included.
- D. Response to Specification: The Contractor shall submit a point-by-point statement of compliance with each paragraph of the security specification. The statement of compliance shall list each paragraph by number and indicate "COMPLY" opposite the number for each paragraph where the Contractor fully complies with the specification. Where the proposed system cannot meet the requirements of the paragraph, and does not offer an equivalent solution, the offers shall indicate "DOES NOT COMPLY" opposite the paragraph number. Where the proposed system does not comply with the paragraph as written, but the bidder feels it will

accomplish the intent of the paragraph in a manner different from that described, the offers shall indicate "COMPARABLE". The offers shall include a statement fully describing the "comparable" method of satisfying the requirement. Where a full and concise description is not provided, the offered system shall be considered as not complying with the specification. Any submission that does not include a point-by-point statement of compliance, as described above, shall be disqualified. Submittals for products shall be in precise order with the product section of the specification. Submittals not in proper sequence will be rejected.

1.19 LIKE ITEMS

- A. Where two or more items of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer. All equipment provided shall be complete, new, and free of any defects.

1.20 WARRANTY

- A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contractor received written notification of final acceptance from the COTR. Demonstration and training shall be performed prior to system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the COTR's satisfaction, and at the Contractor's expense. The Contractor shall provide quarterly inspections during the warranty period. The contractor shall provide written documentation to the COTR on conditions and findings of the system and device(s). In addition, the contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty. The warranty period shall be extended until the last inspection and associated corrective actions are complete. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of it's failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty

period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

1.22 SINGULAR NUMBER

Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. All equipment associated within the Security Control Room, Security Console and Security Equipment Room shall be UL 827, UL 1981, and UL 60950 compliant and rated for continuous operation. Environmental conditions (i.e. temperature, humidity, wind, and seismic activity) shall be taken under consideration at each facility and site location prior to installation of the equipment.
- B. All equipment shall operate on a 120 or 240 volts alternating current (VAC); 50 Hz or 60 Hz AC power system unless documented otherwise in subsequent sections listed within this specification. All equipment shall have a back-up source of power that will provide a minimum of [8] <insert hours> hours of run time in the event of a loss of primary power to the facility.
- C. The system shall be designed, installed, and programmed in a manner that will allow for ease of operation, programming, servicing, maintenance, testing, and upgrading of the system.
- D. All equipment and materials for the system will be compatible to ensure correct operation.

2.2 EQUIPMENT ITEMS

- A. The Security Management System shall provide full interface with all components of the security subsystem as follows:
 - 1. Shall allow for communication between the Physical Access Control System and Database Management and all subordinate work and monitoring stations, enrollment centers for badging and biometric

- devices as part of the PACS, local annunciation centers, the electronic Security Management System (SMS), and all other VA redundant or backup command center or other workstations locations.
2. Shall provide automatic continuous communication with all systems that are monitored by the SMS, and shall automatically annunciate any communication failures or system alarms to the SMS operator providing identification of the system, nature of the alarm, and location of the alarm.
 3. Controlling devices shall be utilized to interface the SMS with all field devices.
 4. The Security control room and security console will be supported by an uninterrupted power supply (UPS) or dedicated backup generator power circuit.
 5. The Security Equipment room, Security Control Room, and Security Operator Console shall house the following equipment i.e. refer to individual master specifications for each security subsystem's specific requirements:
 - a. Security Console Bays and Equipment Racks
 - b. Security Network Server and Workstation
 - c. CCTV Monitoring, Controlling, and Recording Equipment
 - d. PACS Monitoring and Controlling Equipment
 - e. IDS Monitoring and Controlling Equipment
 - f. Security Access Detection Monitoring Equipment
 - g. EPPS Monitoring and Controlling Equipment
 - h. Main Panels for all Security Systems
 - i. Power Supply Units (PSU) for all field devices
 - j. Life safety and power monitoring equipment
 - k. All other building systems deemed necessary by the VA to include, but not limited to, heating, ventilation and air conditioning (HVAC), elevator control, portable radio, fire alarm monitoring, and other potential systems.
 - l. Police two-way radio control consoles/units.
- B. Security Console Bays - shall be EIA 310D compliant and:
1. Utilize stand-up, sit-down, and vertical equipment racks in any combination to monitor and control the security subsystems.
 2. Shall be wide enough for equipment that requires a minimum 19 inch (47.5 cm) mounting area.
 3. Shall be made of metal, furnished with wire ways, a power strip, a thermostatic controlled bottom or top mounted fan units, a hinge mounted rear door, a hinge mounted front door made of Plexiglas, and

- a louvered top. When possible, pre-fabricated (standard off-the-shelf) security console equipment shall be used in place of customized designed consoles.
4. A wire management system shall be designed and installed so that all cables are mounted in a manner that they do not interfere with day-to-day operations, are labeled for quick identification, and so that high voltage power cables do not cause signal interference with low voltage and data carrying cables.
 5. Shall be mounted on lockable casters.
 6. Shall be ergonomically designed so that all devices requiring repetitive interaction with by the operator can be easily accessed, observed, and accomplished.
 7. Controls and displays shall be located so that they are not obscured during normal operation. Control and display units installed with a work bench shall be a minimum of 3 in. (7.5 cm) from all edges of the work bench area.
 8. All security subsystem controls shall be installed within the same operating console bay of their associated equipment.
 9. Video monitors shall be mounted above all controls within a console bay and positioned in a manner that minimum strain is placed on the operator viewing them at the console.
 10. At least one workbench for every three (3) console bays shall be provided free of control equipment to allow for appropriate operator workspace.
 11. All console devices shall be labeled and marked with a minimum of quarter inch bold print.
 12. All non-security related equipment that is required to be monitored shall be installed in a console bay separate from the security subsystem equipment and clearing be identified as such.
 13. Console bays and related equipment shall be arranged in priority order and sequenced based upon their pre-defined security subsystem operations criticality established by the Contracting Officer.
 14. The following minimum console technical characteristics shall be taken into consideration when designing for and installing the security console and equipment racks:

	Stand-Up	Sit-Down	Vertical Equipment Rack
Workstation Height	No Greater than 84 in. (210 cm)	No greater than 72 in. (150 cm)	No greater than 96 in. (240 cm)

Bench board Slope	21 in. (52.5 cm)	25 in. (62.5 cm)	N/A
Bench board Angle	15 degrees	15 degrees	N/A
Depth of Console	24 in. (60 cm)	24 in. (60 cm)	N/A
Leg and Feet Clearance	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front	6 sq. ft. from center of Console Slope front
Distance Between Console Rows	96 in. (240 cm)	96 in. (240 cm)	96 in. (240 cm)
Distance Between Console and Wall	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack	36 in. (90 cm) from the rear and/or side of console or rack

C. Security Console Configuration:

1. The size shall be defined by the number of console bays required to house and operate the security subsystems, as well as any other factors that may influence the overall design of the space. A small Access Control System and Database Management shall contain no more than four (4) security console bays. A large Access Control System and Database Management shall contain no less than five (5) and no more than eight (8) security console bays.
2. Shall meet the following minimum spacing requirements to ensure that a Access Control System and Database Management is provided to house existing and future security subsystems and other equipment listed in paragraph 2.3.C:
 - a. 500 square feet for a large Access Control System and Database Management.
 - b. 300 square feet for a small Access Control System and Database Management.
 - c. If office, training room and conference space, is a processing area as well as holding cell space is to be located adjacent to the Access Control System and Database Management, these space requirements also need to be considered.
3. Shall be located in an area within, at a minimum, the first level/line of security defense defined by the VA. If the Access Control System and Database Management is to be located outside the first level of security, then the area shall be constructed or

- retrofit to meet or exceed those requirements outlined in associated VA Master Specifications.
4. Shall not be located within or near an area with little to no blast mitigation standoff space protection, adjacent to an outside wall exposed to vehicle parking and traffic, within a basement or potential flood zone area, in close approximately to major utility areas, or near an exposed air intake(s).
 5. Access shall meet UFAS and ADA accessibility requirements.
 6. Construction shall be slab to slab and free of windows, with the exception of a service window. All penetrations into the room shall be sealed with fire stopping materials. This material shall apply in accordance with Section 07 84 00, FIRESTOPPING.
 7. A service window shall be installed in the wall next to the main entrance of the Access Control System and Database Management or where it best can be monitored and accessed by the security console operator. The window shall meet all requirements set forth in UL 752, to include at a minimum, Class III ballistic level protection. The windows shall be set in a minimum of four (4) inches (100 mm) solid concrete units to ceiling height with either masonry or gypsum wall board to the underside of the slab above. It shall also contain a service tray constructed in a manner that only objects no larger than 3 inches (7.5 cm) in width may pass through it.
 8. The walls making up or surrounding the Access Control System and Database Management shall be made of materials that at a minimum offer Class III ballistic level protection for the security console operator(s).
 9. There will be a main power cut-off button/switch located inside the Access Control System and Database Management in the event of an electrical fire or related event occurs.
 10. Shall have a fire alarm detection unit that is tied into the main building fire alarm system and have at least two fire extinguishers located within it.
 11. Shall utilize a fire suppression system similar to that used by the VA's computer and telecommunications room operating areas.
 12. The floor shall be raised a minimum of 4 inches (10 cm) from the concrete floor base. Wire ways shall be utilized under the raised floor for separation of signal and power wires and cables.
 13. Access shall be monitored and controlled by the PACS via card reader and fixed camera that utilizes a wide angle lens. A 1 in. (2.5 cm) deadbolt shall be utilized as a mechanical override for the door in

the event of electrical failure of the PACS, card reader, or locking mechanism.

14. There shall only be one point of ingress and egress to and from the Security Control Room. The door shall be made of solid core wood or better. If a window is required for the door, then the window shall be ballistic resistant with a Millar covering.
15. A two-way intercom shall be placed at the point of entry into the Security Control Room for access-communication control purposes.
16. A remote push-button door unlocking device shall not be installed for the electronic PACS locking mechanism providing access control into the Security Control Room.
17. All controlling equipment and power supplies that must be wall mounted shall be mounted in a manner that maximizes usability of the Security Control Room wall space. All equipment shall be mounted to three quarter inch fire retardant plywood. The plywood shall be fastened to the wall from slab to slab and fixed to the existing walls supports.

D. Security Control Room Ventilation

1. Shall meet or exceed all requirements laid out in VA Master Specification listed in Division 23, HEATING, VENTILATION, AND AIR CONDITIONING.
2. Controls shall be via a separate air handling system that provides an isolated supply and return system. The Security Control Room shall have a dedicated thermostat control unit and cut-off switch to be able to shut off ventilation to the control room in the event of a chemical, biological, or radiological (CBR) event or other related emergency.
3. There shall be a louver installed in the control room door to assist with ventilation of the room. The louver shall be exactly 12 x 12 inches (30 x 30 cm) and closeable.

E. Security Control Room and Security Console Lighting:

1. The following factors shall be taken into consideration for lighting of the Security Control Room and console area:
 - a. Shadows: To reduce eye strain and fatigue, shadows shall be avoided.
 - b. Glare: The readability of all display panels, labels, and equipment shall not be interfered with or create visibility problems.
2. The following table shall provide guidance on the amount of footcandles required per work area and type of task performed:

Work Area/Type of Task		Footcandles
Main Operating Panels		50
Secondary Display Panels		50
Seated Workstations		100
Reading	Handwriting	100
	Typed Documents	50
	Visual Display Units	10
Logbook Recording		100
Maintenance Area		50
Emergency/Back-up Lighting		10

- F. Remote security console access: For facilities that have a remote, secondary back-up control console or workstation shall apply the following requirements:
1. The secondary stations shall the requirements outlined in Sections 2.2.A-G.
 2. Installation of an intercom station or telephone line shall be installed and provide direct one touch call-up for communications between the primary Security Control Console and secondary Security Control Console.
 3. Secondary stations shall not have priority over a primary Security Control Console.
 4. The primary Access Control System and Database Management shall have the ability to shut off power and a signal to a secondary control station in the event the area has been compromised.
- G. Wires and Cables:
1. Shall meet or exceed the manufactures recommendation for power and signals.
 2. Shall be carried in an enclosed conduit system, utilizing electromagnetic tubing (EMT) to include the equivalent in flexible metal, rigid galvanized steel (RGS) to include the equivalent of liquid tight, polyvinylchloride (PVC) schedule 40 or 80.
 3. All conduits will be sized and installed per the NEC. All security system signal and power cables that traverse or originate in a high security office space will contained in either EMT or RGS conduit.
 4. All conduit, pull boxes, and junction boxes shall be marked with colored permanent tape or paint that will allow it to be distinguished from all other infrastructure conduit.
 5. Conduit fills shall not exceed 50 percent unless otherwise documented.
 6. A pull string shall be pulled along and provided with signal and power cables to assist in future installations.

7. At all locations where there is a wall penetration or core drilling is conducted to allow for conduit to be installed, fire stopping materials shall be applied to that area.
8. High voltage and signal cables shall not share the same conduit and shall be kept separate up to the point of connection. High voltage for the security subsystems shall be any cable or sets of cables carrying 30 VDC/VAC or higher.
9. For all equipment that is carrying digital data between the Security Control Room, Security Equipment Room, Security Console, or at a remote monitoring station, it shall not be less 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 10⁻⁹ @ Maximum Optical Loss Budget

- 5) Operating Mode: Simplex or Full-Duplex
- 6) Wavelength: 1310/1550 nm, Multimode or Singlemode
- 7) Optical Emitter: Laser Diode
- 8) Number of Fibers: 1

c. Connectors

- 1) Optical: ST
- 2) Power and Data: Terminal Block with Screw Clamps
- 3) Video: BNC (Gold Plated Center-Pin)

d. Electrical and Mechanical

- 1) Power: 12 VDC @ 500 mA (stand-alone)
- 3) Current Protection: Automatic Resettable Solid-State Current Limiters

e. Environmental

- 1) MTBF: > 100,000 hours
- 2) Operating Temp: -40 to 74 deg C (-40 to 165 deg F)
- 3) Storage Temp: -40 to 85 deg C (-40 to 185 deg F)
- 4) Relative Humidity: 0% to 95% (non-condensing)

B. Fiber Optic Transmitters: The central-located fiber optic transmitters shall utilize wave division multiplexing to transmit video and signals over standard 62.5/125 multimode fibers.

- 1. The units shall be capable of operating over a range of 4.8 km.
- 2. The units shall be NTSC color compatible.
- 3. The units shall support data rates up to 64 Kbps.
- 4. The units shall be surface or rack mountable.
- 5. The units shall be UL listed.
- 6. The units shall meet or exceed the following specifications:

a. Video

- 1) Input: 1 volt pk-pk (75 ohms)
- 2) Bandwidth: 5Hz - 10 MHz
- 3) Differential Gain: <5%
- 4) Tilt: <1%
- 5) Signal-Noise: 60db
- 6) Wavelength: 850nm
- 7) Number of Fibers: 1
- 8) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
- 9) Connectors:
 - a) Power: Female plug with screw clamps
 - b) Video: BNC
 - c) Optical: ST
- 10) Power: 12 VDC

C. Fiber Optic Receivers: The field-located fiber optic receivers shall utilize wave division multiplexing to receive video signals over standard 62.5/125 multimode fiber.

1. The units shall be capable of operating over a range of 4.8 km.
2. The units shall be NTSC color compatible.
3. The units shall support data rates up to 64 Kbps.
4. The units shall be surface or rack mountable.
5. The units shall be UL listed.
6. The units shall meet or exceed the following specifications:

a. Video

- 1) Output: 1 volt pk-pk (75 ohms)
- 2) Bandwidth: 5Hz - 10 MHz
- 3) Differential Gain: <5%
- 4) Tilt: <1%
- 5) Signal-Noise: 60dB
- 6) Wavelength: 850nm
- 7) Number of Fibers: 1
- 8) Surface Mount: 106.7 x 88.9 x 25.4 mm (4.2 x 3.5 x 1 in)
- 9) Operating Temp: -20 to 70 deg C (-4 to 158 deg F)
- 10) Connectors:
- 11) Power: Female plug block with screw clamps
- 12) Video: BNC
- 13) Optical: ST
- 14) Power: 12 VAC8 Channel Fiber Optic Transcievers (Video&PTZ Control)

D. Fiber Optic Sub Rack with Power Supply

1. The Card Cage Rack shall provide high-density racking for fiber-optic modules. The unit shall be designed to mount in standard 483 mm (19 in) instrument racks and to accommodate the equivalent of 15 1-inch modules.

a. Specifications

- 1) Card Orientation: Vertical
- 2) Construction: Aluminum
- 3) Current Consumption: 0.99 A
- 4) Humidity: 95.0 % RH
- 5) Input Power: 100-240 VAC, 60/50 Hz
- 6) Mounting: Mounts in standard 483 mm (19 in) rack using four (4) screws (optional wall brackets purchased separately)
- 7) Number of Outputs: 1.0
- 8) Number of Slots 15.0

- 9) Operating Temperature: -40 to +75 deg C (-40.0 to 167.0 deg F)
- 10) Output Voltage: 13.5 V
- 11) Output Current 6.0 A
- 12) Power Dissipation: 28.0 W
- 13) Power Factor: 48.0
- 14) Power Supply: (built-in)
- 15) Rack Units: 3RU
- 16) Redundant Capability: Yes
- 17) Weight: 2.43 kg (5.35 lb)
- 18) Width: 483 mm (19.0 in)

2.4 TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES (TVSS) AND SURGE SUPPRESSION

A. Transient Voltage Surge Suppression

1. All cables and conductors extending beyond building perimeter, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage surge suppression protection (TVSS) UL listed in accordance with Standard 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 915 mm (36 in) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:
 - a. A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - b. An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.
 - c. Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equivalent.
 - d. Operating Temperature and Humidity: -40 to + 85 deg C (-40 to 185 deg F), and 0 to 95 percent relative humidity, non-condensing.

B. Physical Access Control Systems

1. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:
 - a. UL1449 2nd Edition, 2007, listed

- b. UL1449 S.V.R. of 400 Volts or lower
 - c. Status Indicator Light(s)
 - d. Minimum Surge Current Capacity: 40,000 Amps (8 x 20 μ 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 μ 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 μ 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 μ Sec)
- D. Intrusion Detection Systems
 - 1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:
 - a. UL 1449, 2nd Edition 2007, listed
 - b. UL 1449 S.V.R. of 400 Volts or lower
 - c. Status Indicator Lights
 - d. Center screw for terminating Class II transformers
 - e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 μ Sec)
 - 2. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:
 - a. UL 497A Listed
 - b. Multi Stage protection design
 - c. Surge Current Capacity: 9,000 Amps (8x20 μ Sec)
 - d. Clamp Voltage: 130Vrms
 - e. Auto reset current protection not to exceed 150 milliAmps
 - 3. Suppressors shall be installed on all burglar alarm initiating and signaling loops and addressable circuits which enter or leave separate buildings. The following criteria shall be met:
 - a. UL 497B for data communications or annunciation (powered loops)
 - b. Fail-short/fail-safe mode.
 - c. Surge Current Capacity: 9,000 Amps (8x20 μ Sec)
 - d. Clamp Voltage: 15 Vrms
 - e. Joule Rating: 76 Joules per pair (10x1000 μ Sec)
 - f. Auto-reset current protection not to exceed 150 milliAmps for UL 497A devices.
- E. Video Surveillance System
 - 1. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and include protection for

12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 450VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:

a. Head-End Power

- 1) UL 1778, cUL (Battery Back Up)
- 2) Minimum Surge Current Capacity: 65,000 Amps (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

F. Grounding and Surge Suppression

1. The Security Contractor shall provide grounding and surge suppression to stabilize the voltage under normal operating conditions. This is to ensure the operation of over current devices, such as fuses, circuit breakers, and relays, underground-fault conditions.
2. The Contractor shall engineer, provide, and install proper grounding and surge suppression as required by local jurisdiction and prevailing codes and standards, referenced in this document.
3. Principal grounding components and features shall include: main grounding buses, grounding, and bonding connections to service equipment.
4. The Contractor shall provide detail drawings of interconnection with other grounding systems including lightning protection systems.

5. The Contractor shall provide details of locations and sizes of grounding conductors and grounding buses in electrical, data, and communication equipment rooms and closets.
6. AC power receptacles are not to be used as a ground reference point.
7. Any cable that is shielded shall require a ground in accordance with applicable codes, the best practices of the trade, and all manufactures' installation instructions.

G. 120 VAC Surge Suppression

1. Continuous Current: Unlimited (parallel connection)
2. Max Surge Current: 13,500 Amps
3. Protection Modes: L - N, L - G, N - G
4. Warranty: Ten Year Limited Warranty
5. Dimension: 73.7 x 41.1 x 52.1 mm (2.90 x 1.62 x 2.05 in)
6. Weight: 2.88 g (0.18 lbs)
7. Housing: ABS

2.5 INSTALLATION KIT

A. General:

1. The kit shall be provided that, at a minimum, includes all connectors and terminals, labeling systems, audio spade lugs, barrier strips, punch blocks or wire wrap terminals, heat shrink tubing, cable ties, solder, hangers, clamps, bolts, conduit, cable duct, and/or cable tray, etc., required to accomplish a neat and secure installation. All wires shall terminate in a spade lug and barrier strip, wire wrap terminal or punch block. Unfinished or unlabeled wire connections shall not be allowed. All unused and partially opened installation kit boxes, coaxial, fiber-optic, and twisted pair cable reels, conduit, cable tray, and/or cable duct bundles, wire rolls, physical installation hardware shall be turned over to the Contracting Officer. The following sections outline the minimum required installation sub-kits to be used:

2. System Grounding:

- a. The grounding kit shall include all cable and installation hardware required. All head end equipment and power supplies shall be connected to earth ground via internal building wiring, according to the NEC.
- b. This includes, but is not limited to:
 - 1) Coaxial Cable Shields
 - 2) Control Cable Shields
 - 3) Data Cable Shields
 - 4) Equipment Racks

- 5) Equipment Cabinets
 - 6) Conduits
 - 7) Cable Duct blocks
 - 8) Cable Trays
 - 9) Power Panels
 - 10) Grounding
 - 11) Connector Panels
3. Coaxial Cable: The coaxial cable kit shall include all coaxial connectors, cable tying straps, heat shrink tabbing, hangers, clamps, etc., required to accomplish a neat and secure installation.
4. Wire and Cable: The wire and cable kit shall include all connectors and terminals, audio spade lugs, barrier straps, punch blocks, wire wrap strips, heat shrink tubing, tie wraps, solder, hangers, clamps, labels etc., required to accomplish a neat and orderly installation.
5. Conduit, Cable Duct, and Cable Tray: The kit shall include all conduit, duct, trays, junction boxes, back boxes, cover plates, feed through nipples, hangers, clamps, other hardware required to accomplish a neat and secure conduit, cable duct, and/or cable tray installation in accordance with the NEC and this document.
6. Equipment Interface: The equipment kit shall include any item or quantity of equipment, cable, mounting hardware and materials needed to interface the systems with the identified sub-system(s) according to the OEM requirements and this document.
7. Labels: The labeling kit shall include any item or quantity of labels, tools, stencils, and materials needed to label each subsystem according to the OEM requirements, as-installed drawings, and this document.
8. Documentation: The documentation kit shall include any item or quantity of items, computer discs, as installed drawings, equipment, maintenance, and operation manuals, and OEM materials needed to provide the system documentation as required by this document and explained herein.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Equipment location shall be as close as practical to locations shown on the drawings.
- G. Inaccessible Equipment:
 - 1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
 - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.2 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section 07 84 00 "Firestopping."

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 DEMONSTRATION AND TRAINING

- A. Training shall be provided in accordance with Article, INSTRUCTIONS, of Section 01 00 00, GENERAL REQUIREMENTS.

- B. Training shall be provided for the particular equipment or system as required in each associated specification.
- C. A training schedule shall be developed and submitted by the contractor and approved by the Resident Engineer at least 30 days prior to the planned training.
- D. Provide services of manufacturer's technical representative for <insert hours> hours to instruct VA personnel in operation and maintenance of units.
- E. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

3.5 WORK PERFORMANCE

- A. Job site safety and worker safety is the responsibility of the contractor.
- B. For work on existing stations, arrange, phase and perform work to assure electronic safety and security service for other buildings at all times. Refer to Article OPERATIONS AND STORAGE AREAS under Section 01 00 00, GENERAL REQUIREMENTS.
- C. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
- D. Coordinate location of equipment and conduit with other trades to minimize interferences. See the GENERAL CONDITIONS.

3.6 SYSTEM PROGRAMMING

- A. General Programming Requirements
 - 1. This following section shall be used by the contractor to identify the anticipated level of effort (LOE) required setup, program, and configure the Electronic Security System (ESS). The contractor shall be responsible for providing all setup, configuration, and programming to include data entry for the Security Management System (SMS) and subsystems [(e.g., video matrix switch, intercoms, digital video recorders, intrusion devices, including integration of subsystems to the SMS (e.g., camera call up, time synchronization, intercoms)]. System programming for existing or new SMS servers shall not be conducted at the project site.
- B. Level of Effort for Programming
 - 1. The Contractor shall perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the SMS software. The Contractor's copy of

the SMS software shall be of the Owners current version. Once system programming has been completed, the Contractor shall deliver the data to the Resident Engineer on data entry forms and an approved electronic medium, utilizing data from the contract documents. The completed forms shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it. The Contractor shall not upload system programming until the Resident Engineer has provided written approval. The Contractor is responsible for backing up the system prior to uploading new programming data. Additional programming requirements are provided as follows:

- a. Programming for New SMS Server: The contractor shall provide all other system related programming. The contractor will be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings) along with coordinating with Resident Engineer for device configurations, standards, and groupings. VA shall provide database to support Contractor's data entry tasks. The contractor shall anticipate a weekly coordination meeting and working with Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss.
 - b. Programming for Existing SMS Servers: The contractor shall perform all related system programming except for personnel data as noted. The contractor will not be responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings). The contractor shall anticipate a weekly coordination meeting and working alongside of Resident Engineer to ensure data uploading is performed without incident of loss of function or data loss. System programming for SMS servers shall be performed by using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.
2. The Contractor shall identify and request from the Resident Engineer, any additional data needed to provide a complete and operational system as described in the contract documents.
 3. Contractor and Resident Engineer coordination on programming requires a high level of coordination to ensure programming is performed in accordance with VA requirements and programming uploads do not disrupt existing systems functionality. The contractor shall

anticipate a minimum a weekly coordination meeting. Contractor shall ensure data uploading is performed without incident of loss of function or data loss. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on VA ESS projects. Calculations to determine actual levels of effort shall be confirmed by the contractor before project award.

Description of Systems	Description of Tasks						
	Develop System Loading Sheets	Coordination	Initial Set-up Configuration	Graphic Maps	System Programming	Final Checks	Level of Effort (Typical Tasks)
SMS Setup & Configuration	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs	e.g., Load system Operating System and Application software, general system configurations	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization	e.g., check all system diagnostics (e.g., clients, panels)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log, Keystrokes, mouse clicks, multi-screen configuration

Electronic Entry Control Systems	e.g., setup of device, door groups & schedule s, 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 & schedule s, 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., confirmi ng 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, configure components)		e.g., programming call-ups recording	e.g., confirm area of coverage, call-up per event generated and recording rates	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups
Intercoms Systems	e.g., programming events & call-ups	e.g., confirming device configurations, naming conventions, event description and narratives	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics		e.g., programming events & call-ups	e.g., confirm operation, SMS event generation and camera call-up	e.g., setup linkages, events for activations, device troubles, land devices on graphic maps
Console Monitoring Components	N/A	per monitor	per monitor	per graphic map	N/A	per monitor	N/A
Note: Programming tasks are supported through the contractor's development of the Technical Data Package Submittals.							

Table 1 Contractor Level of Effort

3.7 TESTING AND ACCEPTANCE

A. Performance Requirements

1. General:

- a. The Contractor shall perform contract field, performance verification, and endurance testing and make adjustments of the completed security system when permitted. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Resident Engineer at least 60 calendar days prior to the test and after the Contractor has received written approval of the specific test procedures.
 - b. The COTR shall witness all testing and system adjustments during testing. Written permission shall be obtained from the Resident Engineer before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Resident Engineer at the conclusion of each phase of testing and prior to Resident Engineer approval of the test.
2. Test Procedures and Reports: The test procedures, compliant w/ VA standard test procedures, shall explain in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification. The test reports shall be used to document results of the tests. The reports shall be delivered to the Resident Engineer within seven (7) calendar days after completion of each test.

SPEC WRITER NOTE: Remove Pre-delivery Testing paragraph (B) and all references to pre-delivery testing if Pre-delivery Testing is not required for the Project.

B. Pre-Delivery Testing

1. The purpose of the pre-delivery test is to establish that a system is suitable for installation. As such, pre-delivery test shall be a mock-up of the system as planned in the contract documents. The Contractor shall assemble the Security Test System at the Contractors local project within 50-miles of the project site, and perform tests to demonstrate the performance of the system complies with the contract requirements in accordance with the approved pre-delivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies

- of all data produced during pre-delivery testing, including results of each test procedure, shall be documented and delivered to the Resident Engineer at the conclusion of pre-delivery testing and prior to Resident Engineer's approval of the test. The test report shall be arranged so all commands, stimuli, and responses are correlated to allow logical interpretation. For Existing System modifications, the contractor shall provide their own server with loaded applicable software to support PDT.
2. Test Setup: The pre-delivery test setup shall include the following:
- a. All console equipment.
 - 1) At least one of each type of data transmission media (DTM) and associated equipment to provide a fully integrated PACS.
 - 2) The number of local processors shall equal the amount required by the site design.
 - 3) Enough sensor simulators to provide alarm signal inputs to the system equal to the number of sensors required by the design. The alarm signals shall be manually or software generated.
 - 4) Contractor to prove to owner all systems are appropriately sized and configured as sized.
 - 5) Integration of VASS, intercom systems, other subsystems.
 - 3. During the bidding process the contractor shall submit a request for information to the Owner to determine if a pre-delivery test will be required. If a pre-delivery test is not required, the contractor shall provide a written notification that the Pre-delivery Test is not required in their shop drawings submission.
- D. The inspection and test will be conducted by a factory-certified contractor representative and witnessed by a Government Representative. The results of the inspection will be officially recorded by a designated Government Representative and maintained on file by the Resident Engineer (RE), until completion of the entire project. The results will be compared to the Acceptance Test results.
- E. Contractor's Field Testing (CFT)
- 1. The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by this Contractor within the base of camera poles shall be tested as specified in IEEE STD 142. The Contractor shall test all security systems and equipment, and provide written proof of a 100% operational system before a date is established for the system acceptance test. Documentation package for CFT shall include completed (fully annotated details of test

details) for each device and system tested, and annotated loading sheets documenting complete testing to Resident Engineer approval. CFT test documentation package shall conform to submittal requirements outlined in this Section. The Contractor's field testing procedures shall be identical to the Resident Engineer's acceptance testing procedures. The Contractor shall provide the Resident Engineer with a written listing of all equipment and software indicating all equipment and components have been tested and passed. The Contractor shall deliver a written report to the Resident Engineer stating the installed complete system has been calibrated, tested, and is ready to begin performance verification testing; describing the results of the functional tests, diagnostics, and calibrations; and the report shall also include a copy of the approved acceptance test procedure. Performance verification testing shall not take place until written notice by contractor is received certifying that a contractors field test was successful.

F. Performance Verification Test (PVT)

1. Test team:

a. After the system has been pretested and the Contractor has submitted the pretest results and certification to the Resident Engineer, then the Contractor shall schedule an acceptance test to date and give the Resident Engineer written, notice as described herein, prior to the date the acceptance test is expected to begin. The system shall be tested in the presence of a Government Representative, an OEM certified representative, representative of the Contractor and other approved by the Resident Engineer. The system shall be tested utilizing the approved test equipment to certify proof of performance, FCC, UL and Emergency Service compliance. The test shall verify that the total system meets all the requirements of this specification. The notification of the acceptance test shall include the expected length (in time) of the test.

2. The Contractor shall demonstrate the completed Physical Access Control System PACS complies with the contract requirements. In addition, the Contractor shall provide written certification that the system is 100% operational prior to establishing a date for starting PVT. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT will be stopped and aborted as soon as 10 technical deficiencies are found requiring correction. The Contractor shall be responsible for

all travel and lodging expenses incurred for out-of-town personnel required to be present for resumption of the PVT. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.

3. The PVT, as specified, shall not begin until receipt of written certification that the Contractors Field Testing was successful. This shall include certification of successful completion of testing as specified in paragraph "Contractor's Field Testing", and upon successful completion of testing at any time when the system fails to perform as specified. Upon termination of testing by the Resident Engineer or Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II.
4. Upon successful completion of the acceptance test, the Contractor shall deliver test reports and other documentation, as specified, to the Resident Engineer prior to commencing the endurance test.
5. Additional Components of the PVT shall include:
 - a. System Inventory
 - 1) All Device equipment
 - 2) All Software
 - 3) All Logon and Passwords
 - 4) All Cabling System Matrices
 - 5) All Cable Testing Documents
 - 6) All System and Cabinet Keys
 - b. Inspection
 - 1) Contractor shall record an inspection punch list noting all system deficiencies. The contractor shall prepare an inspection punch list format for Resident Engineers approval.
 - 2) As a minimum the punch list shall include a listing of punch list items, punch list item location, description of item problem, date noted, date corrected, and details of how item was corrected.
6. Partial PVT - At the discretion of Resident engineer, the Performance Verification Test may be performed in part should a 100% compliant CFT be performed. In the event that a partial PVT will be performed instead of a complete PVT; the partial PVT shall be performed by testing 10% of the system. The contractor shall perform a test of each procedure on select devices or equipment.

G. Endurance Test

1. The Contractor shall demonstrate the specified probability of detection and false alarm rate requirements of the completed system.

- The endurance test shall be conducted in phases as specified below. The endurance test shall not be started until the Resident Engineer notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. VA shall operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing. VA will maintain a log of all system deficiencies. The Resident Engineer may terminate testing at any time the system fails to perform as specified. Upon termination of testing, the Contractor shall commence an assessment period as described for Phase II. During the last day of the test, the Contractor shall verify the appropriate operation of the system. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Resident Engineer prior to acceptance of the system.
2. Phase I (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the Resident Engineer. If the system experiences no failures, the Contractor may proceed directly to Phase III testing after receiving written permission from the Resident Engineer.
 3. Phase II (Assessment):
 - a. After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Resident Engineer. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
 - b. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Resident Engineer. The meeting shall not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a

written determine of either the restart date or require Phase I be repeated.

4. Phase III (Testing): The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized in writing by the COTR.

5. Phase IV (Assessment):

1. After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the COTR. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and recommend the point at which testing should be resumed.
2. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the COTR. The meeting shall not be scheduled earlier than five (5) business days after receipt of the report by the COTR. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions for the performance verification test. Based on the review meeting the test should not be scheduled earlier than five (5) business days after the Resident Engineer receives the report. As a part of this test review meeting, the Contractor shall demonstrate all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Resident Engineer will provide a written determine of either the restart date or require Phase III be repeated. After the conclusion of any re-testing which the Resident Engineer may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

H. Exclusions

1. The Contractor will not be held responsible for failures in system performance resulting from the following:
 - a. An outage of the main power in excess of the capability of any backup power source provided the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the PACS performed as specified.

- b. Failure of an Owner furnished equipment or communications link, provided the failure was not due to Contractor furnished equipment, installation, or software.
- c. Failure of existing Owner owned equipment, provided the failure was not due to Contractor furnished equipment, installation, or software.

- - - E N D - - -

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification the conductors and cables required for a fully functional for electronic safety and security (ESS) system.

1.2 RELATED WORK

SPEC WRITER NOTE: Delete any item or paragraph not applicable on the Section.

- 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.
- F. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.
- G. Section 31 20 00 - EARTH MOVING. For excavation and backfill for cables that are installed in conduit.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- F. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- G. RCDD: Registered Communications Distribution Designer.

- H. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- I. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- J. UTP: Unshielded twisted pair.

1.4 QUALITY ASSURANCE

- A. See section 28 05 00, Paragraph 1.4.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 - 1. Manufacturer's Literature and Data: Showing each cable type and rating.
 - 2. Certificates: Two weeks prior to final inspection, deliver to the Resident Engineer/COTR four copies of the certification that the material is in accordance with the drawings and specifications and diagrams for cable management system.
 - 3. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.
 - 4. Wiring Diagrams. Show typical wiring schematics including the following:
 - a. Workstation outlets, jacks, and jack assemblies.
 - b. Patch cords.
 - c. Patch panels.
 - 5. Cable Administration Drawings: As specified in Part 3 "Identification" Article.
 - 6. Project planning documents as specified in Part 3.

7. Maintenance Data: For wire and cable to include in maintenance manuals.

1.6 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by the basic designation only.
- B. American Society of Testing Material (ASTM):
D2301-04.....Standard Specification for Vinyl Chloride
Plastic Pressure Sensitive Electrical Insulating
Tape
- C. Federal Specifications (Fed. Spec.):
A-A-59544-08.....Cable and Wire, Electrical (Power, Fixed
Installation)
- D. National Fire Protection Association (NFPA):
70-11.....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):
44-05.....Thermoset-Insulated Wires and Cables
83-08.....Thermoplastic-Insulated Wires and Cables
467-07.....Electrical Grounding and Bonding Equipment
486A-03.....Wire Connectors and Soldering Lugs for Use with
Copper Conductors
486C-04.....Splicing Wire Connectors
486D-05.....Insulated Wire Connector Systems for Underground
Use or in Damp or Wet Locations
486E-00.....Equipment Wiring Terminals for Use with Aluminum
and/or Copper Conductors
493-07.....Thermoplastic-Insulated Underground Feeder and
Branch Circuit Cable
514B-04.....Fittings for Cable and Conduit
1479-03.....Fire Tests of Through-Penetration Fire Stops

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test optical fiber cable to determine the continuity of the strand end to end. Use [optical-fiber flashlight] [or] [optical loss test set] <Insert test>.
 2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. 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. Cable Trays:
1. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by [electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick] [hot-dip galvanizing, complying with ASTM A 123/A 123M Grade 0.55, not less than 0.002165 inch (0.055 mm) thick].
 2. Basket Cable Trays: [6 inches (150 mm) wide and 2 inches (50 mm) deep] <Insert dimensions>. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
 3. Trough Cable Trays: [Nominally 6 inches (150 mm)] <Insert dimension> wide.
 4. Ladder Cable Trays: [Nominally 18 inches (455 mm)] <Insert dimension> wide, and a rung spacing of [12 inches (305 mm)] <Insert spacing>.
 5. Channel Cable Trays: One-piece construction, [nominally 4 inches (100 mm)] <Insert dimension> wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.
 6. Solid-Bottom Cable Trays: One-piece construction, [nominally 12 inches (305 mm)] <Insert dimension> wide. Provide [with] [without] solid covers.
- 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, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, [fire-retardant treated,] 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

- A. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, [Category 5e] [Category 6].
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG [; or MPP, CMP, MPR, CMR, MP, or MPG].
 - b. Communications, Plenum Rated: Type CMP [; or MPP], complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR [; or MPP, CMP, or MPR], complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX [; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG].
 - e. Multipurpose: Type MP or MPG [; or MPP or MPR].
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR [or MPP], complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- B. Connecting Blocks: [110-style for Category 5e] [110-style for Category 6] [66-style for Category 5e]. Provide blocks for the number of cables terminated on the block, plus [25] <Insert percentage> percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

- A. Description: Multimode, [50/125] [62.5/125]-micrometer, [24] <Insert number>-fiber, [nonconductive,] tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with [TIA/EIA-492AAAA-B] [TIA/EIA-492AAAA-A] for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. General Purpose, Nonconductive: Type OFN or OFNG [, or OFNR, OFNP].
 - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - c. Riser Rated, Nonconductive: Type OFNR [or OFNP], complying with UL 1666.
 - d. General Purpose, Conductive: Type OFC or OFCG [; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP].
 - e. Plenum Rated, Conductive: Type OFCP [or OFNP], complying with NFPA 262.
 - f. Riser Rated, Conductive: Type OFCR [; or OFNR, OFCP, or OFNP], complying with UL 1666.
5. Conductive cable shall be [steel] [aluminum] armored type.
6. Maximum Attenuation: [3.50] <Insert number> dB/km at 850 nm; [1.5] <Insert number> dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

B. Jacket:

1. Jacket Color: [Aqua for 50/125-micrometer cable] [Orange for 62.5/125-micrometer cable].
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

- A. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
 1. Quick-connect, simplex and duplex, [Type SC] [Type ST] [Type LC] [Type MT-RJ] connectors. Insertion loss shall be not more than 0.75 dB.
 2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

- A. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission

applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

B. RG-11/U: NFPA 70, Type CATV.

1. No. [14] <Insert size> AWG, solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4. Jacketed with sunlight-resistant, black PVC or PE.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

C. RG59/U: NFPA 70, Type CATVR.

1. No. [20] <Insert size> AWG, solid, silver-plated, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
4. Color-coded PVC jacket.

D. RG-6/U: NFPA 70, Type CATV or CM.

1. No. [16] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor installations.

E. RG59/U: NFPA 70, Type CATV.

1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.
3. PVC jacket.

F. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. [20] <Insert size> AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.
3. Copolymer jacket.

G. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA

70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV[, or CATVP or CATVR].
2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
3. CATV Riser Rated: Type CATVR[; or CATVP, CATVR, or CATV], complying with UL 1666.
4. CATV Limited Rating: Type CATVX.

2.8 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.9 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Polypropylene insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. PVC jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Plastic insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Plastic jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM[or CMG].
1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.11 LOW-VOLTAGE CONTROL CABLE

- A. Paired Lock Cable: NFPA 70, Type CMG.
 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.
- C. Paired Lock Cable: NFPA 70, Type CMG.
 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1581.
- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Plastic jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.12 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

- B. Class 2 Control Circuits: Stranded copper, [Type THHN-THWN, in raceway] [power-limited cable, concealed in building finishes] [power-limited tray cable, in cable tray] complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.13 FIRE ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, [not less than] [No. 18 AWG] [<Insert wire size> AWG] [size as recommended by system manufacturer].
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor [with outer jacket] with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.14 IDENTIFICATION PRODUCTS

- A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

2.16 WIRE LUBRICATING COMPOUND

- A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
- B. Shall not be used on wire for isolated type electrical power systems.

2.17 FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall be self-extinguishing and shall not support combustion. It shall be arc-proof and fireproof.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus and be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200-ampere arc for not less than 30 seconds.
- E. Securing tape: Glass cloth electrical tape not less than 0.18 mm (7 mils) thick, and 19 mm (3/4 inch) wide.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points.

- Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 9. Pulling Cable:
 - a. Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - b. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - c. Use ropes made of nonmetallic material for pulling feeders.
 - d. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Resident Engineer/COTR.
 - e. Pull in multiple cables together in a single conduit.
 - C. Splice cables and wires where necessary only in outlet boxes, junction boxes, or pull boxes.
 1. Splices and terminations shall be mechanically and electrically secure.
 2. Where the Government determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Government.
 - D. Seal cable and wire entering a building from underground, between the wire and conduit where the cable exits the conduit, with a non-hardening approved compound.
 - E. Unless otherwise specified in other sections install wiring and connect to equipment/devices to perform the required functions as shown and specified.
 - F. Except where otherwise required, install a separate power supply circuit for each system so that malfunctions in any system will not affect other systems.
 - G. Where separate power supply circuits are not shown, connect the systems to the nearest panel boards of suitable voltages, which are intended to supply such systems and have suitable spare circuit breakers or space for installation.
 - H. Install a red warning indicator on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems.
 - I. System voltages shall be 120 volts or lower where shown on the drawings or as required by the NEC.
 - J. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

K. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

L. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [60 inches (1525 mm)] <Insert dimension> apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

M. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [72 inches (1830 mm)] <Insert size> long shall be neatly coiled not less than [12 inches (300 mm)] <Insert size> in diameter below each feed point.

N. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

O. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
- 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
- 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
- 5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
- 6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 28 Section CONDUITS AND BACKBOXES FOR ELECTRICAL SYSTEMS."
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is[not] permitted.

3. Signaling Line Circuits: Power-limited fire alarm cables [may] [shall not] be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONTROL CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, No. 14 AWG.
 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.4 CONNECTIONS

- A. Comply with requirements in Division 28 Section, PHYSICAL ACCESS CONTROL for connecting, terminating, and identifying wires and cables.
- B. Comply with requirements in Division 28 Section "INTRUSION DETECTION" for connecting, terminating, and identifying wires and cables.

- C. Comply with requirements in Division 28 Section "VIDEO SURVEILLANCE" for connecting, terminating, and identifying wires and cables.
- D. Comply with requirements in Division 28 Section "ELECTRONIC PERSONAL PROTECTION SYSTEMS" for connecting, terminating, and identifying wires and cables.
- E. Comply with requirements in Division 28 Section "FIRE DETECTION AND ALARM" for connecting, terminating, and identifying wires and cables.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "PENETRATION FIRESTOPPING."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 28 Section "GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY."

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.
- B. Install a permanent wire marker on each wire at each termination.
- C. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
- D. Wire markers shall retain their markings after cleaning.
- E. In each handhole, install embossed brass tags to identify the system served and function.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting

bars in connection blocks. Test cables after termination but not cross connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."

- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 EXISITNG WIRING

- A. Unless specifically indicated on the plans, existing wiring shall not be reused for the new installation. Only wiring that conforms to the specifications and applicable codes may be reused. If existing wiring does not meet these requirements, existing wiring may not be reused and new wires shall be installed.

- - - E N D - - -

SECTION 28 05 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.
- 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.
- E. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS. Requirements for commissioning.

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 Resident Engineer.
 - 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):
- 44-05Thermoset-Insulated Wires and Cables
 - 83-08Thermoplastic-Insulated Wires and Cables
 - 467-07Grounding and Bonding Equipment
 - 486A-486B-03Wire 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 mm² (10 AWG) and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 25 mm² (4 AWG) and larger shall be permitted to be identified per NEC.
- B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (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.

SPEC WRITER NOTE: Include Standard Detail on drawings. Edit detail to suit project requirements.

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 mm² (6 AWG) insulated ground wire with shield bonding connectors.

2.7 COMPUTER ROOM GROUND

- A. Provide 50mm² (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 50mm² (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, ladder, etc. to the circulating ground wire with a minimum 25mm² (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 in 2.9.A, and
 2. Connect each additional room item to the circulating ground wire as indicated in 2.9.A.

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.

SPEC WRITER NOTE: Remove the paragraph below if not required for the project.

- 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.

SPEC WRITER NOTE: If appropriate for project, include details involving

grounding for patient equipment and areas
on plans.

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 mm² (6AWG) bonding jumpers.
 - 2. Bond at all intermediate metallic enclosures and across all joints using 16 mm² (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 mm² (6 AWG) bonding jumper at all intermediate metallic enclosures and across all section junctions.
 - 2. Install insulated 16 mm² (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 mm² (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 mm² (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 of fourth ground electrode system, or the telecommunications system circulating ground system be connected to the lightning protection system. The Facility's structural steel may be used to connected the lightning protection system at the direction of the Resident Engineer 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 may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
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.

3.12 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.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.13 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 will 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.

- - - E N D - - -

SECTION 28 08 00

COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 28.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the VA will manage the commissioning process.

1.2 RELATED WORK

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

1.3 SUMMARY

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

1.4 DEFINITIONS

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

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 28 is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 28, is required in cooperation with the VA and the Commissioning Agent.
- B. The Facility exterior closure systems commissioning will include the systems listed in Section 01 19 00 General Commissioning Requirements:

1.6 SUBMITTALS

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

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

3.2 PRE-FUNCTIONAL CHECKLISTS

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

type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 28 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

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

3.5 TRAINING OF VA PERSONNEL

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

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91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 28 Sections for
additional Contractor training requirements.

----- **END** -----

SECTION 28 13 00
PHYSICAL ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the finishing, installation, connection, testing and certification of a complete and fully operating Physical Access Control System, hereinafter referred to as the PACS.
- B. This Section includes a Physical Access Control System consisting of a system server, [one or more networked workstation computers,] 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
 - f. Credential cards and readers
 - g. Biometric identity verification equipment
 - h. Push-button switches
 - i. RS-232 ASCII interface
 - k. Monitoring of field-installed devices
 - l. Interface with paging systems.
 - m. Reporting
 - 2. Security:
 - d. Video and camera control.
- C. System Architecture:
 - 1. Criticality, operational requirements, and/or limiting points of failure may dictate the development of an enterprise and regional server architecture as opposed to system capacity. Provide server and workstation configurations with all necessary connectors, interfaces and accessories as shown.
- D. PACS shall provide secure and reliable identification of Federal employees and contractors by utilizing credential authentication per FIPS-201.
- E. Physical Access Control System (PACS) shall consist of:
 - 1. Head-End equipment server,
 - 2. One or more networked PC-based workstations,
 - 3. Physical Access Control System and Database Management Software,
 - 4. Credential validation software/hardware,
 - 5. Field installed controllers,

6. PIV Middleware,
7. Card readers,
8. Biometric identification devices,
9. PIV cards,
10. Supportive information system,
11. Door locks and sensors,
12. Power supplies,
13. Interfaces with:
 - a. Video Surveillance and Assessment System,
 - c. Automatic door operators,
 - d. Intrusion Detection System,
 - e. Intercommunication System
- F. Head-End equipment server, workstations and controllers shall be connected by a high-speed electronic data transmission network.
- G. Information system supporting PACS , Head-End equipment server, workstations, network switches, routers and controllers shall comply with FIPS 200 requirements (Minimum Security Requirements for Federal Information and Information Systems) and NIST Special Publication 800-53 (Recommended Security Controls for Federal Information Systems).
- H. PACS system shall support:
 1. Multiple credential authentication modes,
 2. Bidirectional communication with the reader,
 3. Incident response policy implementation capability; system shall have capability to automatically change access privileges for certain user groups to high security areas in case of incident/emergency.
 4. Visitor management,
- I. All security relevant decisions shall be made on "secure side of the door". Secure side processing shall include;
 1. Challenge/response management,
 2. PKI path discovery and validation,
 3. Credential identifier processing,
 4. Authorization decisions.
- J. For locations where secure side processing is not applicable the tamper switches and certified cryptographic processing shall be provided per FIPS-140-2.
- K. System Software: Based on Windows 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 <insert operating system> 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.
- P. Number of points:
 - 1. PACS shall support multiple autonomous regional servers that can connect to a master command and controller server.

2. Unlimited number of access control readers, unlimited number of inputs or outputs, unlimited number of client workstations, unlimited number of cardholders.
3. Total system solution to enable enterprise-wide, networked, multi-user access to all system resources via a wide range of options for connectivity with the customer's existing LAN and WAN.

Q. Console Network:

1. Console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.

R. Network(s) connecting PCs and Controllers shall comply with NIST

Special Publication 800-53 (Recommended Security Controls for Federal Information Systems) and consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet [10 BASE-T] [100 BASE-TX], star topology network based on TCP/IP.
2. Direct-connected, RS-232 cable from the COM port of the Central Station to the first Controller, then RS-485 to interconnect the remainder of the Controllers at that Location.

1.2 RELATED WORK

- A. Section 01 00 00 - GENERAL REQUIREMENTS. For General Requirements.
- B. Section 07 84 00 - FIRESTOPPING. Requirements for firestopping application and use.
- F. Section 08 71 00 - DOOR HARDWARE. Requirements for door installation.
- J. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- K. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- L. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- O. Section 28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY. For general requirements that are common to more than one section in Division 28.

- P. Section 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for conductors and cables.
- Q. Section 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY. Requirements for grounding of equipment.
- R. Section 28 05 28.33 - CONDUITS AND BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- S. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. For requirements for commissioning, systems readiness checklists, and training.
- T. Section 28 13 16 - ACCESS CONTROL SYSTEM AND DATABASE MANAGEMENT. Requirements for control and operation of all security systems.
- W. Section 28 23 00 - VIDEO SURVEILLANCE. Requirements for security camera systems.
- X. Section 28 26 00 - ELECTRONIC PERSONAL PROTECTION SYSTEM (EPPS). Requirements for emergency and interior communications.

1.3 QUALITY ASSURANCE

- A. The Contractor shall be responsible for providing, installing, and the operation of the PACS as shown. The Contractor shall also provide certification as required.
- B. The security system will be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete Information Technology (IT) computer network.
- C. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.
- D. Product Qualifications:
 - 1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
 - 2. The Government reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.
- E. Contractor Qualifications:
 - 1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years experience

installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the Security Management System's (PACS) manufacturer. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The Resident Engineer reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.

- a. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
- b. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.

- F. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.4 SUBMITTALS

- A. Submit below items in conjunction with Master Specification Sections 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, Section 02 41 00, DEMOLITION, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- B. Provide certificates of compliance with Section 1.3, Quality Assurance.
- C. Provide a complete and thorough pre-installation and as-built design package in both electronic format and on paper, minimum size 48 x 48 inches (1220 x 1220 millimeters); drawing submittals shall be per the established project schedule.
- D. Shop drawing and as-built packages shall include, but not be limited to:
1. Index Sheet that shall:
 - a. Define each page of the design package to include facility name, building name, floor, and sheet number.
 - b. Provide a complete list of all security abbreviations and symbols.
 - c. Reference all general notes that are utilized within the design package.
 - d. Specification and scope of work pages for all individual security systems that are applicable to the design package that will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a detailed device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Clearly define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.

- d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
3. A detailed riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.
 - d. Wire/cable types shall be defined by a wire and cable schedule. The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
4. A detailed system drawing for each applicable security system shall:
 - a. Clearly identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
5. A detailed schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.

- e. In addition, for the PACS, provide the door ID, door type (e.g. wood or metal), locking mechanism (e.g. strike or electromagnetic lock) and control device (e.g. card reader or biometrics).
6. Detail and elevation drawings for all devices that define how they were installed and mounted.
- E. Pre-installation design packages shall go through a full review process conducted by the Contractor along with a VA representative to ensure all work has been clearly defined and completed. All reviews shall be conducted in accordance with the project schedule. There shall be four (4) stages to the review process:
 1. 35 percent
 2. 65 percent
 3. 90 percent
 4. 100 percent
- F. Provide manufacturer security system product cut-sheets. Submit for approval at least 30 days prior to commencement of formal testing, a Security System Operational Test Plan. Include procedures for operational testing of each component and security subsystem, to include performance of an integrated system test.
- G. Submit manufacture's certification of Underwriters Laboratories, Inc. (UL) listing as specified. Provide all maintenance and operating manuals per Section 01 00 00, GENERAL REQUIREMENTS, and Section 28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY.
- H. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- I. General: Submittals shall be in full compliance of the Contract Documents. All submittals shall be provided in accordance with this section. Submittals lacking the breath or depth these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and shall require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
 1. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination drawings refer to Specification Section 01 33 10 - DESIGN SUBMITTAL PROCEDURES, which outline basic

- submittal requirements and coordination. Section 01 33 10 shall be used in conjunction with this section.
2. The Contractor shall identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
 3. Each package shall be submitted at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
 4. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for Resident Engineer and Contractor review stamps.
 5. Technical Data Drawings shall be in the latest version of AutoCAD®, drawn accurately, and in accordance with VA CAD Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. The Contractor shall not reproduce Contract Documents or copy standard information as the basis of the Technical Data Drawings. If departures from the technical data drawings are subsequently deemed necessary by the Contractor, details of such departures and the reasons thereof shall be submitted in writing to the Resident Engineer for approval before the initiation of work.
 6. Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
 - a. Binders: For each manual, provide heavy duty, commercial quality, durable three (3) ring vinyl covered loose leaf binders, sized to receive 8.5 x 11 in paper, and appropriate capacity to accommodate the contents. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - 1) Where two (2) or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-referencing other binders where necessary to provide essential

information for communication of proper operation and or maintenance of the component or system.

- 2) Identify each binder on the front and spine with printed binder title, Project title or name, and subject matter covered. Indicate the volume number if applicable.
- b. Dividers: Provide heavy paper dividers with celluloid tabs for each Section. Mark each tab to indicate contents.
- c. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
- d. Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if not available, specially prepared data, neatly typewritten on 8.5 inches by 11 inches 20 pound white bond paper.
- e. Drawings: Where drawings and/or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind them with the text.
 - 1) Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.
 - 2) If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a type written page indicating the drawing title, description of contents and drawing location at the appropriate location of the manual.
 - 3) Drawings shall be sized to ensure details and text is of legible size. Text shall be no less than 1/16" tall.
- f. Manual Content: In each manual include information specified in the individual Specification section, and the following information for each major component of building equipment and controls:
 - 1) General system or equipment description.
 - 2) Design factors and assumptions.
 - 3) Copies of applicable Shop Drawings and Product Data.
 - 4) System or equipment identification including: manufacturer, model and serial numbers of each component, operating instructions, emergency instructions, wiring diagrams, inspection and test procedures, maintenance procedures and schedules, precautions against improper use and maintenance,

- repair instructions, sources of required maintenance materials and related services, and a manual index.
- g. Binder Organization: Organize each manual into separate sections for each piece of related equipment. At a minimum, each manual shall contain a title page, table of contents, copies of Product Data supplemented by drawings and written text, and copies of each warranty, bond, certifications, and service Contract issued. Refer to Group I through V Technical Data Package Submittal requirements for required section content.
 - h. Title Page: Provide a title page as the first sheet of each manual to include the following information; project name and address, subject matter covered by the manual, name and address of the Project, date of the submittal, name, address, and telephone number of the Contractor, and cross references to related systems in other operating and/or maintenance manuals.
 - i. Table of Contents: After the title page, include a type written table of contents for each volume, arranged systematically according to the Project Manual format. Provide a list of each product included, identified by product name or other appropriate identifying symbols and indexed to the content of the volume. Where more than one (1) volume is required to hold data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
 - j. General Information Section: Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the installer and maintenance Contractor. In addition, list a local source for replacement parts and equipment.
 - k. Drawings: Provide specially prepared drawings where necessary to supplement the manufacturers printed data to illustrate the relationship between components of equipment or systems, or provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.
 - l. Manufacturer's Data: Where manufacturer's standard printed data is included in the manuals, include only those sheets that are pertinent to the part or product installed. Mark each sheet to

- identify each part or product included in the installation. Where more than one (1) item in tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information which is not applicable.
- m. Where manufacturer's standard printed data is not available and the information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement the data included in the manual, prepare written text to provide the necessary information. Organize the text in a consistent format under a separate heading for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure. Where similar or more than one product is listed on the submittal the Contractor shall differentiate by highlighting the specific product to be utilized.
 - n. Calculations: Provide a section for circuit and panel calculations.
 - o. Loading Sheets: Provide a section for DGP Loading Sheets.
 - p. Certifications: Provide section for Contractor's manufacturer certifications.
7. Contractor Review: Review submittals prior to transmittal. Determine and verify field measurements and field construction criteria. Verify manufacturer's catalog numbers and conformance of submittal with requirements of contract documents. Return non-conforming or incomplete submittals with requirements of the work and contract documents. Apply Contractor's stamp with signature certifying the review and verification of products occurred, and the field dimensions, adjacent construction, and coordination of information is in accordance with the requirements of the contract documents.
8. Resubmission: Revise and resubmit submittals as required within 15 calendar days of return of submittal. Make resubmissions under procedures specified for initial submittals. Identify all changes made since previous submittal.
9. Product Data: Within 15 calendar days after execution of the contract, the Contractor shall submit for approval a complete list

of all of major products proposed for use. The data shall include name of manufacturer, trade name, model number, the associated contract document section number, paragraph number, and the referenced standards for each listed product.

J. Group 1 Technical Data Package: Group I Technical Data Package shall be one submittal consisting of the following content and organization. Refer to VA Special Conditions Document for drawing format and content requirements. The data package shall include the following:

1. Section I - Drawings:

- a. General - Drawings shall conform to VA Special Conditions and CAD Standards Documents. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings.
- b. Cover Sheet - Cover sheet shall consist of Project Title and Address, Project Number, Area and Vicinity Maps.
- c. General Information Sheets - General Information Sheets shall consist of General Notes, Abbreviations, Symbols, Wire and Cable Schedule, Project Phasing, and Sheet Index.
- d. Floor Plans - Floor plans shall be produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall receive floor plans from the prime A/E to develop these drawing sets. Security devices shall be placed on drawings in scale. All text associated with security details shall be 1/8" tall and meet VA text standard for AutoCAD™ drawings. Floor plans shall identify the following:
 - 1) security devices by symbol,
 - 2) the associated device point number (derived from the loading sheets),
 - 3) wire & cable types and counts
 - 4) conduit sizing and routing
 - 5) conduit riser systems
 - 6) device and area detail call outs
- e. Architectural details - Architectural details shall be produced for each device mounting type (door details for doors with physical access control, reader pedestals and mounts, security panel and power supply details).

- f. Riser Diagrams - Contractor shall provide a riser diagram indicating riser architecture and distribution of the physical access control system throughout the facility (or area in scope).
- g. Block Diagrams - Contractor shall provide a block diagram for the entire system architecture and interconnections with SMS subsystems. Block diagram shall identify SMS subsystem (e.g., physical access control, intrusion detection, closed circuit television, intercom, and other associated subsystems) integration; and data transmission and media conversion methodologies.
- h. Interconnection Diagrams - Contractor shall provide interconnection diagram for each sensor, and device component. Interconnection diagram shall identify termination locations, standard wire detail to include termination schedule. Diagram shall also identify interfaces to other systems such as elevator control, fire alarm systems, and security management systems.
- i. Security Details:
 - 1) Panel Assembly Detail - For each panel assembly, a panel assembly details shall be provided identifying individual panel component size and content.
 - 2) Panel Details - Provide security panel details identify general arrangement of the security system components, backboard size, wire through size and location, and power circuit requirements.
 - 3) Device Mounting Details - Provide mounting detailed drawing for each security device (physical access control system, intrusion detection, video surveillance and assessment, and intercom systems) for each type of wall and ceiling configuration in project. Device details shall include device, mounting detail, wiring and conduit routing.
 - 4) Details of connections to power supplies and grounding
 - 5) Details of surge protection device installation
 - 6) Sensor detection patterns - Each system sensor shall have associated detection patterns.
 - 7) Equipment Rack Detail - For each equipment rack, provide a scaled detail of the equipment rack location and rack space utilization. Use of BISCII wire management standards shall be employed to identify wire management methodology. Transitions

between equipment racks shall be shown to include use vertical and horizontal latter rack system.

- 8) Security Control Room - The contractor shall provide a layout plan for the Security Control Room. The layout plan shall identify all equipment and details associated with the installation.
- 9) Operator Console - The contractor shall provide a layout plan for the Operator Console. The layout plan shall identify all equipment and details associated with the installation.
Equipment room - the contractor shall provide a layout plan for the equipment room. The layout plan shall identify all equipment and details associated with the installation.
- 10) Equipment Room - Equipment room details shall provide architectural, electrical, mechanical, plumbing, IT/Data and associated equipment and device placements both vertical and horizontally.
- j. Electrical Panel Schedule - Electrical Panel Details shall be provided for all SMS systems electrical power circuits. Panel details shall be provided identifying panel type (Standard, Emergency Power, Emergency/Uninterrupted Power Source, and Uninterrupted Power Source Only), panel location, circuit number, and circuit amperage rating.
- k. Door Schedule - A door schedule shall be developed for each door equipped with electronic security components. At a minimum, the door schedule shall be coordinated with Division 08 work and include the following information:
 - 1) Item Number
 - 2) Door Number (Derived from A/E Drawings)
 - 3) Floor Plan Sheet Number
 - 4) Standard Detail Number
 - 5) Door Description (Derived from Loading Sheets)
 - 6) Data Gathering Panel Input Number
 - 7) Door Position or Monitoring Device Type & Model Number
 - 8) Lock Type, Model Number & Power Input/Draw (standby/active)
 - 9) Card Reader Type & Model Number
 - 10) Shunting Device Type & Model Number
 - 11) Sounder Type & Model Number
 - 12) Manufacturer

- 13) Misc. devices as required
 - a) Delayed Egress Type & Model Number
 - b) Intercom
 - c) Camera
 - d) Electric Transfer Hinge
 - e) Electric Pass-through device
 - 14) Remarks column indicating special notes or door configurations
2. Camera Schedule - A camera schedule shall be developed for each camera. Contractors shall coordinate with the Resident Engineer to determine camera starting numbers and naming conventions. All drawings shall identify wire and cable standardization methodology. Color coding of all wiring conductors and jackets is required and shall be communicated consistently throughout the drawings package submittal. At a minimum, the camera schedule shall include the following information:
- a. Item Number
 - b. Camera Number
 - c. Naming Conventions
 - d. Description of Camera Coverage
 - e. Camera Location
 - f. Floor Plan Sheet Number
 - g. Camera Type
 - h. Mounting Type
 - i. Standard Detail Reference
 - j. Power Input & Draw
 - k. Power Panel Location
 - l. Remarks Column for Camera
3. Section II - Data Gathering Panel Documentation Package
- a. Contractor shall provide Data Gathering Panel (DGP) input and output documentation packages for review at the Shop Drawing submittal stage and also with the as-built documentation package. The documentation packages shall be provided in both printed and magnetic form at both review stages.
 - b. The Contractor shall provide loading sheet documentation package for the associated DGP, including input and output boards for all field panels associated with the project. Documentation shall be provided in current version Microsoft Excel spreadsheets following the format currently utilized by VA. A separate

spreadsheet file shall be generated for each DGP and associated field panels.

- c. The spreadsheet names shall follow a sequence that shall display the spreadsheets in numerical order according to the DGP system number. The spreadsheet shall include the prefix in the file name that uniquely identifies the project site. The spreadsheet shall detail all connected items such as card readers, alarm inputs, and relay output connections. The spreadsheet shall include an individual section (row) for each panel input, output and card reader. The spreadsheet shall automatically calculate the system numbers for card readers, inputs, and outputs based upon data entered in initialization fields.
- d. All entries must be verified against the field devices. Copies of the floor plans shall be forwarded under separate cover.
- e. The DGP spreadsheet shall include an entry section for the following information:
 - 1) DGP number
 - 2) First Reader Number
 - 3) First Monitor Point Number
 - 4) First Relay Number
 - 5) DGP, input or output Location
 - 6) DGP Chain Number
 - 7) DGP Cabinet Tamper Input Number
 - 8) DGP Power Fail Input Number
 - 9) Number of Monitor Points Reserved For Expansion Boards
 - 10) Number of Control Points (Relays) Reserved For Expansion Boards
- f. The DGP, input module and output module spreadsheets shall automatically calculate the following information based upon the associated entries in the above fields:
 - 1) System Numbers for Card Readers
 - 2) System Numbers for Monitor Point Inputs
 - 3) System Numbers for Control Points (Relays)
 - 4) Next DGP or input module First Monitor Point Number
 - 5) Next DGP or output module First Control Point Number
- g. The DGP spreadsheet shall provide the following information for each card reader:
 - 1) DGP Reader Number

- 2) System Reader Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: In Reader, Out Reader, etc.)
 - 6) Description Field
 - 7) DGP Input Location
 - 8) Date Test
 - 9) Date Passed
 - 10) Cable Type
 - 11) Camera Numbers (of cameras viewing the reader location)
- h. The DGP and input module spreadsheet shall provide the following information for each monitor point (alarm input).
- 1) DGP Monitor Point Input Number
 - 2) System Monitor Point Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device Type i.e.: Door Contact, Motion Detector, etc.)
 - 6) DGP or input module Input Location
 - 7) Date Test
 - 8) Date Passed
 - 9) Cable Type
 - 10) Camera Numbers (of associated alarm event preset call-ups)
- i. The DGP and output module spreadsheet shall provide the following information for each control point (output relay).
- 1) DGP Control Point (Relay) Number
 - 2) System (Control Point) Number
 - 3) Cable ID Number
 - 4) Description Field (Room Number)
 - 5) Description Field (Device: Lock Control, Local Sounder, etc.)
 - 6) Description Field
 - 7) DGP or OUTPUT MODULE Output Location
 - 8) Date Test
 - 9) Date Passed Cable Type
 - 10) Camera Number (of associated alarm event preset call-ups)
- j. The DGP, input module and output module spreadsheet shall include the following information or directions in the header and footer:

- 1) Header
 - a) DGP Input and Output Worksheet
 - b) Enter Beginning Reader, Input, and Output Starting Numbers and Sheet Will Automatically Calculate the Remaining System Numbers.
- 2) Footer
 - a) File Name
 - b) Date Printed
 - c) Page Number
4. Section III - Construction Mock-up: In areas with exposed EMT/Conduit Raceways, contractor shall conceal raceway as much as practical and unobtrusively. In addition, historic significance must be considered to determine installation means and methods for approval by the owner.
5. Section IV - Manufacturers' Data: The data package shall include manufacturers' data for all materials and equipment, including sensors, local processors and console equipment provided under this specification.
6. Section V - System Description and Analysis: The data package shall include system descriptions, analysis, and calculations used in sizing equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The data package shall include the following:
 - a. Central processor memory size; communication speed and protocol description; rigid disk system size and configuration; flexible disk system size and configuration; back-up media size and configuration; alarm response time calculations; command response time calculations; start-up operations; expansion capability and method of implementation; sample copy of each report specified; and color photographs representative of typical graphics.
 - b. Software Data: The data package shall consist of descriptions of the operation and capability of the system, and application software as specified.

- c. Overall System Reliability Calculations: The data package shall include all manufacturers' reliability data and calculations required to show compliance with the specified reliability.
- 7. Section VI - Certifications & References: All specified manufacturer's certifications shall be included with the data package. Contractor shall provide Project references as outlined in Paragraph 1.4 "Quality Assurance".
- K. Group II Technical Data Package
 - 1. The Contractor shall prepare a report of "Current Site Conditions" and submit a report to the Resident Engineer documenting changes to the site, particularly those conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions which affect the installation of the system or its performance. The Contractor shall not correct any deficiency without written permission from the COTR.
 - 2. System Configuration and Functionality: The contractor shall provide the results of the meeting with VA to develop system requirements and functionality including but not limited to:
 - a. Baseline configuration
 - b. Access levels
 - c. Schedules (intrusion detection, physical access control, holidays, etc.)
 - d. Badge database
 - e. System monitoring and reporting (unit level and central control)
 - f. Naming conventions and descriptors
- L. Group III Technical Data Package
 - 1. Development of Test Procedures: The Contractor will prepare performance test procedures for the system testing. The test procedures shall follow the format of the VA Testing procedures and be customized to the contract requirements. The Contractor will deliver the test procedures to the Resident Engineer for approval at least 60 calendar days prior to the requested test date.
- M. Group IV Technical Data Package
 - 1. Performance Verification Test
 - a. Based on the successful completion of the pre-delivery test, the Contractor shall finalize the test procedures and report forms

for the performance verification test (PVT) and the endurance test. The PVT shall follow the format, layout and content of the pre-delivery test. The Contractor shall deliver the PVT and endurance test procedures to the Resident Engineer for approval. The Contractor may schedule the PVT after receiving written approval of the test procedures. The Contractor shall deliver the final PVT and endurance test reports within 14 calendar days from completion of the tests. Refer to Part 3 of this section for System Testing and Acceptance requirements.

2. Training Documentation

- a. New Facilities and Major Renovations: Familiarization training shall be provided for new equipment or systems. Training can include site familiarization training for VA technicians and administrative personnel. Training shall include general information on new system layout including closet locations, turnover of the completed system including all documentation, including manuals, software, key systems, and full system administration rights. Lesson plans and training manuals training shall be oriented to type of training to be provided.
- b. New Unit Control Room:
 - 1) Provide the security personnel with training in the use, operation, and maintenance of the entire control room system (Unit Control and Equipment Rooms). The training documentation must include the operation and maintenance. The first of the training sessions shall take place prior to system turnover and the second immediately after turnover. Coordinate the training sessions with the Owner. Completed classroom sessions will be witnessed and documented by the Architect/Engineer, and approved by the Resident Engineer. Instruction is not to begin until the system is operational as designed.
 - 2) The training documents will cover the operation and the maintenance manuals and the control console operators' manuals and service manuals in detail, stressing all important operational and service diagnostic information necessary for the maintenance and operations personnel to efficiently use and maintain all systems.

- 3) Provide an illustrated control console operator's manual and service manual. The operator's manual shall be written in laymen's language and printed so as to become a permanent reference document for the operators, describing all control panel switch operations, graphic symbol definitions and all indicating functions and a complete explanation of all software.
 - 4) The service manual shall be written in laymen's language and printed so as to become a permanent reference document for maintenance personnel, describing how to run internal self diagnostic software programs, troubleshoot head end hardware and field devices with a complete scenario simulation of all possible system malfunctions and the appropriate corrective measures.
 - 5) Provide a professional color DVD instructional recording of all the operational procedures described in the operator's manual. All charts used in the training session shall be clearly presented on the video. Any DVD found to be inferior in recording or material content shall be reproduced at no cost until an acceptable DVD is submitted. Provide four copies of the training DVD, one to the architect/engineer and three to the owner.
3. System Configuration and Data Entry:
- a. The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., video matrix switch, intercom, digital video recorders, network video recorders). All data entry shall be performed per VA standards & guidelines. The Contractor is responsible for participating in all meetings with the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
 - 1) Physical Access control system components,
 - 2) All intrusion detection system components,
 - 3) Video surveillance, control and recording systems,

- 4) Intercom systems components,
 - 5) All other security subsystems shown in the contract documents.
 - b. The Contractor is responsible for compiling the card access database for the VA employees, including programming reader configurations, access shifts, schedules, exceptions, card classes and card enrollment databases.
 - c. Refer to Part 3 for system programming requirements and planning guidelines.
4. Graphics: Based on CAD as-built drawings developed for the construction project, create all map sets showing locations of all alarms and field devices. Graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points shall be delivered with the system. The Contractor shall create and install all graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the COTR, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 203.2 x 254 mm (8 x 10 in) of each type of graphic to be used for the completed Security system. The graphics examples shall be delivered to the Resident Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.
- N. Group V Technical Data Package: Final copies of the manuals shall be delivered to the Resident Engineer as part of the acceptance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each sub-contractor installing equipment or systems, as well as the nearest service representatives for each item of equipment for each system. The manuals shall include a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made

during installation, checkout, and acceptance. Six (6) hard-copies and one (1) soft copy on CD of each item listed below shall be delivered as a part of final systems acceptance.

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the entire system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes. Manufacturer developed literature may be used; however, shall be produced to match the project requirements.
2. Equipment Manual: A manual describing all equipment furnished including:
 - a. General description and specifications; installation and checkout procedures; equipment electrical schematics and layout drawings; system schematics and layout drawings; alignment and calibration procedures; manufacturer's repair list indicating sources of supply; and interface definition.
3. Software Manual: The software manual shall describe the functions of all software and include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
 - a. Definition of terms and functions; use of system and applications software; procedures for system initialization, start-up, and shutdown; alarm reports; reports generation, database format and data entry requirements; directory of all disk files; and description of all communications protocols including data formats, command characters, and a sample of each type of data transfer.
4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:
 - a. Computers and peripherals; system start-up and shutdown procedures; use of system, command, and applications software; recovery and restart procedures; graphic alarm presentation; use of report generator and generation of reports; data entry; operator commands' alarm messages, and printing formats; and system access requirements.

5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, recommend schedules, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
6. Spare Parts & Components Data: At the conclusion of the Contractor's work, the Contractor shall submit to the Resident Engineer a complete list of the manufacturer's recommended spare parts and components required to satisfactorily maintain and service the systems, as well as unit pricing for those parts and components.
7. Operation, Maintenance & Service Manuals: The Contractor shall provide two (2) complete sets of operating and maintenance manuals in the form of an instructional manual for use by the VA Security Guard Force personnel. The manuals shall be organized into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder. If multiple volumes are required, each volume shall be fully indexed and coordinated.
8. Equipment and Systems Maintenance Manual: The Contractor shall provide the following descriptive information for each piece of equipment, operating system, and electronic system:
 - a. Equipment and/or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and test.
 - f. Complete nomenclature and number of replacement parts.
 - g. Provide operating and maintenance instructions including assembly drawings and diagrams required for maintenance and a list of items recommended to stock as spare parts.
 - h. Provide information detailing essential maintenance procedures including the following: routine operations, trouble shooting guide, disassembly, repair and re-assembly, alignment, adjusting, and checking.
 - i. Provide information on equipment and system operating procedures, including the following; start-up procedures, routine and normal operating instructions, regulation and control procedures, instructions on stopping, shut-down and emergency instructions, required sequences for electric and electronic systems, and special operating instructions.

- j. Manufacturer equipment and systems maintenance manuals are permissible.
9. Project Redlines: During construction, the Contractor shall maintain an up-to-date set of construction redlines detailing current location and configuration of the project components. The redline documents shall be marked with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office. The Contractor will provide access to redline documents anytime during the project for review and inspection by the Resident Engineer or authorized Office of Protection Services representative. Master redlines shall be neatly maintained throughout the project and secured under lock and key in the contractor's onsite project office. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings. Prior to producing Record Construction Documents, the contractor will submit the Master Redline document to the Resident Engineer for review and approval of all changes or modifications to the documents. Each sheet shall have Resident Engineer initials indicating authorization to produce "As Built" documents. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
10. Record Specifications: The Contractor shall maintain one (1) copy of the Project Specifications, including addenda and modifications issued, for Project Record Documents. The Contractor shall mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in the Contract Specifications and modifications issued. (Note related Project Record Drawing information where applicable). The Contractor shall pay particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later. Upon completion of the mark ups, the Contractor shall submit record Specifications to the COTR. As with master relines, Contractor shall maintain record specifications for Resident Engineer review and inspection at anytime.

11. Record Product Data: The Contractor shall maintain one (1) copy of each Product Data submittal for Project Record Document purposes. The Data shall be marked to indicate the actual product installed where the installation varies substantially from that indicated in the Product Data submitted. Significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation shall be included. Particular attention will be given to information on concealed products and installations that cannot be readily identified or recorded later. Note related Change Orders and mark up of Record Construction Documents, where applicable. Upon completion of mark up, submit a complete set of Record Product Data to the COTR.
12. Miscellaneous Records: The Contractor shall maintain one (1) copy of miscellaneous records for Project Record Document purposes. Refer to other Specifications for miscellaneous record-keeping requirements and submittals concerning various construction activities. Before substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Categories of requirements resulting in miscellaneous records include, a minimum of the following:
 - a. Certificates received instead of labels on bulk products.
 - b. Testing and qualification of tradesmen. ("Contractor's Qualifications")
 - c. Documented qualification of installation firms.
 - d. Load and performance testing.
 - e. Inspections and certifications.
 - f. Final inspection and correction procedures.
 - g. Project schedule
13. Record Construction Documents (Record As-Built)
 - a. Upon project completion, the contractor shall submit the project master redlines to the Resident Engineer prior to development of Record construction documents. The Resident Engineer shall be given a minimum of a thirty (30) day review period to determine the adequacy of the master redlines. If the master redlines are found suitable by the Resident Engineer, the Resident Engineer will initial and date each sheet and turn redlines over to the contractor for as built development.

- b. The Contractor shall provide the Resident Engineer a complete set of "as-built" drawings and original master redlined marked "as-built" blue-line in the latest version of AutoCAD drawings unlocked on CD or DVD. The as-built drawing shall include security device number, security closet connection location, data gathering panel number, and input or output number as applicable. All corrective notations made by the Contractor shall be legible when submitted to the COTR. If, in the opinion of the COTR, any redlined notation is not legible, it shall be returned to the Contractor for re-submission at no extra cost to the Owner. The Contractor shall organize the Record Drawing sheets into manageable sets bound with durable paper cover sheets with suitable titles, dates, and other identifications printed on the cover. The submitted as built shall be in editable formats and the ownership of the drawings shall be fully relinquished to the owner.
 - c. Where feasible, the individual or entity that obtained record data, whether the individual or entity is the installer, sub-contractor, or similar entity, is required to prepare the mark up on Record Drawings. Accurately record the information in a comprehensive drawing technique. Record the data when possible after it has been obtained. For concealed installations, record and check the mark up before concealment. At the time of substantial completion, submit the Record Construction Documents to the COTR. The Contractor shall organize into bound and labeled sets for the COTR's continued usage. Provide device, conduit, and cable lengths on the conduit drawings. Exact in-field conduit placement/routings shall be shown. All conduits shall be illustrated in their entire length from termination in security closets; no arrowed conduit runs shall be shown. Pull box and junction box sizes are to be shown if larger than 100mm (4 inch).
- O. FIPS 201 Compliance Certificates
- 1. Provide Certificates for all software components and device types utilizing credential verification. Provide certificates for:
 - b. Card Readers
 - d. PIV Middleware
 - e. Template Matcher

- f. Electromagnetically Opaque Sleeve
- g. Certificate Management
 - 1) CAK Authentication System
 - 2) PIV Authentication System
- P. Approvals will be based on complete submission of manuals together with shop drawings.
- Q. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 28 08 00 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.

1.6 DEFINITIONS

- A. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.
- B. Access Control List: A list of (identifier, permissions) pairs associated with a resource or an asset. As an expression of security policy, a person may perform an operation on a resource or asset if and only if the person's identifier is present in the access control list (explicitly or implicitly), and the permissions in the (identifier, permissions) pair include the permission to perform the requested operation.
- C. Access Control: A function or a system that restricts access to authorized persons only.
- D. API Application Programming Interface
- E. Assurance Level (or E-Authentication Assurance Level): A measure of trust or confidence in an authentication mechanism defined in OMB Memorandum M-04-04 and NIST Special Publication (SP) 800-63, in terms of four levels: [M-04-04]
 - 1. Level 1: LITTLE OR NO confidence
 - 2. Level 2: SOME confidence
 - 3. Level 3: HIGH confidence
 - 4. Level 4: VERY HIGH confidence
- F. Authentication: A process that establishes the origin of information, or determines an entity's identity. In this publication, authentication often means the performance of a PIV authentication mechanism.
- G. Authenticator: A memory, possession, or quality of a person that can serve as proof of identity, when presented to a verifier of the

appropriate kind. For example, passwords, cryptographic keys, and fingerprints are authenticators.

- H. Authorization: A process that associates permission to access a resource or asset with a person and the person's identifier(s).
- I. BIO or BIO-A: A FIPS 201 authentication mechanism that is implemented by using a Fingerprint data object sent from the PIV Card to the PACS. Note that the short-hand "BIO (-A)" is used throughout the document to represent both BIO and BIO-A authentication mechanisms.
- J. Biometric: An authenticator produced from measurable qualities of a living person.
- K. CAC EP - CAC End Point with end point PIV applet
- L. CAC NG - CAC Next Generation with transitional PIV applet
- M. Card Authentication Key (CAK): A PIV authentication mechanism (or the PIV Card key of the same name) that is implemented by an asymmetric or symmetric key challenge/response protocol. The CAK is an optional mechanism defined in NIST SP 800-73. [SP800-73] NIST strongly recommends that every PIV Card contain an asymmetric CAK and corresponding certificate, and that agencies use the asymmetric CAK protocol, rather than a symmetric CAK protocol, whenever the CAK authentication mechanism is used with PACS.
- N. CCTV: Closed-circuit television.
- O. Central Station: A PC with software designated as the main controlling PC of the PACS. Where this term is presented with initial capital letters, this definition applies.
- P. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.
- Q. CPU: Central processing unit.
- R. Credential: Data assigned to an entity and used to identify that entity.
- S. File Server: A PC in a network that stores the programs and data files shared by users.
- T. FIPS Federal Information Processing Standards
- U. FRAC - First Responder Authentication Credential
- V. HSPD Homeland Security Presidential Directive
- W. I/O: Input/Output.
- X. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification

entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

- Y. IEC International Electrotechnical Commission
- Z. ISO International Organization for Standardization
- AA. KB Kilobyte
- BB. kbit/s Kilobits / second
- CC. LAN: Local area network.
- DD. LED: Light-emitting diode.
- EE. Legacy CAC - Contact only Common Access Card with v1 and v2 applets
- FF. Location: A Location on the network having a PC-to-Controller communications link, with additional Controllers at the Location connected to the PC-to-Controller link with RS-485 communications loop. Where this term is presented with an initial capital letter, this definition applies.
- GG. NIST: National Institute of Standards and Technology
- HH. PACS: Physical Access Control System
- II. PC/SC: Personal Computer / Smart Card
- JJ. PC: Personal computer. This acronym applies to the Central Station, workstations, and file servers.
- KK. PCI Bus: Peripheral component interconnect; a peripheral bus providing a high-speed data path between the CPU and peripheral devices (such as monitor, disk drive, or network).
- LL. PDF: (Portable Document Format.) The file format used by the Acrobat document exchange system software from Adobe.
- MM. PIV: Personal Identification Verification
- NN. PIV-I - PIV Interoperable credential
- OO. PPS: Protocol and Parameters Selection
- PP. RF: Radio frequency.
- QQ. ROM: Read-only memory. ROM data are maintained through losses of power.
- RR. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
- SS. RS-485: An TIA/EIA standard for multipoint communications.
- TT. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

UU. TPDU: Transport Protocol Data Unit
VV. TWIC - Transportation Worker Identification Credential
WW. UPS: Uninterruptible power supply.
XX. Vcc: Voltage at the Common Collector
YY. WAN: Wide area network.
ZZ. WAV: The digital audio format used in Microsoft Windows.
AAA. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.
BBB. Windows: Operating system by Microsoft Corporation.
CCC. Workstation: A PC with software that is configured for specific limited security system functions.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.8 MAINTENANCE & SERVICE

- A. General Requirements
 - 1. The Contractor shall provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system. The Contractor shall provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled

adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes all software updates, panel firmware, and the following new items: computers, equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, physical access control equipment, facility interface, signal transmission equipment, and video equipment.

C. Personnel

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. The Resident Engineer shall be advised in writing of the name of the designated service representative, and of any change in personnel. The Resident Engineer shall be provided copies of system manufacturer certification for the designated service representative.

D. Schedule of Work

1. The work shall be performed during regular working hours, Monday through Friday, excluding federal holidays. These inspections shall include:
 - a) The Contractor shall perform two (2) minor inspections at six (6) month intervals or more if required by the manufacturer, and two (2) major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
 - 1) Minor Inspections shall include visual checks and operational tests of all console equipment, peripheral equipment, local processors, sensors, electrical and mechanical controls, and adjustments on printers.
 - 2) Major Inspections shall include all work described for Minor Inspections and the following: clean all system equipment and local processors including interior and exterior surfaces; perform diagnostics on all equipment; operational tests of the CPU, switcher, peripheral equipment, recording devices, monitors, picture quality from each camera; check, walk test, and calibrate each sensor; run all system software diagnostics

and correct all problems; and resolve any previous outstanding problems.

E. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.
 - a. For catastrophic system failures, the Contractor shall provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.
 - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the

amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.9 PERFORMANCE REQUIREMENTS

- A. PACS shall provide support for multiple authentication modes and bidirectional communication with the reader. PACS shall provide implementation capability for enterprise security policy and incident response.
- B. All processing of authentication information must occur on the "safe side" of a door

SPEC WRITER NOTE: Select facility risk levels per Facility Security Level (FSL) Determination.

- C. Physical Access Control System shall provide access to following Security Areas:
1. Controlled
 2. Limited
 3. Exclusion
- D. PACS shall provide:
1. One authentication factor for access to Controlled security areas
 2. Two authentication factors for access to Limited security areas
 3. Three authentication factors for access to Exclusion security areas
- E. PACS shall provide Credential Validation and Path Validation per NIST 800-116.
- F. The PACS System shall have an Enterprise Path Validation Module (PVM) component that processes X.509 certification paths composed of X.509 v3 certificates and X.509 v2 CRLs. The PVM component MUST support the following features:
1. Name chaining;
 2. Signature chaining;
 3. Certificate validity;
 4. Key usage, basic constraints, and certificate policies certificate extensions;
 5. Full CRLs; and
 6. CRLs segmented on names.
- G. Distributed Processing: System shall be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for physical access control. If communications to Central Station are lost, all Controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the Central Station.
- H. Number of Locations: Support unlimited number of separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.
1. Each Location shall have its own database and history in the Central Station. Locations may be combined to share a common database.
- I. Data Capacity:

1. [130] <Insert number> different card-reader formats.
2. [999] <Insert number> comments.
3. [16] <Insert number> graphic file types for importing maps.

J. 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.

K. System Network Requirements:

1. Interconnect system components and provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
2. Communication shall not require operator initiation or response, and shall return to normal after partial or total network interruption such as power loss or transient upset.
3. System shall automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.
4. Communications Controller may 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.

M. Field equipment shall include Controllers, sensors, and controls.

Controllers shall serve as an interface between the Central Station and sensors and controls. Data exchange between the Central Station and the Controllers shall include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the Central Station shall include status data such as intrusion alarms, status reports, and entry-control records.

Controllers are classified as alarm-annunciation or entry-control type.

N. System Response to Alarms: 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.[This response time shall be maintained during system heavy load.]

- O. False Alarm Reduction: The design of Central Station and Controllers shall contain features to reduce false alarms. Equipment and software shall comply with SIA CP-01.
- P. Error Detection: A cyclic code error detection method shall be used between Controllers and the Central Station, which shall detect single- and double-bit errors, burst errors of eight bits or less, and at least 99 percent of all other multibit and burst error conditions.
Interactive or product error detection codes alone will not be acceptable. A message shall be in error if one bit is received incorrectly. System shall retransmit messages with detected errors. A two-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the Central Station shall print a communication failure alarm message. System shall monitor the frequency of data transmission failure for display and logging.
- Q. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.
- R. Door Hardware Interface: Coordinate with Division 08 Sections that specify door hardware required to be monitored or controlled by the PACS. The Controllers in this Section shall have electrical characteristics that match the signal and power requirements of door hardware. Integrate door hardware specified in Division 08 Sections to function with the controls and PC-based software and hardware in this Section.
- S. References to industry and trade association standards and codes are minimum installation requirement standards.
- T. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

1.10 EQUIPMENT AND MATERIALS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts shall be available.

- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
 - 1. Components of an assembled unit need not be products of the same manufacturer.
 - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
 - 3. Components shall be compatible with each other and with the total assembly for the intended service.
 - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing Is Specified:
 - 1. The Government shall have the option of witnessing factory tests. The contractor shall notify the VA through the Resident Engineer a minimum of 15 working days prior to the manufacturers making the factory tests.
 - 2. Four copies of certified test reports containing all test data shall be furnished to the Resident Engineer prior to final inspection and not more than 90 days after completion of the tests.
 - 3. When equipment fails to meet factory test and re-inspection is required, the contractor shall be liable for all additional expenses, including expenses of the Government.

1.11 WARRANTY OF CONSTRUCTION.

- A. Warrant PACS work subject to the Article "Warranty of Construction" of FAR clause 52.246-21.
- B. Demonstration and training shall be performed prior to system acceptance.

1.12 GENERAL REQUIREMENTS

- A. For general requirements that are common to more than one section in Division 28 refer to Section 28 05 00, REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATIONS.
- B. General requirements applicable to this section include:
 - 1. General Arrangement Of Contract Documents,
 - 2. Delivery, Handling and Storage,
 - 3. Project Conditions,

4. Electrical Power,
5. Lightning, Power Surge Suppression, and Grounding,
6. Electronic Components,
7. Substitute Materials and Equipment, and
8. Like Items.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturer shall be Schneider Electric Continuum, no exceptions. All equipment and materials for the system will be compatible to ensure correct operation as outlined in FIPS 201, March 2006 and HSPD-12.
- B. The security system characteristics listed in this section will serve as a guide in selection of equipment and materials for the PACS. If updated or more suitable versions are available then the Contracting Officer will approve the acceptance of prior to an installation.
- C. PACS equipment shall meet or exceed all requirements listed below.
- D. A PACS shall be comprised of, but not limited to, the following components:
 1. Physical Access Control System
 2. Application Software
 3. System Database
 4. Surge and Tamper Protection
 5. Standard Workstation Hardware
 6. Communications Workstation
 7. Controllers (Data Gathering Panel)
 8. Secondary Alarm Annunciator
 9. Keypads
 10. Card Readers
 11. Credential Cards
 12. Biometric Identity Verification Equipment
 13. Enrolment Center (To be provided in accordance with the VA PIV enrollment and issuance system.)
 14. System Sensors and Related Equipment
 15. Push Button Switches
 16. Interfaces
 17. Door and Gate Hardware interface

18. RS-232 ASCII Interface
19. Floor Select Elevator Control
20. After-Hours HVAC Control
21. Real Time Guard Tour
22. Video and Camera Control
23. Cables
24. Transformers

2.10 CARD READERS

- A. Power: Card reader shall be powered from its associated Controller, including its standby power source.
- B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the Controller. Response time shall be [800]<insert number>ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.
- C. Enclosure: Suitable for surface, semiflush, or pedestal mounting. Mounting types shall additionally be suitable for installation in the following locations:
 1. Indoors, controlled environment.
 2. Indoors, uncontrolled environment.
 3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.
- D. Display: LED or other type of visual indicator display shall provide visual[and audible] status indications and user prompts. Indicate power on/off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
- E. Shall be utilized for controlling the locking hardware on a door and allows for reporting back to the main control panel with the time/date the door was accessed, the name of the person accessing the point of entry, and its location.
- F. Will be fully programmable and addressable, locally and remotely, and hardwired to the system.
- G. Shall be individually home run to the main panel.
- H. Shall be installed in a manner that they comply with:
 1. The Uniform Federal Accessibility Standards (UFAS)
 2. The Americans with Disabilities Act (ADA)

3. The ADA Standards for Accessible Design

- I. Shall support a variety of card readers that must encompass a wide functional range. The PACS may combine any of the card readers described below for installations requiring multiple types of card reader capability (i.e., card only, card and/or PIN, card and/or biometrics, card and/or pin and/or biometrics, supervised inputs, etc.). These card readers shall be available in the approved technology to meet FIPS 201, and is ISO 14443 A or B, ISO/IEC 7816 compliant. The reader output can be Wiegand, RS-22, 485 or TCP/IP.
- J. Shall be housed in an aluminum bezel with a wide lead-in for easy card entry.
- K. Shall contain read head electronics, and a sender to encode digital door control signals.
- L. LED's shall be utilized to indicate card reader status and access status.
- M. Shall be able to support a user defined downloadable off-line mode of operation (e.g. locked, unlocked), which will go in effect during loss of communication with the main control panel.
- N. Shall provide audible feedback to indicate access granted/denied decisions. Upon a card swipe, two audible tones or beeps shall indicate access granted and three tones or beeps shall indicate access denied. All keypad buttons shall provide tactile audible feedback.
- O. Shall have a minimum of two programmable inputs and two programmable outputs.
- P. All card readers that utilize keypad controls along with a reader and shall meet the following specifications:
 - 1. Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Communications protocol shall be compatible with the local processor.
- Q. Shall include a Light Emitting Diode (LED) or other type of visual indicator display and provide visual or visual and audible status indications and user prompts. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus five (5)

degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

1. Shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.
2. Shall be powered from the source as designed and shall not dissipate more than 150 Watts.
3. Shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.
4. Shall provide a means for users to indicate a duress situation by entering a special code.

R. PIV Contact Card Reader

1. Application Protocol Data Unit (APDU) Support: At a minimum, the contact interface shall support all card commands for contact based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
2. Buffer Size: The reader must contain a buffer large enough to receive the maximum size frame permitted by International Organization for Standardization International Electrotechnical Commission (ISO/IEC) 7816-3:1997, Section 9.4.
3. Programming Voltage: PIV Readers shall not generate a Programming Voltage.
4. Support for Operating Class: PIV Readers shall support cards with Class A Vccs as defined in ISO/IEC 7816-3:1997 and ISO/IEC 7816-3:1997/Amd 1:2002.
5. Retrieval Time: Retrieval time¹ for 12.5 kilobytes (KB) of data through the contact interface of the reader shall not exceed 2.0 seconds.
6. Transmission Protocol: The PIV Reader shall support both the character-based T=0 protocol and block-based T=1 protocol as defined in ISO/IEC 7816-3:1997.

7. Support for PPS Procedure: The reader shall support Protocol and Parameters Selection (PPS) procedure by having the ability to read character TA1 of the Answer to Reset (ATR) sent by the card as defined in ISO/IEC 7816-3:1997.

S. Contactless Smart Cards and Readers

1. Smart card readers shall read credential cards whose characteristics of size and technology meet those defined by ISO/IEC 7816, 14443, 15693.
2. The readers shall have "flash" download capability to accommodate card format changes.
3. The card reader shall have the capability of reading the card data and transmitting the data to the main monitoring panel.
4. The card reader shall be contactless and meet or exceed the following technical characteristics:
 - a. Data Output Formats: FIPS 201 low outputs the FASC-N in an assortment of Wiegand bit formats from 40 - 200 bits. FIPS 201 medium outputs a combination FASC-N and HMAC in an assortment of Wiegand bit formats from 32 - 232 bits. All Wiegand formats or the upgradeability from Low to Medium Levels can be field configured with the use of a command card.
 - b. FIPS 201 readers shall be able to read, but not be limited to, DESfire and iCLASS cards.
 - c. Reader range shall comply with ISO standards 7816, 14443, and 15693, and also take into consideration conditions, are at a minimum 1" to 2" (2.5 - 5 cm).
 - d. APDU Support: At a minimum, the contactless interface shall support all card commands for contactless based access specified in Section 7, End-point PIV Card Application Card Command Interface of SP 800-73-1, Interfaces for Personal Identity Verification.
 - e. Buffer Size: The reader shall contain a buffer large enough to receive the maximum size frame permitted by ISO/IEC 7816-3, Section 9.4.
 - f. ISO 14443 Support: The PIV Reader shall support parts (1 through 4) of ISO/IEC 14443 as amended in the References of this publication.
 - g. Type A and B Communication Signal Interfaces: The contactless interface of the reader shall support both the Type A and Type B

communication signal interfaces as defined in ISO/IEC 14443-2:2001.

- h. Type A and B Initialization and Anti-Collision The contactless interface of the reader shall support both Type A and Type B initialization and anti-collision methods as defined in ISO/IEC 14443-3:2001.
- i. Type A and B Transmission Protocols: The contactless interface of the reader shall support both Type A and Type B transmission protocols as defined in ISO/IEC 14443-4:2001.
- j. Retrieval Time: Retrieval time for 4 KB of data through the contactless interface of the reader shall not exceed 2.0 seconds.
- k. Transmission Speeds: The contactless interface of the reader shall support bit rates of fc/128 (~106 kbits/s), fc/64 (~212 kbits/s), and configurable to allow activation/deactivation.
- l. Readability Range: The reader shall not be able to read PIV card more than 10cm(4inch) from the reader

2.13 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 (± 14) degrees. The detector shall operate on 12 VDC with approximately 26 mA continuous current draw. The detector shall have an externally visible activation LED. The motion detector shall measure approximately 38 mm H x 158 mm W x 38 mm D (1.5 x 6.25 x 1.5 in). The detector shall be immune to radio frequency interference. The detector shall not activate or set-up on critical frequencies in the range 26 to 950 Megahertz using a 50

watt transmitter located 30.5 cm (1 ft) from the unit or attached wiring. The detector shall be available on gray or black enclosures. The color of the housing shall be coordinated with the surrounding surface.

E. Crash Bar:

1. Emergency Exit with Alarm (Panic):

- a. Entry control portals shall include panic bar emergency exit hardware as designed.
- b. Panic bar emergency exit hardware shall provide an alarm shunt signal to the PACS and SMS.
- c. The panic bar shall include a conspicuous warning sign with one (1) inch (2.5 cm) high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.
- d. Operation of the panic bar hardware shall generate an intrusion alarm that reports to both the SMS and Intrusion Detection System. The use of a micro switch installed within the panic bar shall be utilized for this.
- e. The panic bar shall utilize a fully mechanical connection only and shall not depend upon electric power for operation.
- f. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-pass. Refer to Section 2.2.I.9 for key-bypass specifications.

g. Normal Exit:

- 1) Entry control portals shall include panic bar non-emergency exit hardware as designed.
- 2) Panic bar non-emergency exit hardware shall be monitored by and report to the SMS.
- 3) Operation of the panic bar hardware shall not generate a locally audible or an intrusion alarm within the IDS.
- 4) When exiting, the panic bar shall depend upon a mechanical connection only. The exterior, non-secure side of the door shall be provided with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the SMS.
- 5) The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt manually by either pressing the panic bar or with a key by-

pass. Refer to Section 2.2.I.9 for key-bypass specifications. The strikes/bolts shall include a micro switch to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system in the event the door is left open or accessed without the identification credentials.

F. Key Bypass:

1. Shall be utilized for all doors that have a mortise or rim mounted door hardware.
2. Each door shall be individually keyed with one master key per secured area.
3. Cylinders shall be six (6)-pin and made of brass or equivalent. Keys for the cylinders shall be constructed of solid material and produced and cut by the same distributor. Keys shall not be purchased, cut, and supplied by multiple dealers.
4. All keys shall have a serial number cut into the key. No two serial numbers shall be the same.
5. All keys and cylinders shall be stored in a secure area that is monitored by the Intrusion Detection System.

G. Automatic Door Opener and Closer:

1. Shall be low energy operators.
2. Door closing force shall be adjustable to ensure adequate closing control.
3. Shall have an adjustable back-check feature to cushion the door opening speed if opened violently.
4. Motor assist shall be adjustable from 0 to 30 seconds in five (5) second increments. Motor assist shall restart the time cycle with each new activation of the initiating device.
5. Unit shall have a three-position selector mode switch that shall permit unit to be switched "ON" to monitor for function activation, switched to "H/O" for indefinite hold open function or switched to "OFF," which shall deactivate all control functions but will allow standard door operation by means of the internal mechanical closer.
6. Door control shall be adjustable to provide compliance with the requirements of the Americans with Disabilities Act (ADA) and ANSI standards A117.1.
7. All automatic door openers and closers shall:
 - a. Meet UL standards.

- b. Be fire rated.
 - c. Have push and go function to activate power operator or power assist function.
 - d. Have push button controls for setting door close and door open positions.
 - e. Have open obstruction detection and close obstruction detection built into the unit.
 - f. Have door closer assembly with adjustable spring size, back-check valve, sweep valve, latch valve, speed control valve and pressure adjustment valve to control door closing.
 - g. Have motor start-up delay, vestibule interface delay; electric lock delay and door hold open delay up to 30 seconds. All operators shall close door under full spring power when power is removed.
 - h. Are to be hard wired with power input of 120 VAC, 60Hz and connected to a dedicated circuit breaker located on a power panel reserved for security equipment.
- H. Door Status Indicators:
- 1. Shall monitor and report door status to the SMS.
 - 2. Door Position Sensor:
 - a. Shall provide an open or closed indication for all doors operated on the PACS and report directly to the SMS.
 - b. Shall also provide alarm input to the Intrusion Detection System for all doors operated by the PACS and all other doors that require monitoring by the intrusion detection system.
 - c. Switches for doors operated by the PACS shall be double pole double throw (DPDT). One side of the switch shall monitor door position and the other side if the switch shall report to the intrusion detection system. For doors with electromagnetic locks a magnetic bonding sensor (MBS) can be used in place of one side of a DPDT switch, in turn allowing for the use of a single pole double throw (SPDT) switch in it place of a DPDT switch.
 - d. Switches for doors not operated by the PACS shall be SPDT and report directly to the IDS.
 - e. Shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

2.15 PORTAL CONTROL DEVICES

- A. Shall be used to assist the PACS.

- B. Such devices shall:
 - 1. Provide a means of monitoring the doors status.
 - 2. Allow for exiting a space via either a push button, request to exit, or panic/crash bar.
 - 3. Provide a means of override to the PACS via a keypad or key bypass.
 - 4. Assist door operations utilizing automatic openers and closures.
 - 5. Provide a secondary means of access to a space via a keypad.
- C. Shall be connected to and monitored by the main PACS panel.
- D. Shall be installed in a manner that they comply with:
 - 1. The Uniform Federal Accessibility Standards (UFAS)
 - 2. The Americans with Disabilities Act (ADA)
 - 3. The ADA Standards for Accessible Design
- E. Shall provide a secondary means of physical access control within a secure area.
- F. Push-Button Switches:
 - 1. Shall be momentary contact, back lighted push buttons, and stainless steel switch enclosures for each push button as shown. Buttons are to be utilized for secondary means of releasing a locking mechanism.
 - a. In an area where a push button is being utilized for remote access of the locking device then no more than two (2) buttons shall operate one door from within one secure space. Buttons will not be wired in series with one other.
 - b. In an area where locally stationed guards control entry to multiple secure points via remote switches. An interface board shall be designed and constructed for only the amount of buttons it shall house. These buttons shall be flush mounted and clearly labeled for ease of use. All buttons shall be connected to the PACS and SMS system for monitoring purposes.
 - c. Shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.
- G. Entry Control Devices:
 - 1. Shall be hardwired to the PACS main control panel and operated by either a card reader or a biometric device via a relay on the main control panel.
 - 2. Shall be fail-safe in the event of power failure to the PACS system.
 - 3. Shall operate at 24 VCD, with the exception of turnstiles and be powered by a separate power supply dedicated to the door control system. Each power supply shall be rated to operate a minimum of two

- doors simultaneously without error to the system or overload the power supply unit.
4. Shall have a diode or metal-oxide varistor (MOV) to protect the controller and power supply from reverse current surges or back-check.
 5. Electric Strikes/Bolts: Shall be:
 - a. Made of heavy-duty construction and tamper resistant design.
 - b. Tested to over one million cycles.
 - c. Rated for a minimum of 1000 lbs. holding strength.
 - d. Utilize an actuating solenoid for the strike/bolt. The solenoid shall move from fully open to fully closed position and back in not more than 500 milliseconds and be rated for continuous duty.
 - e. Utilize a signal switch that will indicate to the system if the strike/bolt is not engaged or is unlocked when it should be secured.
 - f. Flush mounted within the door frame.
 6. Electric Mortise Locks: Shall be installed within the door and an electric transfer hinge shall be utilized to allow the wires to be transferred from the door frame to the lock. If utilized with a double door then the lock shall be installed inside the active leaf. Electric Mortise Locks shall:
 - a. These locks shall be provided and installed by the Division 8 "DOOR HARDWARE" Contractor.
 - b. Have integrated Request to Exit switch for doors receiving physical access control devices.
 - b. Provide integration of the Electric Mortise Locks with the PACS for:
 - 1) Lock Power
 - 2) Request to Exit switch.

2.17 INTERFACES

A. CCTV System Interface

1. An RS232 [Ethernet] interface associated driver, and controller shall be provided for connection of the SMS Central Computer to the CCTV Alarm interface and switcher. The interface shall provide alarm data to the CCTV Alarm interface for automatic camera call-up.

If required the Security Contractor shall be responsible for programming the command strings into the SMS Server.

B. Intercom System Interface

1. The CCTV call-up from intercom stations shall be through the intercom unit via RS232 [Ethernet] communications interface to the SMS system, then through the matrix switcher.

a. Application Software

- 1) Provides the interface between the Alarm Annunciation System and Operator; all sensors, local processors and data links, drive displays, report alarms, and report generation.
- 2) Software is categorized as System Software and Application Software. System Software must consist of software to support set-up, operation, hard drive back-ups and maintenance processor. Application Software must consist of software to provide the completion of Physical Access Control System.

C. Power Supplies:

1. Shall be UL rated and able to adequately power (enter number) entry control devices on a continuous base without failure.
2. Shall meet the following minimum technical characteristics:

INPUT POWER	110 VAC 60 HZ (enter amperage)A
OUTPUT VOLTAGE	12 VDC Nominal (13.8 VDC) 24 VDC Nominal (27.6 VDC) Filtered and Regulated
BATTERY	Dependant on Output Voltage shall provide up to < > Ah
OUTPUT CURRENT	[10] amp max. [@ 13.8] VDC [5] amp max. [@ 27.6] VDC
PRIMARY FUSE SIZE	6.3 amp (non-removable)
BATTERY FUSE SIZE	12 amp, 3AG
CHARGING CIRCUIT	Built-in standard

2.19 AFTER-HOURS HVAC CONTROL

- A. After-Hours HVAC Control: Provide for any credential read to activate or control individual HVAC zones based on access level. This control

module shall control and record the after-hours use of the heating and cooling system in zones or tenant space.

1. This control shall give the administrator the ability to determine how much extra energy consumption each tenant is responsible for. This information can be used in billing tenants for the extra after-hour usage.
 2. At the specified time every day, the HVAC shall automatically go into its after-hours mode. It shall then revert into its normal business hours mode by a tenant using an access code or card at a designated keypad or reader.
 3. Once enabled, the tenant's HVAC zone shall be under thermostat control for a preset amount of time. When the preset amount of time elapses, the HVAC for that zone shall revert back to after-hours mode unless a tenant uses his/her code or card again. This shall continue until the unit automatically returns to its normal business hours operation.
- B. Control module activates the HVAC system after a valid access by any of three methods; however, the HVAC control shall always allow for manual override from the PC.
1. By time expiration after access of an adjustable period from 1 second to 546 minutes (9.1 hours).
 2. By use of the card or code again at the same or different reader or keypad.
 3. By system returning to its normal business hours operation.
- C. After-hours HVAC control shall operate with all other features running simultaneously and use the central-station PC that controls access for the building but shall not rely on the host PC for any HVAC control decisions.

2.21 VIDEO AND CAMERA CONTROL

- A. Control station or designated workstation displays live video from a CCTV source.
1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom command auxiliary controls.
 2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.

3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.
- B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.
- C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.22 WIRES AND CABLES

- A. Refer to section 280513 "CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY".

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.
- B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.2 CURRENT SITE CONDITIONS

- A. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions which will affect performance of the

system to the Owner in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Owner.

3.3 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

- A. Comply with recommendations in SIA CP-01.
- B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."
- C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
 - 1. Record setup data for control station and workstations.
 - 2. For each Location, record setup of Controller features and access requirements.
 - 3. Propose start and stop times for time zones and holidays, and match up access levels for doors.
 - 4. Set up groups, linking, and list inputs and outputs for each Controller.
 - 5. Assign action message names and compose messages.
 - 6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
 - 7. Prepare and install alarm graphic maps.
 - 8. Develop user-defined fields.
 - 9. Develop screen layout formats.
 - 10. Propose setups for guard tours and key control.
 - 11. Discuss badge layout options; design badges.
 - 12. Complete system diagnostics and operation verification.

13. Prepare a specific plan for system testing, startup, and demonstration.
 14. Develop acceptance test concept and, on approval, develop specifics of the test.
 15. Develop cable and asset management system details; input data from construction documents. Include system schematics and Technical Drawings.
- D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.5 CABLING

- A. Comply with NECA 1, "Good Workmanship in Electrical Contracting."
- B. Install cables and wiring according to requirements in Division 28 Section "Conductors and Cables for Electronic Safety and Security."
- C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- 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 may 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 5E rating of components and that ensure Category 5E performance of completed and linked signal paths, end to end.
- F. Install cables without damaging conductors, shield, or jacket.
- G. Boxes and enclosures containing security system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered to be accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.
- H. Install end-of-line resistors at the field device location and not at the Controller or panel location.

3.6 CABLE APPLICATION

- A. Comply with EIA/TIA-569, "Commercial Building Standard for Telecommunications Pathways and Spaces."
- B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.
- C. RS-232 Cabling: Install at a maximum distance of 50 feet (15 m).
- D. RS-485 Cabling: Install at a maximum distance of 4000 feet (1220 m).
- E. Card Readers and Keypads:
 - 1. Install number of conductor pairs recommended by manufacturer for the functions specified.
 - 2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from Controller to the reader is 250 feet (75 m), and install No. 20 AWG wire if maximum distance is 500 feet (150 m).
 - 3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the Controller.
 - 4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
- F. Install minimum No. 16 AWG cable from Controller to electrically powered locks. Do not exceed [250 feet (75 m)] [500 feet (150 m)] <Insert distance>.
- G. Install minimum No. 18 AWG ac power wire from transformer to Controller, with a maximum distance of [25 feet (8 m)] <Insert distance>.

3.7 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Signal Ground:
 - 1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
 - 2. Bus: Mount on wall of main equipment room with standoff insulators.
 - 3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.8 INSTALLATION

- A. System installation shall be in accordance with UL 294, manufacturer and related documents and references, for each type of security subsystem designed, engineered and installed.
- B. Components shall be configured with appropriate "service points" to pinpoint system trouble in less than 30 minutes.
- C. The Contractor shall install all system components including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, documentation listed in Sections 1.4 and 1.5 of this document, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a operable system.
- D. The PACS will be designed, engineered, installed, and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the system is a stand alone or a network.
- E. For integration purposes, the PACS shall be integrated where appropriate with the following associated security subsystems:
 - 1. CCTV:
 - a. Provide 24 hour coverage of all entry points to the perimeter and agency buildings. As well as all emergency exits utilizing a fixed color camera.
 - b. Be able to monitor, control and record cameras on a 24 hours basis.
 - c. Be programmed automatically call up a camera when an access point is but into an alarm state.
 - d. For additional PACS system requirements as they relate to the CCTV, refer to Section 28 23 00, VIDEO SURVEILLANCE.
 - 2. IDS:
 - a. Be able monitor door control sensors.
 - b. Be able to monitor and control the IDS on a 24 hours basis.
 - c. Be programmed to go into an alarm state when an IDS device is put into an alarm state, and notify the operator via an audible alarm.
 - d. For additional PACS system requirements as they relate to the IDS, refer to Section 28 16 11, INTRUSION DETECTION SYSTEM.
 - 3. Security Access Detection:

- a. Be able to monitor all objects that have been screened with an x-ray machine and be able to monitor all data acquired by the bomb detection unit.
 - b. For additional PACS system requirements as they relate to the Security Access Detection, refer to Section 28 13 53, SECURITY ACCESS DETECTION.
- 4. EPPS:
 - a. Be programmed to go into an alarm state when an emergency call box or duress alarm/panic device is activated, and notify the Physical Access Control System and Database Management of an alarm event.
 - b. For additional PACS requirements as they relate to the EPPS, refer to Section 28 26 00, ELECTRONIC PERSONAL PROTECTION SYSTEM.
- F. Integration with these security subsystems shall be achieved by computer programming or the direct hardwiring of the systems.
- G. For programming purposes refer to the manufacturers requirements for correct system operations. Ensure computers being utilized for system integration meet or exceed the minimum system requirements outlined on the systems software packages.
- H. The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system. The Contractor shall not take any corrective action without written permission from the Government.
- I. The Contractor shall visit the site and verify that site conditions are in agreement/compliance with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Contracting Officer in the form of a report. The Contractor shall not take any corrective action without written permission received from the Contracting Officer.
- J. Existing Equipment:
 - 1. The Contractor shall connect to and utilize existing door equipment, control signal transmission lines, and devices as outlined in the design package. Door equipment and signal lines that are usable in their original configuration without modification may be reused with Contracting Officer approval.
 - 2. The Contractor shall perform a field survey, including testing and inspection of all existing door equipment and signal lines intended

- to be incorporated into the PACS, and furnish a report to the Contracting Officer as part of the site survey report. For those items considered nonfunctioning, provide (with the report) specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include a schedule for connection to all existing equipment.
3. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Contracting Officer approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment.
 4. The Contractor shall be held responsible for repair costs due to Contractor negligence, abuse, or improper installation of equipment.
 5. The Contracting Officer shall be provided a full list of all equipment that is to be removed or replaced by the Contractor, to include description and serial/manufacturer numbers where possible. The Contractor shall dispose of all equipment that has been removed or replaced based upon approval of the Contracting Officer after reviewing the equipment removal list. In all areas where equipment is removed or replaced the Contractor shall repair those areas to match the current existing conditions.
- K. Enclosure Penetrations: All enclosure penetrations shall be from the bottom of the enclosure unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water and will comply with VA Master Specification 07 84 00, Firestopping. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer and in such a manner that the cable is not damaged.
- L. Cold Galvanizing: All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.
- M. Control Panels:

1. Connect power and signal lines to the controller.
2. Program the panel as outlined by the design and per the manufacturer's programming guidelines.

N. SMS:

1. Coordinate with the VA agency's IT personnel to place the computer on the local LAN or Intranet and provide the security system protection levels required to insure only authorized VA personnel have access to the system.
2. Program and set-up the SMS to ensure it is in fully operation.

O. Card Readers:

1. Connect all signal inputs and outputs as shown and specified.
2. Terminate input signals as required.
3. Program and address the reader as per the design package.
4. Readers shall be surface or flushed mounted and all appropriate hardware shall be provided to ensure the unit is installed in an enclosed conduit system.

P. Biometrics:

1. Connect all signal input and output cables along with all power cables.
2. Program and ensure the device is in operating order.

Q. Portal Control Devices:

1. Install all signal input and output cables as well as all power cables.
2. Devices shall be surface or flush mounted as per the design package.
3. Program all devices and ensure they are working.

R. Door Status Indicators:

1. Install all signal input and output cables as well as all power cables.
2. RTE's shall be surface mounted and angled in a manner that they cannot be compromised from the non-secure side of a windowed door, or allow for easy release of the locking device from a distance no greater than 6 feet from the base of the door.
3. Door position sensors shall be surface or flush mounted and wide gap with the ability to operate at a maximum distance of up to 2" (5 cm).

S. Entry Control Devices:

1. Install all signal input and power cables.
2. Strikes and bolts shall be mounted within the door frame.

3. Mortise locks shall be mounted within the door and an electric transfer hinge shall be utilized to transfer the wire from within the door frame to the mortise lock inside the door.
4. Electromagnetic locks shall be installed with the mag-lock mounted to the door frame and the metal plate mounted to the door.

T. System Start-Up:

1. The Contractor shall not apply power to the PACS until the following items have been completed:
 - a. PACS equipment items and have been set up in accordance with manufacturer's instructions.
 - b. A visual inspection of the PACS has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
 - c. System wiring has been tested and verified as correctly connected as indicated.
 - d. All system grounding and transient protection systems have been verified as installed and connected as indicated.
 - e. Power supplies to be connected to the PACS have been verified as the correct voltage, phasing, and frequency as indicated.
2. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work efforts.
3. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

U. Supplemental Contractor Quality Control:

1. The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed PACS; and are approved by the Contracting Officer.
2. The Contractor will be present on the job site during the preparatory and initial phases of quality control to provide technical assistance.
3. The Contractor shall also be available on an as needed basis to provide assistance with follow-up phases of quality control.

4. The Contractor shall participate in the testing and validation of the system and shall provide certification that the system installed is fully operational as all construction document requirements have been fulfilled.

3.9 SYSTEM SOFTWARE

- A. Install, configure, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[, test, and adjust] field-assembled components and equipment installation, including connections[, and to assist in field testing]. Report results in writing.
- B. Testing Agency: [Owner will engage] [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 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B.
 2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be

operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.11 PROTECTION

- A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured, with an activated burglar alarm and access-control system reporting to a Central Station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.13 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS.
- 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 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 SYSTEMS & PHYSICAL 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.
- F. Section 26 05 11 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS. Requirements for connection of high voltage.
- G. Section 26 05 21 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Requirements for power cables.
- H. Section 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS. Requirements for infrastructure.
- 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 BACK BOXES FOR ELECTRONIC SAFETY AND SECURITY. Requirements for infrastructure.
- M. Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY. Requirements for requirements for commissioning - systems readiness checklists, and training.
- N. Section 28 13 00 - PHYSICAL ACCESS CONTROL SYSTEMS (PACS). Requirements for physical access control integration.
- P. Section 28 16 00 - INTRUSION DETECTION SYSTEM. Requirements for integration with intrusion detection system.

R. 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 must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the

- project. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system. The Contractor shall provide copies of system manufacturer certification for all technicians. The Contractor shall only utilize factory-trained technicians to install, program, and service the PACS. The Contractor shall only utilize factory-trained technicians to install, terminate and service controller/field panels and reader modules. The technicians shall have a minimum of five (5) continuous years of technical experience in electronic security systems. The Contractor shall have a local service facility. The facility shall be located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The facility shall also include appropriate diagnostic equipment to perform diagnostic procedures. The COTR reserves the option of surveying the company's facility to verify the service inventory and presence of a local service organization.
2. The Contractor shall provide proof project superintendent with BICSI Certified Commercial Installer Level 1, Level 2, or Technician to provide oversight of the project.
 3. Cable installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International. The staff member shall provide consistent oversight of the project cabling throughout design, layout, installation, termination and testing.
- G. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.4 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.
- 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 will:
 - 1) Outline all general and job specific work required within the design package.
 - 2) Provide a device identification table outlining device Identification (ID) and use for all security systems equipment utilized in the design package.
 - 2. Drawing sheets that will be plotted on the individual floor plans or site plans shall:
 - a. Include a title block as defined above.
 - b. Define the drawings scale in both standard and metric measurements.
 - c. Provide device identification and location.
 - d. Address all signal and power conduit runs and sizes that are associated with the design of the electronic security system and other security elements (e.g., barriers, etc.).
 - e. Identify all pull box and conduit locations, sizes, and fill capacities.
 - f. Address all general and drawing specific notes for a particular drawing sheet.
 - 3. A riser drawing for each applicable security subsystem shall:
 - a. Indicate the sequence of operation.
 - b. Relationship of integrated components on one diagram.
 - c. Include the number, size, identification, and maximum lengths of interconnecting wires.

- d. Wire/cable types shall be defined by a wire and cable schedule.
The schedule shall utilize a lettering system that will correspond to the wire/cable it represents (example: A = 18 AWG/1 Pair Twisted, Unshielded). This schedule shall also provide the manufacturer's name and part number for the wire/cable being installed.
- 4. A system drawing for each applicable security system shall:
 - a. Identify how all equipment within the system, from main panel to device, shall be laid out and connected.
 - b. Provide full detail of all system components wiring from point-to-point.
 - c. Identify wire types utilized for connection, interconnection with associate security subsystems.
 - d. Show device locations that correspond to the floor plans.
 - e. All general and drawing specific notes shall be included with the system drawings.
- 5. A schedule for all of the applicable security subsystems shall be included. All schedules shall provide the following information:
 - a. Device ID.
 - b. Device Location (e.g. site, building, floor, room number, location, and description).
 - c. Mounting type (e.g. flush, wall, surface, etc.).
 - d. Power supply or circuit breaker and power panel number.
- 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 will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.

1.7 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 COTR shall be advised in writing of the name of the designated service representative, and of any change in personnel. The COTR 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 will place the facility(s) at increased risk.
 - b. For non-catastrophic failures, the Contractor within eight (8) hours with a defect correction time not to exceed 24 hours from notification.

F. Operation

1. Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable portions of the performance verification test.

G. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

H. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

I. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the COTR. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and other documentation affected.

J. Software

1. The Contractor shall provide all software updates when approved by the Owner from the manufacturer during the installation and 12-month warranty period and verify operation of the system. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations and maintenance manuals and software documentation. There shall be at least one (1) scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer's software. All software changes shall be recorded in a log maintained in the unit control room. An electronic copy of the software update shall be maintained within the log. At a minimum, the contractor shall

provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked "SOFTWARE CHANGE LOG".

1.8 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 will 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 will 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 must adhere to all standards described herein.
 7. Systems shall be scaleable, not vendor specific, and allow expansion as required.
 9. All hardwired alarms, switches, and junction boxes shall be protected from tampering and include line supervision.

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.
- J. Duress-Panic Alarms:
 - 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 will 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 to 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 will 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 will 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 may 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 will comply with Federal Communication Commission (FCC) regulations.
8. Radio frequency transmitters will 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
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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, bolts, etc., required to accomplish a neat and secure installation. Unfinished or unlabeled wire connections will 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 will 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, clamps, etc., 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, labels etc., 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 to be installed will 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, refer to Section 27 51 23, INTERCOMMUNICATIONS AND PROGRAM SYSTEMS to integrate additional EPPS equipment.
- 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).
- 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 will appear on the as-built drawings. The labeling format shall be identified and a complete record shall be provided to the Owner with the final documentation. Each cable shall be identified by type or signal being carried and termination points. The labels shall be printed on letter size label sheets that are self laminated vinyl that can be printed from a computer data base or spread sheet. The labels shall be E-Z code WES12112 or equivalent.
- 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 to be protected inside terminal cabinets or suitable NEMA 1 enclosures. Terminate off-premise conductors on input side of device. Connect the output side of the device to the equipment to be protected. Connect ground lug to a low impedance earth ground (less than 10 ohms) via Number 12 AWG insulated, stranded copper conductor.
- 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 [except in accessible indoor ceiling spaces, in attics,] [in hollow gypsum-board partitions,] and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.
- 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] <Insert number> hours' training.

3.8 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 28 08 00 - COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.9 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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